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Unseen positive and negative affective information influences social perception in bipolar I disorder and healthy adults

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Abstract

Bipolar disorder is fundamentally a disorder of emotion regulation, and associated with explicit processing biases for socially relevant emotional information in human faces. Less is known, however, about whether implicit processing of this type of emotional information directly influences social perception. We thus investigated group-related differences in the influence of unconscious emotional processing on conscious person perception judgments using a continuous flash suppression task among 22 individuals with remitted bipolar I disorder (BD; Age_M=30.82, Age_{SD}=7.04; 68.2% female) compared with 22 healthy adults (CTL; Age_M=20.86, Age_{SD}=9.91; 72.2% female). Across both groups, participants rated neutral faces as more trustworthy, warm, and competent when paired with unseen happy faces as compared to unseen angry and neutral faces; participants rated neutral faces as less trustworthy, warm, and competent when paired with unseen angry as compared to neutral faces. These findings suggest that emotion-related disturbances are not explained by early automatic processing stages, and that activity in the dorsal visual stream underlying implicit emotion processing is intact in bipolar disorder. Implications for understanding the etiology of emotion disturbance in BD are discussed.

Keywords

Bipolar disorder; Affect; Social perception; Implicit emotion; Unconscious processing; Continuous flash suppression

Our daily lives are rife with emotional signals from others that we use to guide our judgments of them. For example, a happy face may signal that another person is warm, trustworthy and even competent and may lead us to consequently initiate a friendship or business transaction with them; by contrast, an angry or scowling face may signal an absence of these important social qualities, and we may choose to avoid people as a result. How do we form these powerful initial social impressions? Empirical evidence suggests that

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we often make these deep and long-lasting social judgments using our affective feelings over and above cues in the face as signs of a person's social demeanor and even stable personality characteristics (e.g., Anderson et al., 2012; Barrett and Bar, 2009). Indeed, we form these impressions quite rapidly and often outside of conscious (i.e., “unseen”) awareness.

Much less is known about how affective information processing influences social perception in populations characterized by disturbances in affective and social processing. An ideal candidate to further explore this question is bipolar disorder (BD), a severe and chronic emotional disorder characterized by emotion dysregulation (Gruber, 2011; Johnson et al., 2007), including mood fluctuations that centrally include periods of abnormal and elevated mood (i.e., manic mood episodes) and many BD individuals also experience frequent periods of depressed and dysphoric mood (i.e., depressive mood episodes) (e.g., Leppänen, 2006). Importantly, BD is also characterized by impaired social functioning (e.g., Johnson et al., 1999; MacQueen et al., 2001b; Miklowitz, 2011). Examining affective influences on social perception in BD has the potential to shed insight into the origins of social difficulties in BD specifically, as well as potentially elucidating the role of emotion disturbance in impacting real-world social outcomes more generally.

1. Affective influences on person perception

Affective information is a powerful source from which we make social judgments about other people, influencing decisions about whether to approach or avoid them in everyday contexts. Most of these judgments often occur rapidly and outside of our conscious awareness. A recently developed and well-suited approach to assess the influence of unconscious affective information on conscious social judgments of others is to use visual paradigms that measure (or manipulate) the contents of visual consciousness, such as binocular rivalry (e.g., Anderson et al., 2011a, 2011b; Blake and Logothetis, 2002). One particularly good example is the continuous flash suppression (CFS) paradigm in which people are presented with dynamic (i.e., flashing) visual images to one eye (e. g., neutral faces), while the other eye is presented with a still image (e.g., emotional face). Participants consciously experience seeing only the dynamic images while the still image remains unseen, and suppressed from visual awareness. The CFS paradigm influences the perception of otherwise non-emotional (i.e., neutral) faces even though the images remain “unseen” (i.e. not consciously perceived). This is because they are still being processed by the visual system, just along a different visual “stream”. Neuroimaging studies suggest that the CFS paradigm activates dorsal “where is it and how do I act on it” visual stream regions (Almeida et al., 2010, 2008; Fang and He, 2005) more robustly than ventral “what is it” visual stream areas, particularly when the presentation time is rapid (i.e., ≤ 200 ms; Jiang et al., 2009; Yang et al., 2010) (see Fig. 1).

