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Research report

An individual task meta-analysis of social cognition in euthymic bipolar disorders

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ABSTRACT

Objective: Social cognition has been shown to be affected in bipolar disorders, even during euthymia. However, the social cognitive profile of this group of disorders remains to be ascertained, given that such a broad neuropsychological construct has not been systematically examined in bipolar subjects across different tasks. The aim of this study was to quantify the magnitude of patient-control differences for distinct social cognition assessment instruments: the Hinting Task, the Eyes Test, Faux Pas, the Mayer–Salovey–Caruso Emotional Intelligence Test, and emotional labeling using visual stimuli.
Method: Effect sizes were extracted from studies chosen according to more stringent criteria than previously used in systematic reviews on the topic and pooled by means of meta-analytical procedures.
Results: No significant patient-control differences were found for the recognition of three basic emotions (happiness, sadness, and anger). Small but significant effect sizes favoring healthy controls (Hedges' $g < 0.5$) were noted for emotional intelligence, the Hinting Task, the Eyes Test, and the recognition of fear, disgust, and surprise. A medium effect size (Hedges' $g = 0.58$) was noted for the Faux Pas Test.
Limitations: The possible effects of other neurocognitive impairments on social cognitive performance could not be explored.
Conclusion: On average, small-to-moderate differences may exist between euthymic bipolar disorder subjects and healthy controls regarding social cognitive performance, with mental state decoding being more preserved than mental state reasoning. The influence of clinical and neurocognitive variables, which may play an important role in the social cognitive outcomes of these patients, deserves further clarification.

1. Introduction

It is now widely accepted that a considerable percentage of people affected by bipolar disorders (BDs) exhibit significant impairments in social and vocational adjustment (Huxley and Baldessarini, 2007; Jansen et al., 2012), resulting in more than 75% of the total socio-economic burden that such disorders carry (Das Gupta and Guest, 2002). Functional difficulties have been found to be related to below average neurocognitive performance between episodes (Martino et al., 2008; Tabarés-Seisdedos et al., 2008; Gilbert and Marwaha, 2013; Mackala et al., 2014), which is evident in about 70% of remitted bipolar patients across an array of domains, including different aspects of executive functioning, attention, verbal and visual memory (Burdick et al., 2014; Martino et al., 2014). Despite these considerations and the fact that interpersonal problems are commonly observed among affected subjects in daily clinical practice, BDs' profile of neuropsychological functioning across processes encompassed under the term 'social cognition' remains unclear (Lee et al., 2013; Samamé, 2013). Social cognition refers to a complex set of higher-order neuropsychological domains that enable adaptive behavior in response to others (Amodio and Frith, 2006). In order to provide an organizing framework, the National Institute of Mental Health has delimited five dimensions within this construct: theory of mind, social perception, social knowledge, attribution bias, and emotion processing (Green et al., 2008). Neuropsychological research on BDs has focused mainly on two of these social cognitive dimensions, namely emotion processing and theory of mind. The latter construct refers to the capability to attribute mental states—thoughts, desires, intents, etc.—to oneself an others (Premack and Woodruff, 1978). It encompasses distinct components, which appear at different developmental stages, including the understanding of others' thoughts and feelings, recognition of lie and irony, gaze monitoring, among others.

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As for emotional processing, this domain refers broadly to the processes that enable an individual to perceive and utilize emotions (Green et al., 2008). A salient aspect of this construct, on which research on neuropsychiatric disorders has mainly focused, involves abilities such as labeling, discriminating, and appraising emotions expressed by means of visual and verbal stimuli. Over the last decade, an emotion processing paradigm gaining attention and influence has been conceptualized as emotional intelligence (Mayer et al., 2002), which not only involves the ability to monitor, recognize, and discriminate one's own and other people's emotions, but also to use this emotional information to guide reasoning and behavior in the social environment.

At present, social cognition has not been systematically examined in BDs across different tasks (Lee et al., 2013). Great variability has been observed among studies of social cognition in euthymic bipolar patients: while some of them revealed large magnitudes of impairment (Malhi et al., 2008; Montag et al., 2008) others reported small effect sizes (Martino et al., 2011; Lee et al., 2013) or the absence of patient-control differences (Caletti et al., 2013; Purcell et al., 2013). A preliminary meta-analysis (Samamé et al., 2012) revealed moderate-to-large effect sizes for theory of mind and small effect sizes for emotion recognition, favoring healthy controls. However, in that study, the primary reports included were very heterogeneous with respect to the social cognitive tasks utilized and sample characteristics. Over the last two years, several studies assessing social cognition in BDs have been released, thus making it possible to perform a more comprehensive individual task meta-analysis of theory of mind and emotional processing in this group of disorders.

