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Social cognition in bipolar I and II disorders: an updated systematic review and meta-analysis

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Abstract

Objective In recent years, there has been a rapid increase in reports upon social-cognition impairments in bipolar disorder. This study aimed to compare the characteristics of social cognition domains in bipolar I (BD I) and II (BD II) based on the findings to date.

Methods A systematic literature search was conducted on Web of Science and PubMed from inception to 28 August 2024. Studies with all-age-group of ICD-10, DSM-IV, DSM-IV-TR, or DSM-5 defined BD (I or II) either in a remitted or symptomatic state were included. The risk of bias was measured using the Newcastle–Ottawa Scale, and the quality of the sources was evaluated using GRADE criteria. Results of the studies were measured by synthesizing Hedge's g effect sizes through a random effects meta-analytic approach.

Results A total of 20 studies were included, covering three core domains of social cognition (theory of mind (ToM), emotion processing and attributions). There was no significant difference in ToM between BD I and BD II and in emotion processing between non-psychotic patients with BD I and BD II, and history of psychosis negatively predicted performance on emotion processing. Furthermore, BD II performed worse than BD I in attributions, with a low to moderate summary effect size.

Conclusions BD I and BD II performed similarly on ToM and emotional processing, but BD II had more impaired attributions. Future studies are encouraged to control for the influence of clinical features, to use more neuroscientific techniques, and to explore on other domains of social cognition in bipolar subtypes.

Keywords Bipolar I disorder (BD I), Bipolar II disorder (BD II), Social cognition

Introduction

Bipolar I (BD I) and bipolar II (BD II) are two major subtypes of bipolar disorder (BD), a chronic and recurrent mental illness characterized by both manic or hypomanic episodes and depressive episodes [71]. It has been demonstrated that during manic or hypomanic episodes, individuals with BD I exhibit heightened levels of agitation, impulsivity, irritability, distraction, and self-esteem compared to those with BD II [62]. Conversely, during depressive episodes, BD II persists for a longer duration, is accompanied by more pronounced psychomotor retardation, intense guilt and suicidal thoughts [22, 65]. Moreover, the most recent edition of the International

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Classification of Diseases (ICD-11) has eased the diagnostic criteria for the hypomanic phase of BD [77], leading to an increased detection rate of BD II [4]. However, in clinical settings, early patients frequently present with atypical syndromes, characterized by diffuse and intermittent symptoms, increasing the likelihood of misdiagnosis of BD subtypes [42, 44]. It is unfortunate that there are differences in the treatment options available for BD I and BD II patients with similar emotional symptoms, as well as differences in prognosis [26, 27]. This necessitates the need for accurate differentiation between the two.

Cognitive impairment is a prominent symptom among patients with BD, exhibiting a complex interrelationship with emotionality [40]. During periods of remission, it can significantly impair psychosocial functioning [9, 10, 13, 25]. As with schizophrenia, the literature on the cognitive functioning of BD can be divided into two domains: non-social cognition and social cognition [38]. A substantial body of research has been conducted on non-social cognition in BD (for reviews, see [9, 10], and [13]) as well as in both BD I and BD II (for reviews, see [8, 12, 19, 35]). However, the current reviews have not reached a consensus on comparisons between BD I and BD II, particularly in the domain of executive function [8, 12, 19, 35]. A systematic review highlighted the potential impact of inconsistent measures in the same cognitive domain, as well as the influence of mood phases and comorbidities in patients enrolled in the studies [35].

Social cognition refers to the mental processes that underpin social interactions, enabling individuals to interpret social information and respond appropriately in social situations [28]. In BD, it has been demonstrated to be closely associated with global functioning [37, 68, 70] and modulated the relationship between neurocognition and social functioning [50]. Furthermore, evidence indicated its considerable importance in the long-term clinical management and treatment of BD. For instance, a recent longitudinal study revealed that diminished emotion cognition was associated with heightened severity of mood episodes, an increased number of symptoms, and a higher frequency of psychiatric hospitalizations [17]. On the other hand, the administration of cognitive-behavioral therapy, which functions on social cognition [75], has been demonstrated to result in a significant improvement in emotion and psychosocial functioning among pediatric BD patients experiencing a depressive episode [73].

According to the framework proposed by Green et al. [28, 29], social cognition can be further divided into five domains, namely Theory of Mind (ToM, the ability to infer the intentions, dispositions, and beliefs of others, [5]), emotion processing (broadly reflecting the perception and use of emotions, [23]), social knowledge (the awareness of the roles, rules, and goals that characterize social situations and guide social interactions, [11]), social perception (one's ability to identify social roles, social rules, and social context, [54]), and attributions (how one explains the causes of positive and negative outcomes and how the meaning of events is based on one's attribution of their cause, also referred to as attributional bias or social judgement, [24, 28, 29]). Recently, increased attention has been paid to social cognition in BD, which have been consistently reported to be impaired in BD patients [14, 24, 32]. Among all social cognition domains, deficit in ToM was most frequently reported (reviewed in de Siqueira Rotenberg et al., [16, 24, 66]), even observed in pediatric BD patients [30]. Furthermore, there was substantial evidence of considerable impairment in emotional processing, particularly in the recognition of facial expressions (reviewed in [24, 47, 58]). A recent systematic review reported that although patients with BD demonstrated superior performance on facial emotion recognition than schizophrenia patients, and there was no significant difference between them and patients with attention deficit hyperactivity disorder, they performed worse than major depressive disorder patients [15]. There was also evidence that hostile attributions contributed to poor social functioning in BD [36], and attenuated externalizing bias has been found even in remitted BD [20]. Nevertheless, so far, only one meta-analysis has been conducted to compare social cognition in BD I and BD II [8]. This analysis found no significant differences between the two subtypes on social cognition in general, based on eight articles covering three domains (i.e. ToM, emotional processing and attributions).