Previous studies utilizing CFS paradigms demonstrate that, in healthy adults, unseen affective information exerts a powerful influence on person perception judgments. Neutral faces are rated as more likeable, trustworthy, warm, and even attractive based on whether the neutral faces were paired with an “unseen” happy or angry face (Anderson et al., 2012). These are important results insofar as judgments about another individual's personality traits – such as warmth or trustworthiness – are critical to the first impressions we form of others (e.g., Bar et al., 2006) and subsequent social interactions (Fazio et al., 1981; Hall and Andrzejewski, 2008; Uleman et al., 2005). It was unclear from these studies whether affect manipulated outside of awareness would influence social perception in psychopathologies characterized by both emotion and social-related impairments. One recent study suggests that, among individuals with schizophrenia, the relationship remains intact (Kring et al., 2014). It has yet to be determined, however, whether unseen affective information influences social perception in other severe psychopathologies, especially those whose cardinal clinical criteria involve severe emotional dysregulation, such as BD.

2. Affective influences on person perception in bipolar disorder

Individuals with bipolar disorder (BD) are characterized by abnormally and persistently elevated mood (American Psychiatric Association, 2000), which in turn have impairing clinical consequences (American Psychiatric Association, 2000; Gruber, 2011; Gruber et al., 2008, 2011; Johnson, 2005). Given the fact that BD is a key disorder of both *affective reactivity* (referring to the magnitude of change in emotion from a non-emotional state, or baseline, in response to emotion-eliciting stimuli; e.g., Gross et al., 1998) and disrupted social functioning (referring to disruptions in social relationships, interactions and functioning; e.g., Goldman et al., 1992), it is reasonable to investigate how dysregulated emotional processes may influence person perception. However, no work to our knowledge has yet examined early stage visual stream processing deficits in this disorder and whether they influence subsequent person perception judgments.

Existing work on visual perception in BD provides additional albeit indirect support for the idea that people with BD may be influenced by rapidly presented and visually unseen (i.e., outside of conscious awareness) information. For example, currently manic BD patients demonstrate sensory motor gating deficits (i.e., lower prepulse inhibition and decreased startle habituation; Perry et al., 2001) as well as visual attention processing deficits across low and high load attentional demand conditions (i.e., Serper, 1993). Additional work in adults with BD suggest deficits in visual backward masking paradigms when locating and identifying visual stimuli during periods of acute mania (Green et al., 1994) as well as during symptom remission (MacQueen et al., 2001a), pointing more strongly to difficulties in dorsal stream processing that may represent trait-like features of BD independent of current symptoms. Although important, such findings are constrained in several important ways. First, they do not directly examine whether such difficulties arise from early stage or automatic processing biases in visual perception. Early stages of visual perception detect low spatial frequency information (e.g., low luminance or contrast objects) and are registered via the dorsal visual pathway in the brain, which is critical in facilitating initial predictions of a given visual percept. These initial predictions are rapidly projected to the orbitofrontal cortex and signal emotional predictions about whether to approach or avoid a given percept (e.g., Barrett and Bar, 2009; Kveraga et al., 2007). Second, these findings leave unclear to what extent individuals with BD utilize implicit emotional cues as information to guide their judgments about the more general social environment. Third, it is unclear in explicit perception tasks whether the deficits result from a disruption in low level affective processing, or whether the dysregulation occurs further downstream.

3. The present investigation

The present investigation aimed to determine whether affective information processed outside of conscious awareness (henceforth referred to as "unseen") would directly influence conscious person perception ratings by utilizing a rigorous CFS task. This enabled us to test, for the first time, two competing hypotheses as to whether unconscious processing influences the access of emotional information to conscious awareness in BD. The first perspective (which we refer to as the "*unseen-influence*" hypothesis; **Hypothesis 1a**) predicts that individuals with BD would be influenced by unseen positive and negative emotional faces outside of conscious awareness during a CFS paradigm; specifically, that neutral faces would be rated more positively when paired with unseen happy faces and rated more negatively when paired with unseen angry faces. This work is based upon findings from explicit emotion paradigms demonstrating impaired perception of social stimuli when processing both positive and negative human faces (e.g., Lembke and Ketter, 2002; Trevisani et al., 2008; Venn et al., 2004). The second perspective (which we refer to as the "*seen-influence*" hypothesis; **Hypothesis 1b**) predicts that individuals with BD will not be influenced by unseen positive and negative emotional faces outside of conscious awareness during a CFS paradigm, resulting in no differences in ratings of seen neutral faces they are consciously aware of. This work is based upon findings from explicit emotion paradigms demonstrating difficulties with visual attention processing, including impaired performance on sensory motor gating and visual backward masking paradigms, compared with healthy adults (MacQueen et al., 2001a; Perry et al., 2001; Serper, 1993). Supportive evidence for this hypothesis would suggest that visual information processed through the dorsal visual stream could be consciously perceived in BD.