The aim of this study was to pool findings from primary investigations of social cognition in bipolar patients chosen according to more stringent criteria than previously utilized in research in the field so as to shed light on the social cognitive performance of euthymic BD patients across different tasks. Furthermore, this study was aimed at exploring the possible influence of clinical and demographic variables on patient-control effect sizes for social cognitive domains.

2. Material and methods

2.1. Search strategy and study selection criteria

MOOSE guidelines (Stroup et al., 2000) were followed to conduct this study. An extensive literature search was performed through the online databases PubMed/PsychInfo covering the period from January 1990 to September 2014, using combinations of the following keywords: *bipolar disorder*, *cognitive functioning*, *neuropsychology*, *social cognition*, *emotional intelligence*, *mindreading*, *theory of mind*, *mentalizing*, *mental state decoding*, *mental state reasoning*, *empathy*, *emotion recognition*, *affect recognition*, *emotional expressions*, and *emotional processing*. Furthermore, in order to retrieve unpublished material (theses and congress presentations), the same search was performed using Google Scholar. Reports were selected for this review if they met the following criteria: I) were available with an abstract in English; II) included an asymptomatic adult (aged between 18 and 65) patient group diagnosed with BD (I–II-NOS) according to DSM IV or similar criteria; III) euthymia was ascertained on the basis of standardized measures; IV) included a healthy control group; V) there were more than ten subjects in each of the patient and healthy comparison groups; VI) investigated theory of mind and/or emotion processing; VII) provided data to estimate patient-control effect sizes for social cognitive domains; VIII) used a social cognitive task included in a minimum of three studies.

Furthermore, the reference lists of retrieved reports were handsearched for further relevant investigations. If there were studies with overlapping content based on the same patient sample, we only considered the data from the study with the largest sample. Two studies on the same patient group were only included if they reported different social cognitive measures. We also contacted the authors of three studies (Ioannidi et al., 2013; Thaler et al., 2013; Van Rheenen and Rossell, 2014) for unreported information that was needed.

2.2. Data analysis

Meta-analyses were performed using Comprehensive Meta-Analysis software version 2.0 (Borenstein et al., 2005). The effect size for each social-cognitive measure was calculated as the mean difference between bipolar patients and healthy controls divided by the pooled standard deviation. Hedges' formula was applied to correct for upwardly biased estimation of the effect size in small samples (Hedges and Olkin, 1985). Effect sizes were weighted using the inverse variance method. Whenever BD patients performed poorer than controls, we reported between-group differences by positive effect sizes. If the means and standard deviations of more than one group with euthymic BD were given, the mean values and standard deviations were combined. The homogeneity of the resulting mean weighted effect sizes for each variable was examined using the Q-statistic. The I^2 index was calculated to describe the percentage of total variation across reports due to heterogeneity rather than chance. I^2 values of 25%, 50%, and 75% indicate low, moderate, and high heterogeneity, respectively (Higgins et al., 2003). We chose a random effects model whenever heterogeneity was observed. Only in those analyses with highly homogeneous distributions of effect sizes (Q-test $p > 0.05$, $I^2 = 0.00\%$), the same result could be obtained using either a fixed or a random effects model. Egger's test was used to assess whether there was a tendency for selective publication of positive results. A significance level of $p < 0.05$ was set for the random effects model, homogeneity, and publication bias analyses.

Random effects meta-regression analyses were performed to explore the influence of potential moderator variables on patient-control effect sizes. The restricted information maximum likelihood method was used with a significance level set at $p < 0.05$. Furthermore, sensitivity analyses were conducted to explore heterogeneity.