In recent years, there has been a notable increase in the number of studies examining disparate aspects of social cognition in both BD I and BD II. Some of these studies have reported more impaired emotion processing in BD I [78], Miola et al., 2023), and others have reported more deficient attributions in BD II [52]. Accordingly, the objective of this study was to provide an update systematic review and meta-analysis to facilitate a comparison of the characteristics of BD subtypes across different social cognitive domains.

Methods

The present study was conducted in accordance with the PRISMA 2020 guidelines [51], and the review protocol was registered on PROSPERO under the title "An updated review of social cognition in bipolar I and II disorders" (protocol number CRD42024575401).

Search strategy and study eligibility

A search of the Web of Science and PubMed databases was conducted from inception to 28 August 2024 to identify studies that reported on the comparison of social

cognition performance between BD I and BD II. The search terms were as follows: "bipolar disorder" AND ("social cognit*" OR "Theory of Mind" OR "emotion processing" OR "facial emotion recognition" OR "social knowledge" OR "social perception" OR "attribution" OR "attributional bias" OR "social judgment") AND ("I" OR "II" OR "subtype"). Furthermore, the authors conducted a manual search of the reference lists of the identified articles during the database searches to identify any additional studies not captured by the original search string.

Inclusion criteria were: (1) Study of one or more social-cognitive domains, whether using scales, behavioral measures or neuropsychological tests; (2) comparison was made between BD I and BD II; (3) patients with BD were diagnosed by the ICD-10 [76], DSM-IV [1], DSM-IV-TR [2], or DSM-5 [3] criteria,(4 patients were in remission or had an affective episode; (5 all age groups; and (6 published in English. Exclusion criteria was a quality assessment level of poor.

Data extraction and quality assessment

Literature searches, data extraction and assessment of article quality were carried out independently by two researchers (XC and NQ). A third researcher (BZ) assisted in the adjudication of disagreements that could not be resolved after discussion. We extracted information from eligible full-text articles according to the inclusion criteria. Data extracted from each article included: (1) basic information about the included studies, including author, year of publication; (2) basic characteristics of the study subjects, including number and age of BD I and BD II subjects, their diagnostic criteria, clinical features, history of psychosis, and antipsychotics taking; (3) social cognition domains, tests of interest, and main findings; (4) mean and standard deviation (S.D.) data of social cognition tests for subtypes (BD I and BD II). All the process of data extraction was carried out manually without any automation tools.

The risk of bias of the studies was assessed independently by the two authors (XC and NQ) using the Newcastle–Ottawa Scale (NOS, [74]) in consideration of their nature of case–control study design. The scale consists of three main sections: selection, comparability, and assessment of exposure or outcome. Entries are rated on a scale of 0 to 1. The NOS scale has a total score of 9, and in general, a score of seven or more points indicates good quality, three to six points indicates fair quality, and less than three points indicates poor quality.

Effect measures and synthesis methods

As many of the studies included in the current meta-analysis used different social cognition tasks and the resulting data are all continuous, standardized mean difference (SMD) that could be compared across studies was used as effect size. If more than one social cognition task was used in a study, each task was treated as a separate dataset for the following meta-analysis. For domains with at least three studies that met the inclusion criteria, meta-analyses were performed using Revman 5.3 version recommended by the Cochrane Collaboration. For each social cognition test, the SMD (namely Hedge's g in Revman) and 95% confidence intervals (CI) were calculated from the mean and standard data and then weighted using the inverse variance method and a random effects model. The I^2 indicator was used to assess heterogeneity among the included literature. An I^2 value of less than 40% indicates no significant heterogeneity, 40%–75% indicates substantial heterogeneity, and greater than 75% indicates substantial heterogeneity [31]. Stata 15.0 was used for meta-regression analysis of domains with substantial heterogeneity.

Publication bias analysis and certainty of evidence

Funnel plot and Egger's test were used to analyze the possibility of publication bias. Since positive studies were more likely to be published than negative studies, if the funnel plot was symmetrically distributed, there was no publication bias. Certainty of evidence in the social cognition domains was assessed using the GRADE criteria on the following domains: risk of bias, inconsistency, indirectness, imprecision, and publication bias [61].