4. Method

4.1. Participants

Participants were 22 individuals diagnosed with BD type I, currently remitted, and 22 healthy control (CTL) participants that did not meet current or past criteria for any DSM-IV-TR Axis I disorder. Remitted BD participants were selected in order to examine more trait-like patterns of affective processing independent of current symptoms. Exclusion criteria included history of severe head trauma, stroke, neurological disease, autoimmune disorder, and alcohol or substance abuse in the past six months. The CTL group did not meet criteria for any current or lifetime Axis I disorders assessed (i.e., no anxiety disorders, major depression, mania/hypomania, dysthymia, schizophrenia, schizoaffective disorder, substance abuse, eating disorders, body dysmorphic disorder, hypochondriasis, pain disorder, or adjustment disorders). Demographic and clinical characteristics are listed in Table 1.

4.2. Measures of clinical functioning

4.2.1. Diagnostic evaluation—All Axis I diagnoses were confirmed using the Structured Clinical Interview for DSM-IV (SCID-IV; First et al., 2007). Trained clinical psychology faculty, psychology doctoral candidates, and post-baccalaureate research fellows administered the SCID-IV. Approximately one-third of videotaped interviews (n = 13) were rated by an independent reviewer, and ratings matched 100% (κ_{mean}=1.00) of primary diagnoses and reliability was high across all Axis I comorbid diagnoses (κ_{mean}=1.00).

4.2.2. Mood symptoms

Current symptoms of mania were measured using the Young Mania Rating Scale (YMRS; Young et al., 1978). The YMRS is an 11-item, clinician-rated measure of current manic symptoms with scores ranging from 0 to 60, with higher scores indicating greater manic severity. Scores ≥7 represent clinically significant manic symptom levels. Current symptoms of depression were measured using the Inventory of Depressive Symptomatology (IDS-C; Rush et al., 1996). The IDS-C is a 30-item, clinician-rated measure of current depressive symptoms with scores ranging from 0 to 84, with higher scores indicating greater depressive severity. Scores ≥11 represent clinically significant depressive symptom levels. The IDS-C has been validated in individuals with bipolar disorder (Trivedi et al., 2004) and strongly correlates with other measures of depression severity (Rush et al., 1996). Current remitted status (i.e., neither manic, depressed, nor mixed mood state in the past month) for the BD group was verified according to SCID-IV mood module criteria for the past month and cutoff scores on the YMRS (≤7), and IDS-C (≤11) for the past week. The CTL group also scored below these cutoffs. Intra-class correlations for absolute agreement between the original interviewer and an independent rater were conducted for approximately one-third of videotaped interviews (n=12) and were strong for both the YMRS (ICC=0.96) and IDS-C (ICC=0.98).

4.2.3. Global functioning—The Global Assessment of Functioning Scale (GAF; Luborsky, 1962) was used to assess global functioning in the past week. The GAF assesses overall psychological, social, and occupational functioning on a scale from 1 (lowest level of functioning) to 100 (highest level of functioning). ICC ratings for agreement between the original interviewer and an independent rater for a subset of participants (n=11) were also high (ICC=0.94).

4.3. Materials and procedure

The experiment had three phases: (1) contrast adjustment, (2) face judgment, and (3) objective awareness, each described below. Participants sat with their head positioned on a chin rest while they viewed stimuli through a mirror stereoscope at a distance of 55 cm. Stimuli subtended approximately 3.5° × 5.0° of visual angle and were presented in grayscale surrounded by a frame to facilitate fusion. We determined eye dominance for each participant using the Dolman method. Instructions and stimuli were presented using E-Prime Version 2 (Psychology Software Tools, Inc.) running on a Dell Optiplex 725 and a 17″ Dell LCD flat-screen (1280 × 1024) monitor.

4.3.1. Contrast adjustment—Participants first completed a contrast adjustment task to determine a priori what contrast level rendered the suppressed image invisible individually for each participant. This involved adjusting the contrast of the suppressed image to improve suppression individually for each participant. First, participants' natural eye dominance was assessed using Trials, starting with a 500 ms fixation dot. Next, the participant's dominant eye was presented with a series of three “Mondrian-type” images of houses (upside-down or right-side up) for 100 ms to the assigned non-dominant eye and was suppressed from visual awareness. The contrast adjustment phase began with trials at the highest contrast stimuli (75%) and was adjusted along four contrast levels, as appropriate (75%, 50%, 25% and 12.5% of the image's original contrast and luminance, respectively), across 20 trials in which participants were asked to guess the orientation of the suppressed house. During each trial, participants were asked to guess the orientation of the house (right side-up or upside-down) as well as rate their perceptual experience of the suppressed house on the Perceptual Awareness Scale (PAS; Ramsøy and Overgaard, 2004) using a 4-point scale (1 = no experience, 2 = vague experience, 3 = almost clear experience, or 4 = absolutely clear experience). If participants correctly guessed the orientation of the suppressed house on 14 or more trials, or reported “no experience” (rating of 1) of the house on fewer than 15 trials, the contrast level was reduced to the 50% level. This procedure was repeated until participants correctly guessed the orientation on 13 or fewer trials and reported “no experience” on at least 15 trials or until the 12.5% contrast level was reached. This contrast level was then used for the rest of the face judgment phase.