2.3. Social cognitive variables

The neuropsychological tests used in the studies reviewed were divided into 10 categories. Three different theory of mind overall measures were estimated by pooling standardized differences between patients and controls on accuracy scores of the Hinting Task (Corcoran et al., 1995), the Faux Pas Test (Stone et al., 1998), and Eyes tests based on Baron-Cohen et al. (2001). As for emotion processing, we calculated an emotional intelligence overall effect size by combining the results obtained from research studies including the Managing Emotions component of the Mayer–Salovey–Caruso Emotional Intelligence Test—MSCEIT—(Mayer et al., 2002), administered as a part of the Measurement and Treatment Research to Improve Cognition in Schizophrenia Consensus Cognitive Battery—MATRICS—(Nuechterlein and Green, 2006). Besides, the recognition of basic emotions was assessed by combining accuracy results from studies using emotion labeling tests based on either of two standardized sets of stimuli commonly utilized in neuropsychological research (Ekman and Friesen, 1976; Gur et al., 2001). Effect sizes for the recognition of each of six basic emotions (anger, disgust, fear, happiness, sadness, and surprise) were meta-analyzed separately yielding six overall emotion labeling measures.

2.4. Moderator variables

When at least six studies were pooled together, meta-regression analyses were performed in order to explore the influence of the proportion of type I BD patients, medication (percentage of patients on antipsychotics, antidepressants, and benzodiazepines), mean scores on mood rating scales (HDRS and YMRS), age, and illness duration on the reported effect sizes.

3. Results

Our search strategy enabled us to identify 135 primary studies exploring theory of mind and/or emotion processing in BDs. When these reports were examined further, only 26 met all the selection criteria. Seven of them were excluded as they were based on the same sample used in other studies (Martino et al., 2008; Konstantakopoulos et al., 2010, 2011; Burdick et al., 2011; Hoertnagl et al., 2011; Ioannidi et al., 2011; Ibañez et al., 2012). Finally, 19 reports comparing the social cognitive performance of 712 BD patients (mean age: 40.54 years) with that of 664 healthy controls (mean age: 39.25) were included (Table 1). Both the total sample of primary research reports and the subsamples used in the different analyses were matched on age. Small but significant effect sizes favoring controls were found for years of education in the sample of studies reviewed (Hedges'$g=0.15$, 95% CI=0.001 to 0.29, $p=0.04$, $k=14$). However, given that information on this variable was not available in some of the primary reports, patient-control differences were only calculated for the Hinting Task and basic emotion recognition analyses, for which no significant differences were found.

3.1. Theory of mind performance in BD patients

Small but significant differences were noted for the Eyes Test (Hedges' $g=0.27$, 95% CI=0.09 to 0.44, $p=0.003$) and the Hinting Task (Hedges' $g=0.45$, 95% CI=0.20 to 0.70, $p=0.0005$), whereas a moderate overall patient-control effect size was noted for the Faux Pas Test (Hedges' $g=0.58$, 95% CI=0.38 to 0.78, $p<0.000001$). In all of these analyses the distributions of effect sizes were highly homogeneous (Table 2, Fig. 1). Furthermore, two studies providing separate results for affective and cognitive Faux Pas showed significant medium-to-large effect sizes favoring controls for cognitive aspects, whereas affective aspects of the construct were found to be spared (Fig. 2).

3.2. Emotional processing abilities in BD patients

Small but significant effect sizes were noted for emotional intelligence (Hedges' $g=0.32$, 95% CI=0.13 to 0.51, $p=0.0009$) (Table 2, Fig. 1) and the effect size distribution was highly homogeneous. As for facial affect recognition, no significant patient-control differences were observed for sadness, happiness, fear, and disgust. However, distributions of effect sizes were highly heterogeneous for the latter two variables. The study by Harmer et al. (2002) stood out as a source of heterogeneity in these analyses. After removing the outlier so as to obtain a more homogeneous distribution of effect sizes, patient-control differences became significant, though in the small range, for both fear (Hedges'$g=0.39$, 95% CI=0.13 to 0.66, $p=0.004$) and disgust (Hedges'$g=0.43$, 95% CI=0.19 to 0.67, $p=0.0004$). Small but significant effect sizes were noted for the recognition of surprise (Hedges'$g=0.22$, 95% CI=0.01 to 0.43, $p=0.04$) in the presence of homogeneity. Evidence of publication bias was only found for the recognition of disgust analysis (Table 2, Fig. 3).

3.3. Meta-regression analyses

Meta-regression analyses revealed significant associations between the use of antipsychotics and recognition of disgust ($Z=3.84$, $p=0.0001$, $k=6$) and between the proportion of type I bipolar patients and recognition of sadness ($Z=2.06$, $p=0.04$, $k=6$) and happiness ($Z=2.21$, $p=0.03$, $k=6$). No significant associations were found between the use of antidepressants, benzodiazepines, age, or duration of illness and patient-control effect sizes for social cognitive variables. Further, no significant associations were found between YMRS and HDRS scores and patient-control effect sizes. However, due to the lack of available data, meta-regression analyses including scores on mood rating scales could only be conducted for emotional labeling and the Eyes Test.