Results

All 20 included studies were published between 2002 and 2023, of which 12 were published before 2018 and eight in 2018 and later, including some by one of the authors [52, 53, 78]). The included articles covered three domains of social cognition (ToM, emotion processing, and attributions). As little research was found that focused on the domains of social knowledge or social perception (the only one involved judging socially desirable traits in a self-referential memory task in [38]), we did not analyze these two domains. The flowchart of the literature screen was shown in Fig. 1. Basic information on study participants was presented in Table 1 in order of publication year, and the comparison results of BD I and BD II on the three domains and the study quality rating were summarized in Table 2.

ToM

Quality analysis

As illustrated in Table 2, eight tests in six studies were situated within the domain of ToM, five with a quality assessment of good and three with fair. All tests, with the exception of the Reading the mind in the eyes task in Schenkel et al. [59], found equivalent ToM in BD I

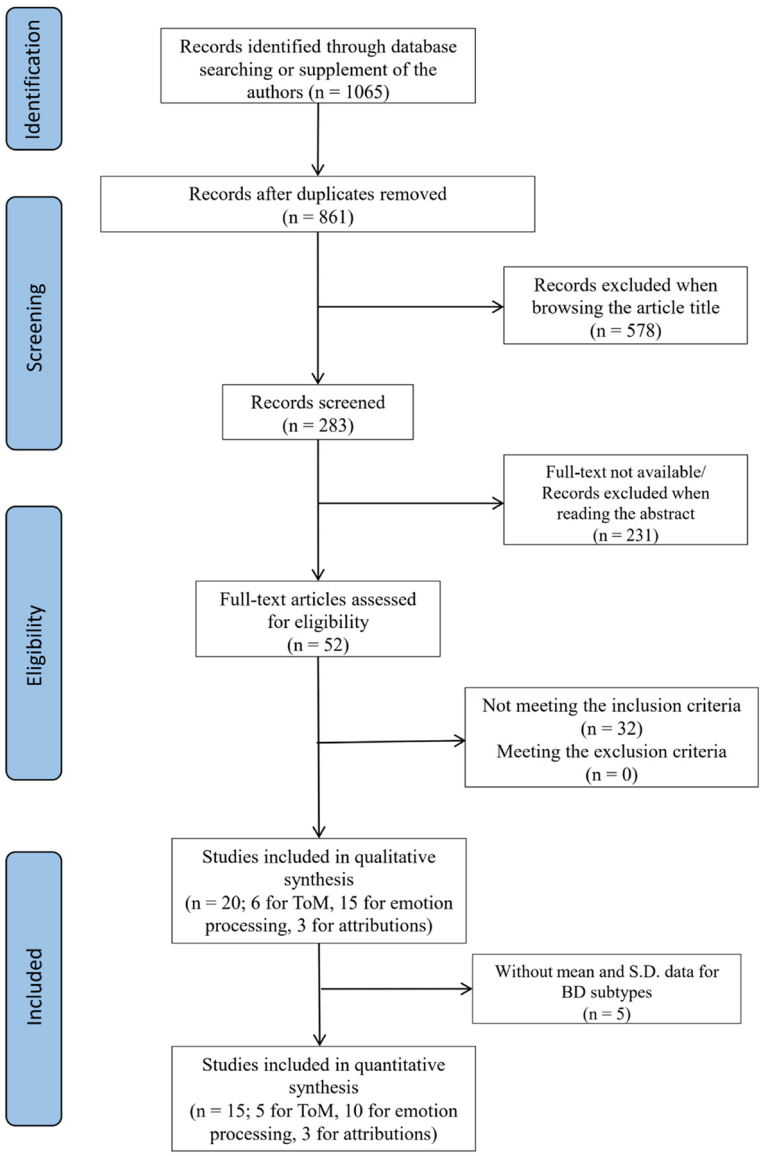

Fig. 1 Flowchart of literature screen

and BD II. More specifically, most research showed that patients with BD I and BD II had equivalent impairments in ToM, whether in a euthymic [43, 21, 48], remitted, depressive or hypomanic state [38, 67], although such impairments were found to be mediated by deficits in attention-executive functions and exposure to psychotropic medications [43]. Furthermore, in euthymic patients, there was little evidence of impaired ToM, only in BD I when manic patients were also enrolled [59], or in BD II when detecting negative mental states [48] (see Tables 1 & 2).

Quantity analysis

One study [67] was not included in quantity analysis since although comparison results were found, mean and S.D. data was missing in the literature, and we contacted the authors for data without receiving a response. A meta-analysis of seven tests in the remaining five studies using random effects model was conducted, the results showed there was no significant difference in TOM between patients with BD I and BD II (BD I: $n = 252$, BD II: $n = 170$; ES = −0.08; 95%CI: [−0.29, 0.13]; Z = 0.76; $P = 0.45$) (also see Fig. 2). As presented in Fig. 3, the funnel plot exhibited

Table 1 Basic information of participants in studies that comparing social cognition of bipolar I (BD I) and bipolar II (BD II)

