Journal of the International Neuropsychological Society (2003), **9**, 623–632.

DOI: 10.1017/S1355617703940021

Facial affect recognition deficits in bipolar disorder

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(RECEIVED April 2, 2001; REVISED July 29, 2002; ACCEPTED August 1, 2002)

Abstract

Patients diagnosed with bipolar disorder (BPD), by definition, have problems with emotional regulation. However, it remains uncertain whether these patients are also deficient at processing other people's emotions, particularly while manic. The present study examined the ability of 25 manic bipolar patients and 25 healthy participants on tasks of facial recognition and facial affect recognition at three different presentation durations: 500 ms, 750 ms, and 1000 ms. The groups did not differ in terms of age, education, sex, ethnicity, or estimated IQ. The groups did not differ significantly on either a novel computerized facial recognition task or the Benton Facial Recognition Test. In contrast, the bipolar group performed significantly more poorly than did the comparison group on a novel facial affect labeling task. Although the patient group had slower reaction times on all 3 computerized tasks, the presentation duration did not have an effect on performance in the patients. This study suggests that patients with bipolar disorder are able to recognize faces, but have difficulty processing facial affective cues. (*JINS*, 2003, *9*, 623–632.)

Keywords: Bipolar disorder, Cognition, Facial affect recognition, Mania, Reaction time

INTRODUCTION

Bipolar disorder (BPD) is a severe mental illness that occurs in approximately 1.5% of the adult population (Kessler et al., 1994). By definition, deficits in emotion regulation are a core feature of BPD. Furthermore, studies have suggested that patients with BPD are impaired in the perception of other people's emotions (Addington & Addington, 1998; Feinberg et al., 1986). Emotion perception is particularly interesting in BPD because it may be linked to the core symptom of the disorder, namely emotion regulation. One way to examine emotion perception is through studies of facial expressions. Facial affect provides a valuable source of information about an individual's emotional state and some emotions, including happiness, sadness, fear, anger, disgust, and surprise are expressed, recognized and labeled similarly across diverse cultures (Ekman & Oster, 1979).

Many studies have examined emotion recognition in clinical populations by using perceptual tasks that require selective attention to socially relevant visual stimuli. However, only a few studies have examined facial affect recognition ability in patients with BPD, particularly during mania, which is the defining mood state of this disorder. Most studies that tested facial affect recognition in BPD were designed to study patients with schizophrenia, with bipolar patients serving as a psychiatric control group. The results of these studies have been inconsistent with regard to the presence or absence of differences in emotion perception between bipolar and healthy participants (Bellack et al., 1996; David, 1993; David & Cutting, 1990; George et al., 1998; Gessler et al., 1989; Mandal, 1986; Rubinow & Post, 1992;). These discrepancies can be attributed in part to the wide range of tasks used, different lengths of presentation for the stimuli and poorly defined patient groups.

There are conflicting reports as to whether face recognition impairment in BPD is specific to affectively valenced stimuli or if it is related to a more general facial processing impairment that is independent of affect. While some studies suggest that patients perform more poorly than controls on non-emotion facial judgment tasks (Bellack et al., 1996; Gessler et al., 1989), others found that patients with BPD do not have primary impairments in facial recognition (Add-

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ington & Addington, 1998; Feinberg et al., 1986). Addington and Addington examined facial affect recognition and face recognition in samples of bipolar outpatients in remission and healthy volunteers. Their results showed that the bipolar group performed significantly worse than healthy volunteers on a facial affect matching task. However, patient and healthy subjects did not differ on a face recognition task that required matching a target face with other faces. Their findings suggest that patients with BPD may have difficulty perceiving differences in facial affect, but not in recognizing people's faces. There was, however, a 500 ms stimuli presentation for the facial affect task, while the facial recognition test was administered with unlimited presentation duration; therefore, the results may have been influenced by the amount of time that participants were able to inspect each stimulus.