4. Discussion

The present study sought to provide an updated meta-analysis of social cognitive performance in remitted BD subjects across different tasks, yielding 10 overall effect sizes for patient-control differences. Small but significant effect sizes were observed for theory of mind as assessed with the Eyes Test and the Hinting Task, whereas a moderate magnitude of impairment was only found for the Faux Pas Test. As for emotion processing, no patient-control differences were found for the recognition of three basic emotions (happiness, anger, and sadness). Small but significant effect sizes were noted for the Mayer–Salovey–Caruso Emotional Intelligence Test and the labeling of fear, disgust, and surprise. The results of this study are quite consistent with a previous meta-analysis by our group (Samamé et al., 2012) indicating that emotion processing and the social perceptual component of theory of mind might be spared or affected to a lesser extent than social reasoning. However, effect sizes for mentalizing variables yielded by the current study are much smaller than previously reported. This may be due to the utilization of more stringent inclusion criteria, which led to the selection of studies based on more homogeneous samples of bipolar patients with regard to mood state and enabled to perform individual task meta-analyses. Furthermore, the homogeneity found in all the theory of mind analyses allowed for weighting from fixed effects model, thus supporting the robustness of our findings.

The results of this study raise several issues about social cognition in BDs. First, our findings of nonsignificant patient-control differences for some variables and small-to-moderate effect sizes for others, interpreted together with evidence from meta-analyses of neurocognition revealing moderate-to-large effect sizes for most measures (Robinson et al., 2006; Torres et al., 2007; Mann-Wrobel et al., 2011), suggest that the neuropsychological profile of euthymic BDs may be characterized by quite preserved social cognitive abilities in comparison to neurocognitive functioning. Moreover, it should also be underscored that patient-control differences for social cognitive performance could at least partly be epiphenomena of between-group differences for other neurocognitive domains. Although the influence of neurocognitive domains on social cognition is still unclear, it has been proposed that preserved executive functioning is needed to succeed at least in some theory of mind tasks such as those requiring attributions about belief, rather than those based on *emotional contagion* and *mirroring* processes (Kalbe et al., 2010). Indeed, two studies included in this review (Shamay-Tsoory et al., 2009; Ioannidi et al., 2011) examined affective and cognitive aspects of Faux Pas separately and found that the affective component of the task, which relies mainly on simulation processes, was preserved, unlike the cognitive aspect, which was found to be affected with a medium-to-large effect size and to correlate with a measure of cognitive flexibility at the primary study level (Shamay-Tsoory et al., 2009). Similarly,

Table 1
Studies included in the meta-analysis.