	Sample size	Age (mean)	Diagnostic criteria	Clinical features	History of psychosis	Antipsychotics
ToM						
[67]	BD I 37, BD II 12	BD 38.5	DSM-IV-TR	Mix of euthymia, depression, mixed and (hypo)mania	No information	63%
[21]	BD I 65, BD II 47	BD I 44.8, BD II 49.0	DSM-IV, ICD-10	Euthymia	No information	No information
[48]	BD I 17, BD II 13	BD I 38.6, BD II 41.2	DSM-5	Euthymia	No information	71% BD I, 54% BD II
Emotion processing						
[39]	BD I 8, BD II 8	No information	DSM-IV	Euthymia	No information	No information
[64]	BD I 25, BD II 11	BD I 37.4, BD II 42.8	DSM-IV	Mix of remission and depression	No information	No information
[18]	BD I 26, BD II 36	BD I 43.2, BD II 42.7	DSM-IV	Euthymia	58% BD I, 28% BD II	58% BD I, 42% BD II taking atypical antipsychotics
[60]	BD I 23, BD II 16	BD I 12.6, BD II 14.6	DSM-IV-TR	BD I in mania or mixed state BD II in hypomania or depression	No information	None
[6]	BD I 39, BD II 5	No information	DSM-IV-TR	Mix of remission and depression	No information	No information
[7]	BD I 164, BD II 107	BD I 41.1, BD II 39.4	DSM-IV-TR	Mix of remission, depression, and mania	No information	BD I 48% BD II 43%
[69]	BD I 29, BD II 24	No information	DSM-IV	Mix of remission, depression and hypomania	83% BD I 13% BD II	53%
[45]	BD I 25, BD II 34	No information	DSM-IV	Community based stable	8%	None
[78]	BD I 39, BD II 22	BD I 20.4, BD II 19.5	DSM-5	Mix of euthymia, depression, and hypomania	No information	No information
[41]	BD I 25, BD II 18	BD I 35.3, BD II 40.9	DSM-5	Euthymia	No information	None
[33]	BD I 76, BD II 149	BD I 32.7, BD II 31.2	DSM-5	Euthymia	No information	54% BD I, 25% BD II
[46]	BD I 20, BD II 28	BD I 45.5, BD II 38.9	DSM-5	Mix of remission and depression	55% BD I, 36% BD II	75% BD I, 36% BD II
Attributions						
[52]	BD I 89 BD II 91	BD I 21.9, BD II 23.0	DSM-5	Mix of euthymia, depression, and hypomania	No information	No information
[53]	BD I 87 BD II 92	BD I 25.2, BD II 25.3	DSM-5	Mix of euthymia, depression, and hypomania	No information	No information
Both ToM and emotion processing						
[43]	BD I 45, BD II 36	BD I 37.2, BD II 42.9	DSM-IV	Euthymia	93% BD I, 6% BD II	No information
[59]	BD I 17, BD II 8	BD I 11.4 BD II 13.4	DSM-IV	Mix of remission, depression, and mania	No information	61% taking atypical antipsychotics
ToM, emotion processing, and attributions						
[38]	BD I 46, BD II 22	No information	DSM-IV	Mix of remission and depression	No information	No information

ICD-10 International Classification of Diseases, 10th Revision, *DSM-IV* Diagnostic and Statistical Manual of Mental Disorders, 4th edition, *DSM-IV-TR* Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision, *DSM-5* Diagnostic and Statistical Manual of Mental Disorders, 5th edition

Table 2 Summary of comparison results and study quality assessment of Theory of Mind (ToM), emotion processing, and attributions in bipolar I (BD I), bipolar II (BD II)