4.3.2. Person perception judgments—During the CFS experimental task (consisting of 30 trials), each trial started with a 500 ms fixation dot. Next, the perceiver's dominant eye was presented with a “Mondrian” type image for 100 ms, followed by a structurally neutral face for 100 ms, followed by another “Mondrian” image for 100 ms. Concurrent with the onset of the structurally neutral face, the suppressed eye was presented with a low-contrast low-luminance smiling, scowling, or neutral face for 200 ms that terminated with the offset of the final “Mondrian” image presented to the dominant eye (Fig. 2). Following this sequence, a backwards mask was presented to both eyes for 500 ms. After the offset of the final “Mondrian” image, perceivers were asked to make three trait judgments about the neutral target's trustworthiness, competence, and warmth using a 4-point Likert scale. First, participants rated the trustworthiness (“how trustworthy is this person?”) on a 1 (untrustworthy) to 4 (trustworthy) scale. Second, they rated competency (“how competent is this person?”) on a 1 (incompetent) to 4 (competent) scale. Third, they rated interpersonal warmth (“how (inter-personally) warm is this person?”) on a 1 (cold) to 4 (warm) scale. Thirty unique facial identities were presented; 10 facial identities were paired with each type of suppressed face type (scowling, smiling, neutral) for a total of 30 trials.

4.3.3. Objective awareness—The final phase was an objective awareness check. Participants were asked to guess the orientation of a suppressed face (upside-down or right-side-up). These trials were identical to the CFS experimental trials except that a scrambled face was presented to the dominant eye instead of a neutral face. Participants completed 60 trials using the same 30 suppressed faces used in the experimental task presented both upright and inverted (rotated 180°). Participants were excluded from analyses if they correctly guessed the face orientation at above chance levels, suggesting they experienced breakthrough during the face judgment phase (i.e., 7 BD and 10 CTL participants) and one participant was removed from analysis for performing two standard deviations below chance level; indicating that the contrast level was set too low and the participant had no objective or subjective awareness of the suppressed stimuli.

5. Results

5.1. Demographic and clinical characteristics

As evident in Table 1, BD and CTL participants did not significantly differ with respect to age, gender, ethnicity, education level, employment status, partnership status, and living status. Additionally, both groups scored well below standardized symptom cutoffs on the YMRS (≤ 7) and IDS-C (≤ 11), though the BD group scored higher on both symptom measures.

5.2. Main analyses

Following previous CFS task convention (e.g., Misangyi et al., 2006), we conducted a 2 (Group: BD, CTL) × 3 (Face: Happy, Angry, Neutral) mixed model repeated-measures ANOVA for each of the three dependent variables (Judgment: trustworthiness, competence, and warmth). Given our focus on differences between trait judgments depending on the affective value of the face suppressed from visual awareness (smiling, scowling, or neutral), our results focused specifically on isolating Condition main effects, Group main effects, and Condition × Group interactions. Results from each analysis are outlined below.

For trustworthiness, we detected a main effect for trustworthiness ratings, $F(2,84) = 11.08$, $p < 0.001$, $\eta_\rho^2=0.21$, suggesting that affective information presented outside of awareness influences first impression judgments of others; this is consistent with previous studies (e.g., Anderson et al., 2012). Follow-up paired samples *t*-tests revealed that neutral target faces paired with suppressed happy faces were rated as more trustworthy than were neutral target faces paired with suppressed neutral faces $t(43) = 2.71$, $p < 0.05$. Neutral target faces paired with suppressed angry faces were rated as less trustworthy than were neutral target faces paired with suppressed neutral faces, $t(71)= -2.73$, $p < 0.01$ (see Table 2). For all three trustworthiness ratings, there was no main effect of Group, $F(1,42)=0.22$, $p=0.64$, $\eta_\rho^2=0.01$; nor was there an interaction between Face × Group for trustworthiness ratings, $F(2,84) = 0.32$, $p = 0.73$, $\eta_\rho^2=0.03$.