Primary study	Sample BD (type) / HC	Criteria of euthymia	Neuropsychological test	Hedges' *g*
Barrera et al. (2012)	12(I–II)/12	HDRS < 7, YMRS < 8	Faux Pas	0.74
			Eyes Test	0.59
Bora et al. (2005)	43(I)/30	HDRS < 7, YMRS < 6	Hinting Task	0.67
			Eyes Test	0.65
Burdick et al. (2014)	136(I–II)/148	Affective stability as defined by HDRS < 12, CARS-M < 8	MSCEIT	0.38
Caletti et al. (2013)	18(I–II)/18	HDRS < 7, YMRS < 10	Faux Pas	0.36
			Eyes Test	0.08
Fernandes (2014)	23(I)/27	HDRS ≤ 8, YMRS ≤ 8	Recognition of happiness	0.28
			Recognition of anger	0.11
			Recognition of fear	0.78
			Recognition of sadness	0.63
Harmer et al. (2002)	20(NR)/20	HDRS ≤ 8, YMRS ≤ 8	Recognition of happiness	0.12
			Recognition of disgust	−0.65
			Recognition of anger	−0.12
			Recognition of fear	−0.44
			Recognition of surprise	0.10
			Recognition of sadness	0.35
Ibañez et al., (2014)	14(II)/41	BDI-II ≤ 6, YMRS ≤ 6	Faux Pas	0.95
			Eyes Test	0.38
Ioannidi et al. (2013)	57(NR)/53	HDRS < 7, YMRS < 7	Faux Pas	0.41
			Hinting Task	0.38
Lee et al. (2013)	68(I–II)/36	Minimal affective symptoms 76% of BDs in euthymia as defined by HDRS < 15, YMRS < 12	MSCEIT	0.23
Martino et al. (2011)	81(I–II)/34	HDRS ≤ 8, YMRS ≤ 6	Faux Pas	0.57
			Eyes Test	0.15
			Recognition of happiness	0.00
			Recognition of disgust	0.57
			Recognition of anger	0.10
			Recognition of fear	0.66
			Recognition of surprise	0.12
			Recognition of sadness	−0.07
Ozel-Kizil et al. (2012)	18(I)/27	HDRS < 7, YMRS < 7	Faux Pas	0.60
Purcell et al. (2013)	26(I)/28	IDS-C < 11, YMRS < 7	Eyes Test	0.00
Robinson (2010)	38(I–II)/27	HDRS ≤ 8, YMRS ≤ 8	Eyes Test	0.03
			Recognition of happiness	−0.26
			Recognition of disgust	0.36
			Recognition of anger	0.32
			Recognition of fear	0.12
			Recognition of sadness	−0.10
Shamay-Tsoory et al. (2009)	19(I)/20	HDRS ≤ 9, YMRS ≤ 7	Faux Pas	0.77
			Eyes Test	0.47
Thaler et al. (2013)	48(I)/24	SCID-IV criteria	Hinting Task	0.33
			Eyes Test	0.29
Thaler et al. (2013)	48(I)/24	SCID-IV criteria	Recognition of happiness	0.02
			Recognition of disgust	0.18
			Recognition of anger	0.13
			Recognition of fear	0.07
			Recognition of surprise	0.24
			Recognition of sadness	0.16
Van Rheenen and Rossell (2014)	17(I–II)/52	MADRS ≤ 8, YMRS ≤ 8	MSCEIT	0.15
Venn et al. (2004)	17(I–II)/17	HDRS < 8, YMRS < 8	Recognition of happiness	0.40
			Recognition of disgust	0.00
			Recognition of anger	0.32
			Recognition of fear	0.73
			Recognition of surprise	0.29
			Recognition of sadness	−0.09
Yalcin-Siedentopf et al. (2014)	57(I)/50	MADRS ≤ 8, YMRS ≤ 8	Recognition of happiness	0.57
			Recognition of disgust	0.72
			Recognition of anger	0.15
			Recognition of fear	0.16
			Recognition of surprise	0.31
			Recognition of sadness	0.38

BD = bipolar disorder patients; HC = healthy controls; BDI-II = Beck Depression Inventory-II; MSCEIT = Mayer–Salovey–Caruso Emotional Intelligence Test; CARS-M = Clinician Administered Rating Scale for Mania; IDS-C = Inventory of Depressive Symptomatology; HDRS = Hamilton Depression Rating Scale; YMRS = Young Mania Rating Scale; NR = not reported.

different studies (Bora et al., 2005; Lahera et al., 2008; Martino et al., 2011) found that patient-control differences for social cognition tasks were mediated by nonsocial cognition.

Another issue that deserves to be elucidated is the possible impact of psychotropic medication on social cognitive performance. In the current study, meta-regression analyses revealed a significant association between exposure to antipsychotics and recognition of disgust. This finding is in accordance with several research reports indicating that these psychotropic agents may have deleterious effects on BD patients' social cognition (Martino et al., 2011) and

Table 2
Mean weighted effect sizes of patient-control differences for social-cognitive domains.

Variable	*k*[a]	BD	HC	ES[b]	95% CI	*Z*[c]	*P*	Q test(*p*)[d]	I^2 (%)[e]	Bias[f]
Eyes Test	9	299	234	0.27	0.09–0.44	2.98	0.003	0.61	0.00	0.48
Faux Pas	7	219	205	0.58	0.38–0.78	5.66	< 0.000001	0.80	0.00	0.20
Hinting Task	3	148	107	0.45	0.20–0.70	3.49	0.0005	0.54	0.00	0.77
MSCEIT	3	221	236	0.32	0.13–0.51	3.31	0.0009	0.66	0.00	0.06
Recognition of surprise	5	223	145	0.22	0.01–0.43	2.02	0.04	0.96	0.00	0.83
Recognition of anger	7	284	199	0.15	−0.04–0.33	1.57	0.12	0.96	0.00	0.97
Recognition of happiness	7	284	199	0.16	−0.07–0.39	1.40	0.16	0.18	32.11	0.81
Recognition of sadness	7	284	199	0.18	−0.02–0.38	1.76	0.08	0.33	13.75	0.88
Recognition of disgust	6	261	172	0.25	−0.11–0.61	1.34	0.18	0.007	68.86	0.02
Recognition of disgust[g]	5	241	152	0.43	0.19–0.67	3.51	0.0004	0.26	24.28	0.03
Recognition of fear	7	284	199	0.29	0.00–0.59	1.95	0.05	0.02	59.04	0.97
Recognition of fear[g]	6	264	179	0.39	0.13–0.65	2.91	0.004	0.13	42.01	0.43