	Cognitive tasks	Main findings	Quality assessment
ToM			
[43]	Faux Pas test, Reading the mind in the eyes	BD I = BD II on Faux Pas test (Hedge's g < 0.001, $p = 1.00$) BD I = BD II on Reading the mind in the eyes (Hedge's g < 0.001, $p = 1.00$)	Good
[67]	False belief stories in picture sequencing task	BD I = BD II	Good
[38]	TASIT	BD I = BD II (Hedge's g = −0.07, $p = 0.79$)	Fair
[59]	Cognitive perspective-taking, Reading the mind in the eyes	BD I = BD II on cognitive perspective-taking (Hedge's g = −0.33, $p = 0.44$) BD I < BD II on Reading the mind in the eyes (**Hedge's g = −0.97, $p = 0.03$**)	Good
[21]	Reading the mind in the eyes	BD I = BD II (Hedge's g = −0.13, $p = 0.50$)	Fair
[48]	Reading the mind in the eyes	BD I = BD II (Hedge's g = 0.44, $p = 0.24$)	Fair
Emotion processing			
[39]	Facial emotion recognition	BD I = BD II on recognition of happiness, sadness, fear, disgust, anger, and surprise	Fair
[64]	Facial emotion recognition	BD I = BD II on recognition of happiness, sadness, fear, disgust, anger, and surprise	Good
[18]	Facial emotion recognition	BD I < BD II on recognition of happiness, sadness, fear, disgust, anger, and neutral (**Hedge's g = −2.66, $p < 0.001$**)	Good
[43]	Ekman-60	BD I = BD II (Hedge's g = −0.18, $p = 0.43$)	Good
[60]	Chicago pediatric emotional acuity task	BD I = BD II (Hedge's g = −0.17, $p = 0.60$)	Good
[38]	Facial emotion recognition, Empathic accuracy, MSCEIT	BD I = BD II on recognition of happiness, sadness, fear, disgust, anger, and surprise (Hedge's g = 0.36, $p = 0.17$) BD I = BD II on empathic accuracy under positive and negative events (Hedge's g = −0.44, $p = 0.09$) BD I > BD II on MSCEIT (**Hedge's g = 0.60, $p = 0.02$**)	Fair
[6]	Facial emotion recognition, identification, and discrimination	BD I = BD II on recognition of happiness, sadness, fear, anger, and neutral BD I = BD II on identification of happiness, sadness, disgust, anger, surprise, and shame BD I = BD II on facial emotion discrimination	Fair
[59]	Emotional perspective-taking	BD I = BD II (Hedge's g = −0.25, $p = 0.56$)	Good
[7]	Facial expression recognition	BD I = BD II	Fair
[69]	Human full-figure point-light displays	BD I = BD II	Good
[45]	Facial emotion recognition	BD I < BD II on recognition of happiness, sadness, fear, and anger (**Hedge's g = −0.67, $p = 0.01$**)	Good
[78]	Facial emotion processing event-related-potentials	BD I = BD II on RTs, accuracies, N1-P3 latencies and amplitudes for neutral, happiness, anger and sadness facial emotions except that BD I < BD II on recognition accuracy of sadness and N1 latencies at frontal and central electrodes to neutral (**Hedge's g = −0.64, $p = 0.02$**)	Fair
[41]	MSCEIT	BD I = BD II (Hedge's g = −0.19, $p = 0.55$)	Good
[33]	Facial emotion recognition	BD I = BD II on recognition of happiness, sadness, fear, disgust, anger, and surprise (**Hedge's g = 0.95, $p = 0.01$**)	Fair
[46]	Facial emotion recognition	BD I < BD II on recognition of sadness, disgust, anger, and neutral (**Hedge's g = −2.00, $p < 0.001$**)	Fair
Attributions			
[38]	TASIT	BD I = BD II (Hedge's g = −0.07, $p = 0.79$)	Fair
[52]	Body image concerns	BD I < BD II on perceived distress/ discrimination because of appearance (**Hedge's g = −0.51, $p < 0.001$**)	Good
[53]	Hypochondriac concerns	BD I = BD II on self-reported symptom effect on social functioning (Hedge's g = −0.27, $p = 0.07$)	Good

TASIT The Awareness of Social Inference Test, Part III, *MSCEIT* Mayer-Salovey-Caruso Emotional Intelligence Test. Hedge's g and related p were not provided for some studies since mean and S.D. data were not available