For competence, there was a significant main effect of Face, $F(2,84) = 5.79$, $p< 0.005$, $\eta_\rho^2=0.12$. Follow-up paired samples *t*-tests revealed that neutral target faces paired with suppressed happy faces were rated as marginally more competent than were neutral target faces paired with suppressed neutral faces, $t(43) = 1.72$, $p=0.09$. Neutral target faces paired with suppressed angry faces were rated as less competent than were neutral target faces paired with suppressed neutral faces, $t(71)=-2.18$, $p<0.05$. There was no main effect of Group for competence ratings, $F(1,42)=0.361$, $p=0.55$, $\eta_\rho^2=0.01$; nor was there a Face × Group interaction for competence ratings, $F(2,84)=0.45$, $p=0.49$, $\eta_\rho^2=0.01$.

For warmth, there was a significant main effect of Face, $F(2,84) = 16.62$, $p< 0.001$, $\eta_\rho^2=0.28$. Follow-up paired samples *t*-tests revealed that neutral target faces paired with suppressed happy faces were rated as more warm than were neutral target faces paired with suppressed neutral faces, $t(43)=3.68$, $p<0.01$. Neutral target faces paired with suppressed angry faces were rated as less warm than were neutral target faces paired with suppressed neutral faces, $t(71)= -3.41$, $p < 0.05$. There was no main effect of Group for warmth ratings, $F(1,42)=0.90$, $p=0.35$, $\eta_\rho^2=0.021$; nor was there a Face × Group interaction for warmth ratings, $F(2,84) = 0.20$, $p = 0.82$, $\eta_\rho^2=0.01$.

5.3. Secondary analyses: potential confounds and moderators

We first examined two potential confounds on our obtained results, including current mood symptoms and medications. First, given that the BD group scored higher in subsyndromal depressive symptoms (IDS-C) and manic symptoms (YMRS), we examined whether observed group differences were influenced by mood symptoms. Bivariate correlations were conducted between symptom scores (YMRS, IDS-C) and ratings for competence, warmth, and trustworthiness across happy, angry, and neutral face types (Bonferroni adjusted *p*-value=0.001). No significant associations emerged between symptom scores and our social perception ratings. Thus, we opted not to include IDS-C or YMRS scores as a covariate in our analyses. This decision was further supported by two conceptual reasons. First, controlling for current symptoms violates important statistical assumptions, as they are intended to minimize within group variability, not between group variability, especially where group status is not randomly assigned (Miller and Chapman, 2001). Second, all groups scored well below the clinical threshold scores on all symptom measures suggesting minimal variability in depressive and manic symptoms (see Table 1). We instead suggest that future studies compare BD participants who score high and low on symptom measures to properly examine the relative influence of symptoms on emotion perception. Second, we examined two individual difference measures relevant to affective disturbance uniquely implicated in BD, including behavioral activation using the Behavioral Inhibition and Activation Scale (BIS-BAS; Carver and White, 1994) and emotion regulation strategies using the Emotion Regulation Questionnaire (ERQ; Gross and John, 2003). Consistent with previous research, people with BD reported greater self-reported behavioral inhibition than controls [BD: M=3.10 (SD=0.49), CTL: M=2.41 (SD=0.63), $F(1,53) = 19.04$, $p< 0.001$], a non-significant trend towards greater behavioral activation than controls [BD: M=3.16 (SD = 0.51), CTL: M=2.91 (SD = 0.45), $F(1,53) = 3.61$, $p = 0.06$], and greater use of maladaptive regulation strategies such as suppression than controls [BD: M=3.26 (SD=1.45), CTL: M=2.55 (SD=1.13), $F(1,53) = 4.07$, $p<0.05$]; but no differences in reappraisal [BD: M=4.42 (SD = 1.42), CTL: M=4.61 (SD = 1.06), $F(1,53) = 0.33$, $p = 0.57$].

6. Discussion

The present investigation aimed to determine whether affective information presented outside of conscious awareness (i.e., “unseen”) would directly influence conscious person perception ratings among adults with bipolar disorder by utilizing a novel CFS task. Supporting our *unseen-influence* prediction, we found that individuals with bipolar disorder rated visibly seen neutral faces as more or less trustworthy, warm and competent depending on whether happy or angry emotional faces were presented outside of conscious awareness. Importantly, this pattern of findings held constant across both the bipolar disorder and healthy control participant groups. In sum, this is the first study to examine affective information presented in a CFS paradigm to BD individuals and it provides critical evidence suggesting that nonconscious emotional information influences social person perception in a similar manner across bipolar disorder and healthy control adults. Notably, these results suggest that processing remains intact in the dorsal visual stream in bipolar disorder.