BD = bipolar disorder patients; HC = healthy controls; CI = confidence interval; MSCEIT = Mayer–Salovey–Caruso Emotional Intelligence Test.

[a] Number of primary studies.
[b] Effect size (Hedges' *g*).
[c] Test of significance of effect size.
[d] Test of homogeneity, based on X^2 with $k-1$ degrees of freedom.
[e] Heterogeneity Index.
[f] Egger's test of publication bias.
[g] After removing the outlier.

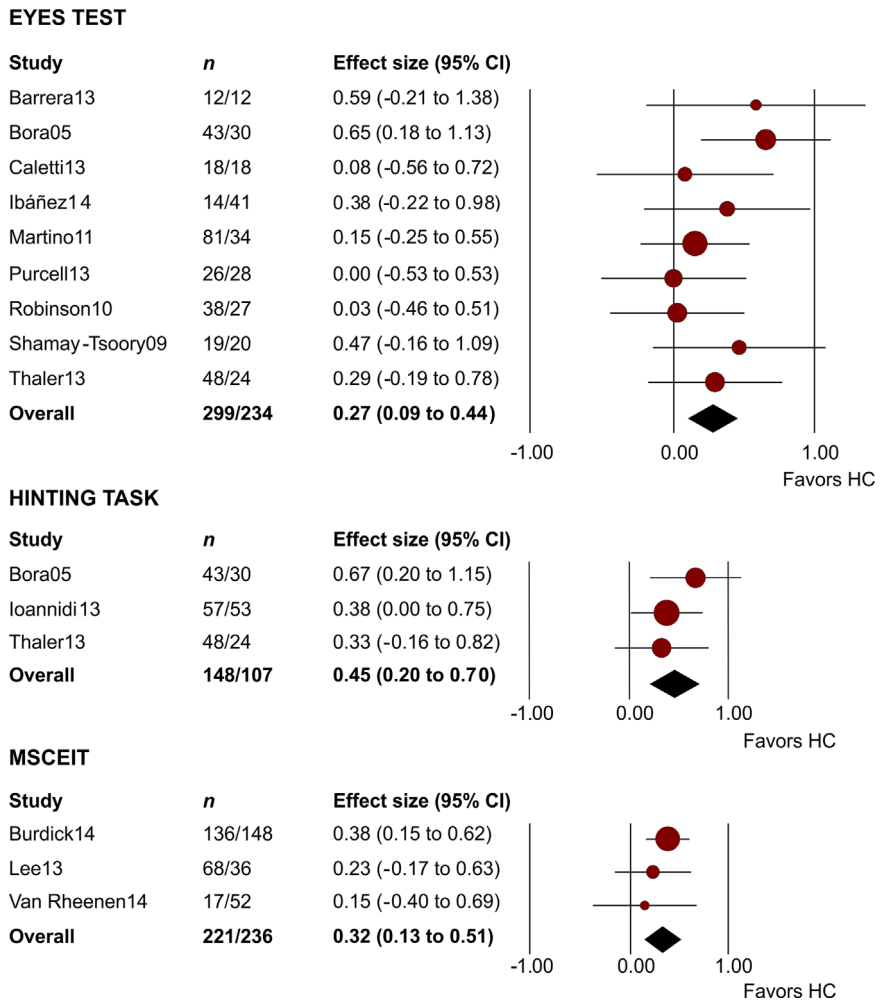

Fig. 1. Forest plot of individual and pooled estimates of the standardized mean differences between bipolar patients and healthy controls for the Eyes Test, the Hinting Task, and the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT). The area of each circle reflects weighting from fixed effects analysis. CI = confidence interval; HC = healthy controls.