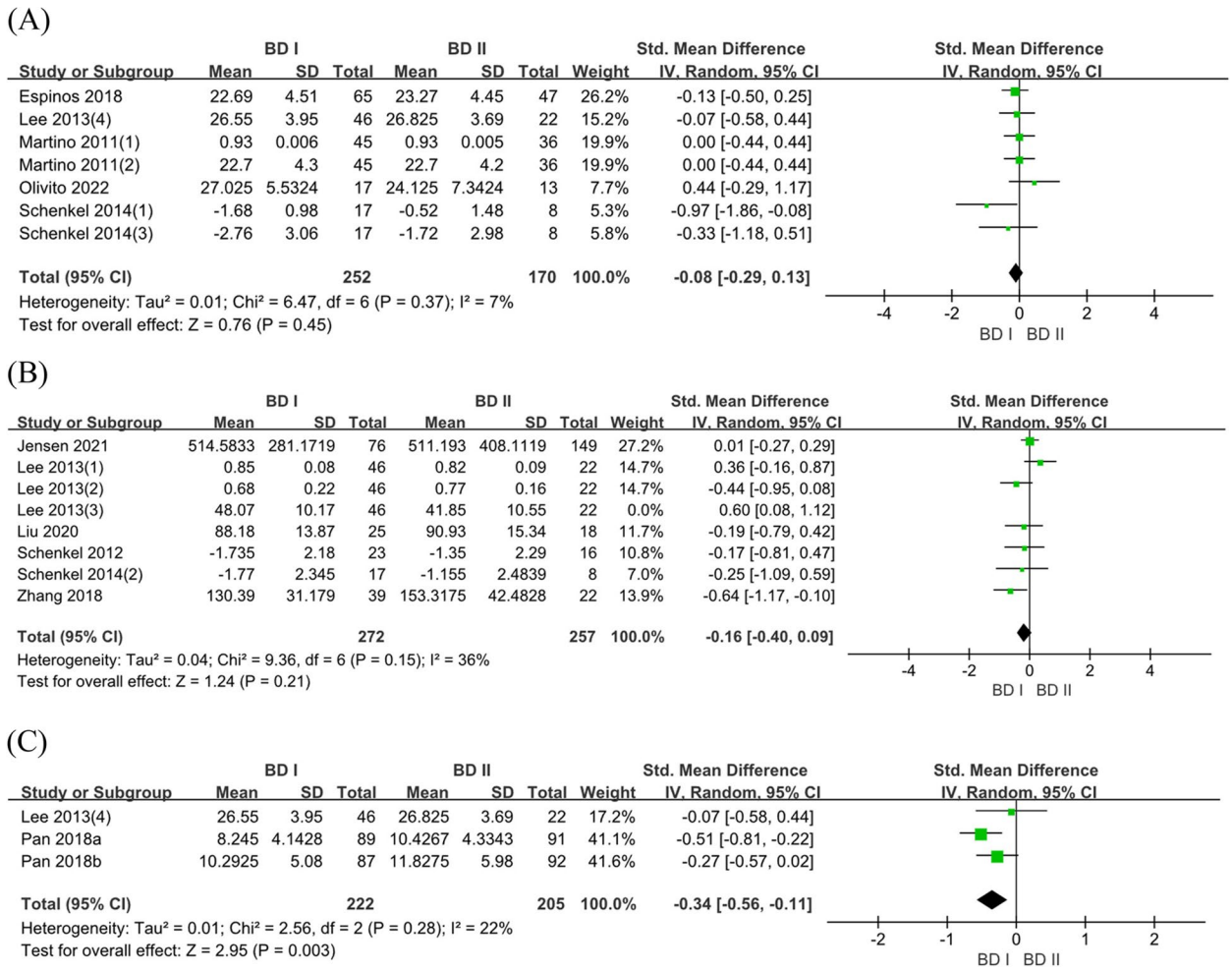

Fig. 2 Forest plot of pooled Hedge's g effect size for comparisons between BD I and BD II on (**A**) Theory of Mind; (**B**) emotion processing (in non-psychotic subjects; MSCEIT in Lee et al. [38] was deleted after sensitivity analysis); and (**C**) attributions

a symmetrical distribution according to the results of Egger's test ($t=-0.07$, $df=4$, $p=0.95$), indicating the absence of significant publication bias upon ToM based on the seven tests. In terms of certainty of evidence, the NOS quality assessment suggested a possible risk of bias in three of the seven included trials, all of which supported the meta-analysis result by showing equivalent ToM in BD I and BD II. Therefore, the certainty of the evidence was downgraded by one level. On the other hand, inconsistency was assessed using the I^2 indicator for heterogeneity and was not found to be significant. Indirectness, imprecision and publication bias were also assessed and were not found to be an issue. In combination with the case–control design, the certainty of the evidence based on the GRADE criteria can generally be interpreted as low.

Emotion processing

Quality analysis

Nineteen tests in 15 studies fell within the domain of emotion processing, eight with a quality assessment of good and 11 with fair. All the tests except for the Facial emotion recognition task in Derntl et al. [18], Merikangas et al. [45], Zhang et al. [78] and Miola et al. [46], as well as the intelligence test in Lee et al. [38], found equivalent emotion processing in BD I and BD II, as manifested by similar performance in emotional intelligence [41], empathic accuracy [38], emotional perspective-taking [59], emotion perception from body movements [69], as well as recognition, identification, and discrimination of happy, sad, fear, disgust, anger, surprise, shame, and neutral facial emotions [6, 7, 33, 38, 39, 43, 60, 64]. However, with a history of psychosis, three studies found more