These findings provide several important insights about emotion and social perception deficits in bipolar disorder. Indeed, examining affective influences on social perception has the potential to shed insight into the origins of social difficulties in BD (e.g., Samamé et al., 2012); it also has the potential role of emotion disturbance impacting real-world social outcomes more generally. First, these findings suggest an important and relevant area of preservation in emotional processing in bipolar disorder. That is, emotional information that is entirely suppressed from visual awareness does significantly influence the social perception of structurally neutral information even in disorders with severe and persistent difficulties in both emotion regulation and social functioning (e.g., Gruber, 2011; Johnson et al., 1999). These findings are consistent with similar areas of preservation observed among adults with schizophrenia (e.g., Kring et al., 2014) suggesting a transdiagnostic domain of relative preservation in early stage social perception among adults with severe psychopathology. Importantly, this CFS paradigm did not suggest deficits in social perception were emerging during the early stage of affective information processing, suggesting that this level of affective processing is intact in bipolar disorder and other psychopathologies. Importantly, the absence of group-related differences on the CFS task suggests a robust pattern of intact processing for the BD group. Thus, the results do not suggest a trait-like vulnerability towards early stage social perception processing deficits outside of mood episodes in this disorder.

Second, these findings are not consistent with models of bipolar disorder that suggest a deficit in dorsal stream processing. This suggests that although BD is characterized by difficulties in attentional processing (e.g., Perry et al., 2001; Serper, 1993), such top-down attention related processing do not influence outcomes on the CFS task. If anything, the present study findings are suggestive of specific conditions under which this type of dorsal visual stream processing might be intact among adults with bipolar disorder. Although we did not directly measure neural processes, previous research has demonstrated that the task-related CFS effects do rely on the dorsal visual stream (Almeida et al., 2010, 2008; Fang and He, 2005), and given that our task presented suppressed images at shorter durations (e.g., 200 ms) further bolsters our confidence that the task performance is largely supported by dorsal and not ventral visual stream pathways. Nonetheless, future research examining distributed patterns of neural networks that may help underlie the observed behaviors emerging in this present investigation are warranted.

Importantly, although the present investigation speaks to mechanisms by which affective information is used to make first impression social judgments of other people, it cannot speak to mechanisms by which affect has a more general influence on perception. That is, our results speak to the finding that affect does have an effect on person perception judgments and that this effect is neither enhanced nor inhibited among adults with bipolar disorder. However, this does not imply that emotion dysregulation observed in this disorder does not have a sustained effect on other aspects of social functioning, as our study measured the specific domain of first impressions. It is thus possible that after these initial social encounters, individuals with BD may be more likely to use affective information (even unseen) to make long-term judgments of others' warmth or competence which may help explain the biased emotional perceptions of others documented in previous research (e.g., Dutra et al., 2014; Piff et al., 2012). Or perhaps that affective information may be utilized in such a way that it predicts too much trustworthiness in the case of BD.

6.1. Limitations and future directions

The present investigation should be carefully interpreted within the confines of several caveats. First, although the CFS task is a well-validated task, it does have ecological validity constraints, including utilizing static photos as affective stimuli that sample a relatively small subsample of possible affective influences on person perception. Future studies should sample a broader array of emotional expressions and types of person perception judgments (e.g., attractiveness). In addition, participants needed to remain ignorant of the affective information presented outside of their consciousness awareness and this precluded us from directly measuring mood before and after stimuli presentation. Measuring change in affect as a result of this type of manipulation may be crucial to understanding mechanism and is an important direction for future research. Second, although it is possible that some conscious awareness of the affective faces may have occurred, our findings suggest that these results are not better accounted for by participants consciously seeing the emotional faces suppressed given contrast levels were individually set and participants included in final analyses did not show evidence of breakthrough on an objective awareness task. Third, given the challenges of accessing an unmedicated BD sample, we were unable to investigate the influence of medication effects on results. We do note that levels of each class of medication were recorded using the Somatotherapy Index (Bauer et al., 1997) and bivariate correlations between intensity of medication dosage and ratings for competence, warmth, and trustworthiness across happy, angry and neutral face types did not reveal a significant pattern of associations. Moreover, other studies of visual and affective perception report similar behavioral patterns regardless of medication status among adults with severe psychopathology such as schizophrenia (Kohler et al., 2010), providing further evidence that medication was not a strong mediator of task performance. Future studies with larger sample sizes, assessment of blood serum levels, and random assignment of individuals on different medication classes are nonetheless warranted. Fourth, in order to obtain ecologically valid populations, participants were not excluded from the BD group on the basis of comorbidities, and so future studies with larger sample sizes and control groups with these comorbid disorders may help isolate potential sources of group differences we did not detect. Fifth, BD participants were remitted at the time of testing which represents a relative strength insofar as it enables the identification of areas of preservation during the remission period but it will be critical to examine the relative influence of depressive and manic mood symptoms. Finally, although our study focused on BD type I as an initial entry point into this research domain, it will be important for future studies to examine whether the obtained results generalize across the spectrum of bipolar disorder presentations.