neurocognition (Donaldson et al., 2003; Frangou et al., 2005; Jamrozinski et al., 2009). Altogether, the potential influence of neurocognition and psychotropic medication, prevents us from concluding that these small-to-moderate patient-control differences for social cognitive measures are trait markers of BD. Further studies controlling for these variables could help to elucidate this

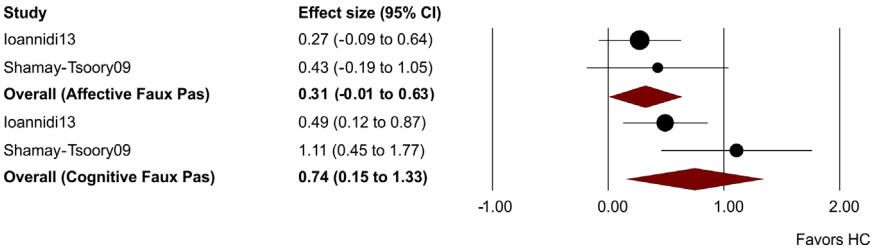

Fig. 2. Individual and pooled patient-control effect sizes for cognitive and affective Faux Pas. CI=confidence interval; HC=healthy controls.

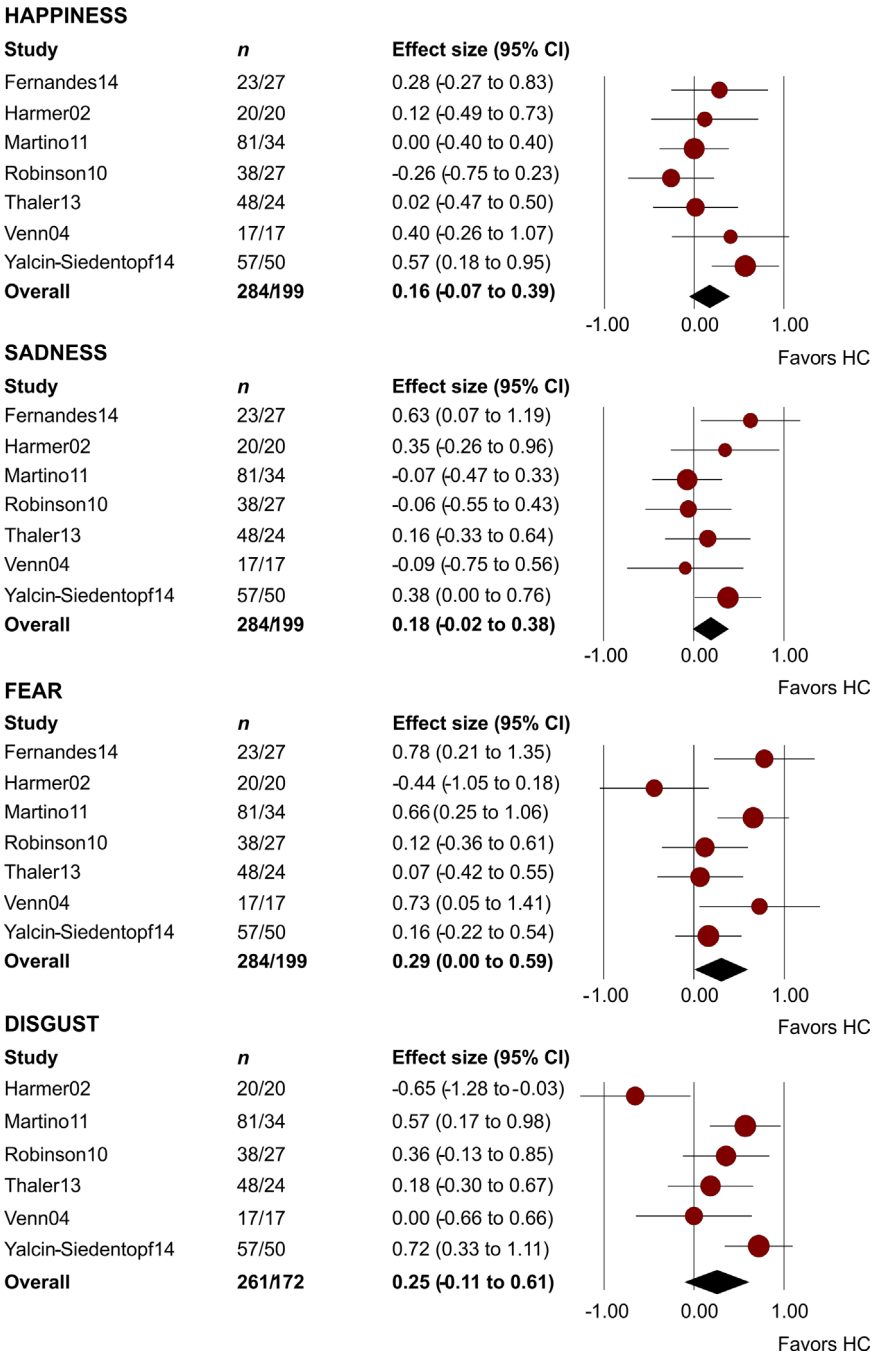

Fig. 3. Forest plot of individual and pooled estimates of the standardized mean differences between bipolar patients and healthy controls for the recognition of happiness, sadness, fear, and disgust. The area of each circle reflects weighting from random effects analysis. CI=confidence interval; HC=healthy controls.

issue. Regardless of whether these impairments are primary or secondary, this profile of neuropsychological functioning in BDs, characterized by quite preserved social cognitive abilities in comparison to neurocognition, contrasts with that of schizophrenia patients, for which an opposite pattern with more conspicuous deficits in social cognitive skills has been shown (Caletti et al., 2013; Lee et al., 2013; Martino and Strejilevich, 2014). Therefore, distinct social cognitive profiles could contribute to understanding differences in clinical features, functional outcome, or even in pathophysiology between these disorders, all of which could also be a focus of future research.

In the current study, the possible effects of some clinical and demographic variables on social cognition were explored by means of meta-regression analyses. No significant associations were found between social cognitive outcomes and age or illness duration. Though the analyses were limited by the small number of studies reviewed and the lack of information on possible moderators in many of the reports, these results are in keeping with different pieces of evidence at the primary study level showing no association between years of illness evolution and social cognition (Bora et al., 2005; Wolf et al., 2010; Martino et al., 2011). Unfortunately, we could not explore the relationship between social cognition and the number of affective episodes. However, evidence from primary studies has not shown any association between these variables (Bora et al., 2005; Martino et al., 2011; Barrera et al., 2012). Such findings are also in accordance with evidence from a recent meta-analysis suggesting a nonprogressive evolution of cognitive features in BDs (Samamé et al., 2014). Nonetheless, further