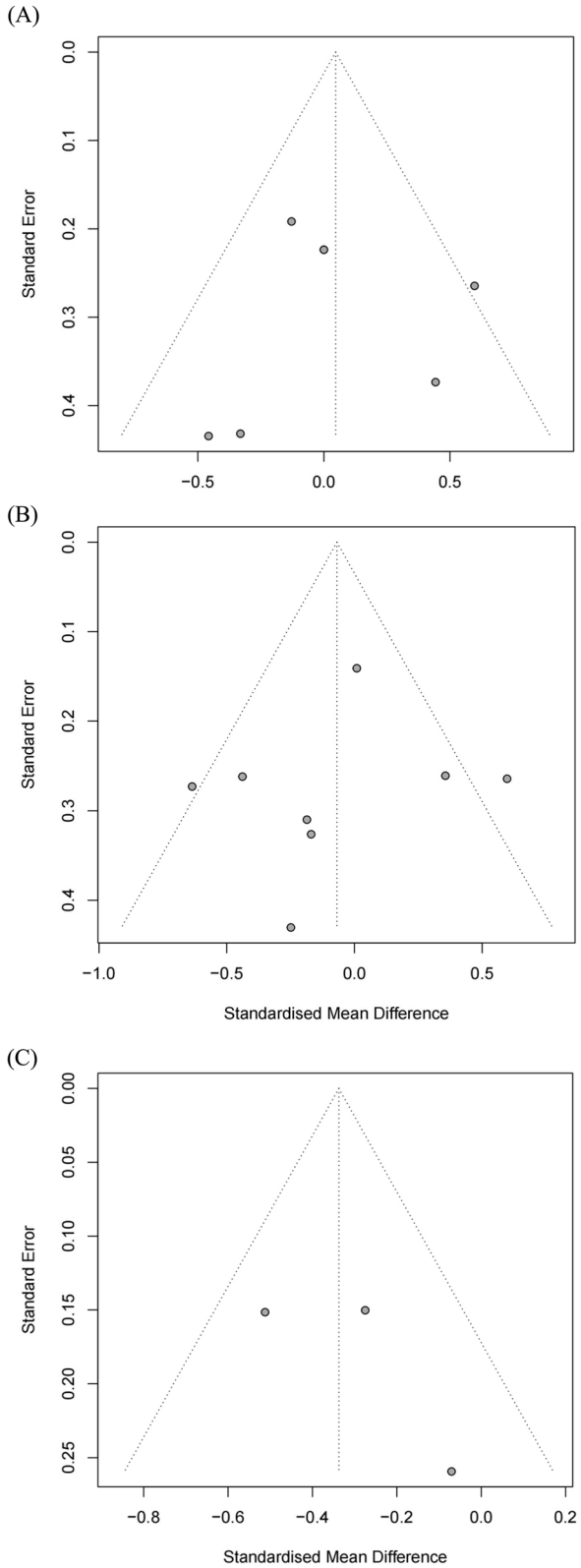

Fig. 3 Funnel plot of standardized mean differences (calculated with Hedge's g) between BD I and BD II on (**A**) Theory of Mind; (**B**) emotion processing (in non-psychotic subjects); and (**C**) attributions

impaired facial emotion recognition in BD I than BD II [18, 45, 46]. Another study found that even in patients without a history of psychosis, BD I was more impaired in recognizing sad faces and had prolonged cerebral coding of neutral faces than BD II [78] (see Tables 1 & 2).

Quantity analysis

Similar to ToM, five studies [6, 7, 39, 64, 69] were not included in quantity analysis for no mean and S.D. data. Since heterogeneity was high ($I^2 = 88\%$) when comparing BD subtypes in all subjects, subgroup analysis was conducted based on the history of psychosis. When comparing BD subtypes in those with a history of psychosis, heterogeneity was still high ($I^2 = 93\%$) and could not be reduced by sensitivity analyses. Further meta-regression showed significant negative prediction of history of psychosis on emotion processing ($\beta = -1.23$, $p = 0.02$).

When comparing between BD subtypes without a history of psychosis, a meta-analysis of eight tests was performed using a random effects model, the results showed a lower level of heterogeneity ($I^2 = 56\%$). Leave-one-out sensitivity analysis further showed that heterogeneity decreased to an acceptable range ($I^2 = 36\%$) after deletion of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) in Lee et al. [38]. Finally, seven tests in six studies [33, 38, 41, 59, 78, 60], were included in a further meta-analysis, showing that there was no significant difference in emotion processing between non-psychotic patients with BD I and BD II (BD I: $n = 272$, BD II: $n = 254$; ES = −0.16; 95%CI: [−0.40, 0.09]; Z = 1.24; $P = 0.21$) (also see Fig. 2). As shown in Fig. 3, the funnel plot was symmetrically distributed according to the Egger's test (t = −0.49, df = 6, $p = 0.64$). Concerning certainty of evidence, the NOS quality assessment suggested a possible risk of bias in four of the seven included tests, most of which supported the meta-analysis result by showing equivalent emotion processing in BD I and BD II. The certainty of the evidence was therefore downgraded by one level. The inconsistency indicated by I^2 was not significant, and indirectness, imprecision and publication bias were not found to be an issue. In combination with the case–control design, the certainty of the evidence can be interpreted as low.

Attributions

Quality analysis

Only three tests in three studies were situated within the domain of attributions, two with a quality assessment of good and one with fair. With mixed sample of patients in remitted, depressive, and/or hypomanic episodes, the three studies demonstrated that patients with BD II attributed distress and perceived discrimination more to their appearance [52], while showed no significant

difference on level of attributing social dysfunction to physical symptoms and inference of others' behaviors when compared with those with BD I [38, 53] (see Tables 1 & 2).

Quantity analysis

A meta-analysis of the three tests using random effects model was conducted. The results showed that patients with BD II had more pronounced attributional bias than those with BD I, with a low- to- moderate summary effect size (BD I: $n=222$, BD II: $n=205$; ES = −0.34; 95%CI: [−0.56, −0.11]; Z = 2.95; $P=0.003$) (also see Fig. 2). As shown in Fig. 3, the funnel plot was symmetrically distributed according to the Egger's test (t = 1.00, df = 1, $p=0.50$). In terms of certainty of evidence, although one of the three included trials showed evidence of a possible risk of bias, its conclusion (suggesting equivalent attributions in BD I and BD II) was inconsistent with the meta-analysis result. Therefore, there was no change in the certainty of the evidence. In addition, the inconsistency indicated by I^2 was not significant, and indirectness, imprecision and publication bias were not found to be a problem. Furthermore, the Hedge's g effect size of Pan et al. [52] was high and supported the result of the meta-analysis. Therefore, the certainty was upgraded by one level. In combination with the case–control design, the certainty of the evidence can be interpreted as moderate.

Discussion

The aim of the present study was to further clarify the differences in social cognitive dysfunction between patients with BD I and BD II. We have added several literature from the last six years [21, 33, 41, 46, 48, 52, 53, 78], covering areas of ToM, emotion processing and attributions, and one of them was based on neurophysiological measures. The most extensively studied domain was emotion processing, and the least number of studies was on attributions. In general, there was no significant publication bias when comparing BD I and BD II of these three domains.