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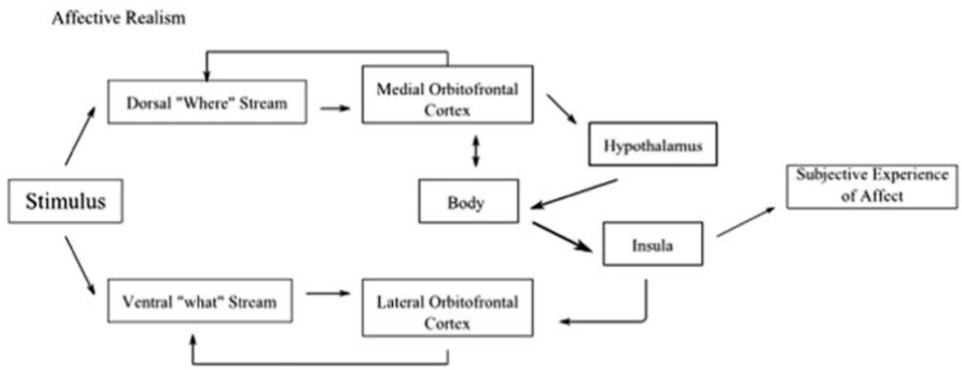

Fig. 1. Neuroanatomical depiction of affective vision

During perception, the brain, via magnocellular pathways in the dorsal visual stream (where is it and what do I need to do about it), makes an initial "gist" level prediction about the scene or object to which visual sensations refer. These areas project to the medial part of OFC, which regulates visceromotor control and has multiple cascading projections to striatum, hypothalamus, brainstem and spinal cord autonomic regulation centers, changing the perceiver's body state. About 15–30 ms after the onset of this process the visual system begins to process more detailed visual input via parvocellular pathway in the ventral stream that is associated with visual consciousness. This information reaches lateral OFC at the same time as afferent body information arrives. With a lot of back and forth between visual cortex and the more lateral areas of prefrontal cortex (via the direct projections that connect them), a finer level of categorization is achieved until finally the object is precisely recognized. This 15–30 ms magnocellular advantage is the window of affective projection where the body state is changed and helps shape visual perception. For ease of presentation, many other connections are not shown here (e.g., reciprocal connections between the ventral and dorsal visual streams, as well as reciprocal connections between the medial and lateral sections of the OFC). Medial OFC is similar to Barbas and Pandya's (1989) "mediodorsal" system within the orbital sector of the prefrontal cortex, whereas the lateral OFC is similar to their "basoventral" system.