longitudinal studies are needed to gain a better insight into the trajectories of social cognitive impairments in this group of disorders. Moreover, meta-regressions revealed significant associations between the proportion of type I BD patients and labeling of happiness and sadness. Given the limitations of meta-regression analyses, these findings should be interpreted cautiously and taking into account the findings of primary studies, which are scant so far. The largest study comparing bipolar subtypes with regard to social cognition (Martino et al., 2011) did not find any differences for the labeling of six basic emotions, Faux Pas, or the Eyes Test. Contrarily, a small study by Lembke and Ketter (2002) found that, although both bipolar subgroups exhibited preserved emotion processing performance, euthymic BD II patients outperformed BD I subjects on fear recognition, whereas Derntl et al. (2009) found that overall emotion recognition performance was preserved in subsyndromal BD II and impaired in BD I. Finally, patient-control differences could also be influenced by the presence of subsyndromal symptoms. Although the primary studies included in this meta-analysis were based on patients meeting stringent criteria of euthymia (except Lee et al. (2013) and Burdick et al. (2014)), most of them did not report scores on mood rating scales for healthy controls, and therefore we could not explore the influence of possible between-group differences for mood symptoms on social cognitive outcomes.

Finally, the noticeable heterogeneity among bipolar patients should be highlighted when interpreting the results of this review. Unlike other neuropsychiatric disorders, BDs are very heterogeneous with regard to neuropsychological features (Burdick et al., 2014; Martino et al., 2014), and the results of meta-analytic findings may be misleading if this issue is not taken into account. Furthermore, it is known that, while several bipolar patients exhibit poor social and vocational adjustment, others do not, and it has also been reported that bipolar traits are associated with leadership abilities as revealed by population-based evidence (Kyaga et al., in press) and biographical data (Jamison, 1989, 1993).

To conclude, the findings of this study suggest that only some aspects of social cognition may be mildly/moderately affected in BDs, particularly those involving mental state reasoning. The effects of neurocognition and medication on social cognition remain to be ascertained.

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Conflict of interest

No conflict declared.

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None.

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