Among the six studies dealing with the domain of ToM, the most frequently used task was "Reading the mind in the eyes", which was used in four studies [21, 48, 59, 67]. Unlike for non-social cognition [35], no significant difference was found between studies using different tasks in ToM, as indicated by the findings using the Faux Pas test [43], False belief stories in picture sequencing task [67], awareness of social inference test [38], cognitive perspective-taking task [59], and the "Reading the mind in the eyes" task [21, 48]. In general, the meta-analysis showed that the BD subtypes had similar performance on ToM with a small effect size. However, differences could be caused by the manic episode of the included participants, which lead to more impaired ToM in BD I than BD II [59]. A recent meta-analysis also revealed a modest correlation between full-manic episode and cognitive deficits in BD [8], which supported that mood phase should be balanced during comparisons between BD subtypes in ToM.

Among the 15 studies involved in the domain of emotion processing, the most frequently employed task was facial emotion recognition/processing, which was used in 12 studies (except for studies of [41, 59, 69]). No significant difference was found between studies using different measurement tasks, as indicated by the findings using emotional perspective-taking [59], empathic accuracy [38], Mayer-Salovey-Caruso emotional intelligence test [38, 41], Human full-figure point-light displays [69], and facial emotion recognition/processing task [6, 7, 18, 33, 38, 39, 43, 45, 46, 60, 64, 78]. In patients without a history of psychosis, this meta-analysis showed similar impaired emotion processing in BD I and BD II, with a small effect size. However, emotion processing was more impaired in BD I than in BD II when psychosis history was recorded in both types [18, 45], Miola et al., 2023). These findings suggested that differences in emotion processing may be caused by the psychiatric history of the included participants. Previous evidence has also shown that a history of psychosis is modestly associated with cognitive deficits in BD [8]. It is therefore important to take this factor into account when making comparisons between different BD subtypes in terms of emotion processing. Another study involved found that BD I performed better than BD II in the face of neutral stimuli at an earlier stage of cerebral encoding [78]. This suggested the need for further investigation into the early cerebral stages of cognitive processing that occur in social cognitive domains. Overall, the results of these studies indicated that the extent of dysfunction in emotion processing was generally comparable between individuals with BD I and BD II. However, there were notable differences in patients with a history of psychosis and in early brain activation in response to specific emotional stimuli.

In the domain of attributions, previous evidence has shown that extreme, rigid attributions contribute to a more severe course of depression in BD patients [63]. Interestingly, this study also found more impaired attributions in BD II with low-to-moderate effect size, with Pan et al. [52] suggesting a more pronounced attributional bias in BD II in terms of affective state and interpersonal problems. On the other hand, Pan et al. (2018b) and Lee et al. [38] showed similar levels of attribution of social dysfunction to physical symptoms and attribution of others' behavior in BD I and BD II. It is also noteworthy that no study has compared their attributional styles in general using the classic measures such as the

Attributional Style Questionnaire [55] or the Internal Personal Situational Attributions Questionnaire [34]. Therefore, further research is needed to examine the overall and situational attributional performance of BD subtypes.

It should be noted that our study suffers from at least the following limitations. First, since most of the studies included in this review did not address information on comorbidities (except [46, 53, 59, 60], we have not assess its potential impact on the characteristics of socio-cognitive domains of the BD subtypes. However, according to epidemiological studies, approximately 90% of individuals with BD had at least one psychiatric comorbidity, most commonly anxiety disorders (e.g., [49, 72]). Therefore, future studies are supposed to take it into account. Second, we have not collected medication information other than antipsychotics, while antidepressants and mood stabilizers may have influence on cognitive function in BD [56, 57]. Third, due to limited evidence, some data on the manifestation of attributions were drawn from partial results of previous studies. Finally, the studies included were case–control designs, which means that more powerful randomized designs are still needed.

Conclusion

The present study focused on assessing socio-cognitive domains of BD I and BD II, and found that BD I and BD II performed similarly on ToM. So did them on emotional processing, but differed when considering psychosis history, specific emotional stimuli, as well as cognitive processing stages. Furthermore, although more impaired attributions was found in BD II with low-to-moderated effect size, more research is still needed in this area. The same is true for social knowledge and social perception. In addition, performance in other relevant domains in BD subtypes, such as emotion regulation, also needs to be comprehensively assessed. Future studies are encouraged to control for the effect of clinical features of BD subtypes, especially medications, psychosis history and comorbidities, when investigating their socio-cognitive characteristics. The incorporation of various neuroscientific techniques such as fMRI, fNIRs and EEG into social cognitive assessment is also encouraged.

Abbreviations

BD	Bipolar disorder
BD I	Bipolar I disorder
BD II	Bipolar II disorder
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4th edition
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th edition
ICD-10	International Classification of Diseases, 10th Revision
MSCEIT	Mayer-Salovey-Caruso Emotional Intelligence Test
TASIT	The Awareness of Social Inference Test, Part III
ToM	Theory of Mind

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Authors' contributions
BZ conceived the study, XC and NQ collected the materials, XC analyzed the data, BZ and XC drafted the paper. All authors revised it and approved the final manuscript.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

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The authors declare no competing interests.

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