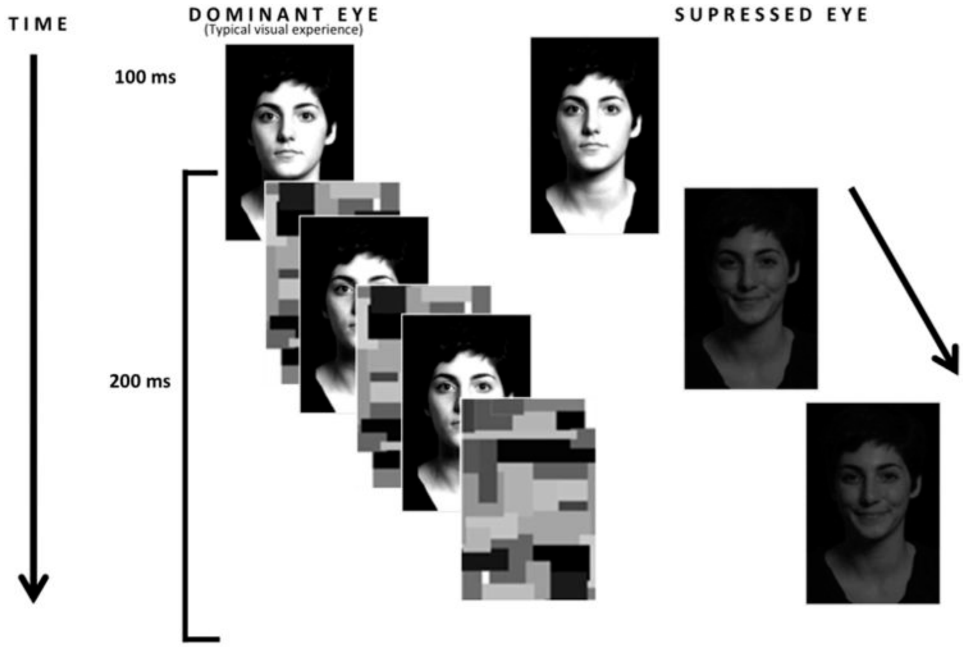

Fig. 2. CFS trial structure

Following a fixation dot (500 ms), the dominant eye was presented with a “Mondrian” image (100 ms) followed by a structurally neutral face (10 ms), and then another Mondrian image (100 ms). The neutral face was presented to the dominant eye concurrently with a low contrast low luminance face (angry, happy, or neutral) to the non-dominant eye (200 ms) until the offset of the second Mondrian image presented to the dominant eye. Identity of the suppressed and dominant face matched. Following this trial structure, a backward mask was presented to both eyes (500 ms).

Table 1

Demographic and clinical characteristics.

	BD (*n*=22)	CTL (*n*=22)	Statistic
Demographic			
Age (Yrs)	30.82 (7.04)	28.86 (9.91)	F=0.57
Female (%)	68.2	72.7	χ^2= 0.11
Caucasian (%)	81.8	77.3	χ^2=4.03
Education (Yrs)	15.12 (2.20)	15.86 (2.44)	F=1.10
Employed/Student (%)	81.8	86.4	χ^2= 0.00
Partnered (%)	54.5	31.8	χ^2= 2.79
Number Children	0.48 (1.03)	0.19 (0.40)	F=1.40
Clinical			
YMRS	1.64 (2.01)	0.43 (0.75)	F=6.68 *
IDS-C	5.50 (3.16)	1.48 (1.40)	F=28.67 **
GAF	73.32 (13.86)	88.91 (1.82)	F=27.35 **
Illness Duration (Yrs)	12.45 (9.89)	–	–
Age at Onset (Yrs)	14.65 (4.67)	–	–
# Medications	1.92 (1.52)	–	–
Lithium	0.29 (0.46)	–	–
Anticonvulsant	0.52 (0.51)	–	–
Antidepressant	0.24 (0.44)	–	–
Neuroleptic	0.43 (0.51)	–	–
Anxiolytic	0.33 (0.48)	–	–
Stimulant	0.19 (0.40)	–	–
# Depressive Episodes	15.14 (22.52)	–	–
# Manic Episodes	9.14 (11.87)	–	–

Note: BD=Bipolar I disorder group; CTL=Healthy control group; Employed=Employed or student status full-time or part-time; Partnered=Married or Live-in-Partner; YMRS=Young Mania Rating Scale; IDS-C=Inventory to Diagnose Depression; GAF=Global Assessment of Functioning; # Comorbid Disorders=the number of current DSM-IV-TR Axis I comorbidities. # Medications=the average number of psychotropic medications currently taken (including anticonvulsants, lithium, neuroleptics, anxiolytics, stimulants, antidepressants, and sedative–hypnotics); Mean values are displayed with standard deviations in parentheses where applicable.

* $p < 0.05$.

** $p < 0.01$.

Table 2

Mean ratings of neutral target faces by suppressed face type and group.

Suppressed face	Trustworthiness		Warmth		Competence	
	CTL	**BD**	**CTL**	**BD**	**CTL**	**BD**
Angry	2.44 (0.46)	2.53 (0.41)	2.37 (0.37)	2.21 (0.47)	2.60 (0.49)	2.62 (0.38)
Happy	2.81 (0.45)	2.84 (0.45)	2.77 (0.47)	2.79 (0.51)	2.88 (0.47)	2.82 (0.30)
Neutral	2.56 (0.41)	2.61 (0.45)	2.44 (0.39)	2.41 (0.33)	2.71 (0.43)	2.71 (0.44)

Note: BD=Bipolar disorder group; CTL=Healthy control group. Values reflect mean ratings (standard deviations in parentheses) of neutral faces presented to the dominant eye concurrently with either an angry, happy or neutral face suppressed to the non-dominant eye. Scores refer to ratings made on a 1 (untrustworthy) to 4 (trustworthy) Likert scale for trustworthiness; 1 (incompetent) to 4 (competent) scale for competence; and 1 (cold) to 4 (warm) Likert scale for warmth.

* The is indicative of significant findings ($p < 0.05$).