Studies have also incorporated various regional brain activation measurements in order to better understand the neural mechanisms involved in these processes. While neuroimaging and lesion studies have implicated the fusiform region of the ventral occipitotemporal cortex as being involved in processing facial affect (Golby et al., 2001; Kanwisher et al., 1997; Puce et al., 1995), other studies have suggested that both cortical (e.g., the prefrontal and temporal regions) and subcortical structures (e.g., the amygdala and basal ganglia) play a vital role in emotion recognition (Breiter et al., 1996; Blair et al., 1999; Gorno-Tempini, 2001; Kilgore et al., 2001; Morris et al., 1996). Further, a recent functional magnetic resonance imaging (fMRI) study conducted by Kesler/West et al. (2001) examining brain activation patterns associated with the processing of different facial expressions concluded that while the processing of faces in general indicate right hemisphere specializations, the processing of varying facial emotions are specific to certain cortical and subcortical areas. For example, happy faces activate the anterior cingulate sulcus, while the superior frontal gyrus is activated during the processing of angry faces. It should be noted that similar neural circuits have been proposed to be involved in the expression of BPD symptomatology as well (Strakowski, in press). Only one published study has examined regional brain activation patterns in patients with BPD during a facial affect recognition task. Yurgelun-Todd et al. (2000) studied brain activation during a fearful face recognition task in a group of stable BPD outpatients and healthy volunteers using fMRI. They found a significant decrease in dorsolateral prefrontal activation and an increase in amygdala activation in the BPD group.

During social interactions, spontaneous facial expressions are often displayed only briefly, and different cues may occur in close proximity to each other as the interaction proceeds (Addington & Addington, 1998; Feinberg et al., 1986). While spontaneous facial expressions are usually sustained for less than 1 s (Davis et al., 1982), there have been no systematic studies examining the actual duration of the different emotions (Ekman et al., 1997). There is, however, evidence that the duration of an expression varies and is related to the intensity of emotional feelings (Ekman et al., 1980). Most studies have permitted participants to examine photographs of faces without time constraints. Few studies have attempted to reproduce this brevity of cue display that is typical of spontaneous facial expressions (Morrison et al., 1988).

With these considerations in mind, the objective of this study was to systematically examine the ability of patients with bipolar disorder to recognize and label facial affect at short ($\leq$ 1 s) presentation durations. The accuracy and speed of facial affect processing at different presentation durations were compared in patients with BPD and healthy volunteers. Two measures of facial recognition, including one with presentation durations similar to the facial affect tasks, were also used to address whether there is a specific deficit in emotion recognition or rather a more generalized facial recognition impairment. It was hypothesized that, compared to healthy volunteers, patients with BPD would perform worse on tasks of facial affect recognition but not face recognition. It was further hypothesized that patients would perform worse than healthy volunteers at the different computer tasks during the shorter presentation durations, but that both groups would perform similarly at longer presentation durations. Finally, it was hypothesized that the response time of patients would be significantly longer than that of healthy volunteers.

METHODS

Research Participants

Twenty-five participants (13 women; 12 men) who met DSM–IV diagnostic criteria for bipolar disorder, currently manic or mixed (American Psychiatric Association, 1994) were recruited from the psychiatric inpatient units of the University of Cincinnati Hospital, Cincinnati, Ohio or the Children's Hospital Medical Center, Cincinnati, Ohio. Twenty-five (16 women; 9 men) healthy volunteers were recruited from surrounding neighborhoods, and were group matched with patients for age, ethnicity, and education. These healthy subjects were included if there was no history of mood or psychotic disorders in themselves or any first-degree relatives. All participants were required to be between the ages of 16 and 45 years, with no history of major medical or neurological illness, no history of head trauma or loss of consciousness greater than 5 min, no history of mental retardation or documented IQ below 70, and an absence of substance abuse or dependence during the previous 3 months as confirmed by negative results on a toxicology screen and by structured clinical assessment. All participants provided written informed consent following an explanation of the study procedures. Healthy participants were paid for their time.

Diagnoses were established using the Structured Clinical Interview for DSM–IV, Patient Version (SCID–P; First et al., 1995) completed by experienced raters with high

https://doi.org/10.1017/S1355617703940021 Published online by Cambridge University Press

interrater reliability (Kappa = .94). Additional clinical information obtained included age, date of onset of illness, history of hospitalization, history of substance use, and treatment history. Affective and psychotic symptoms of all participants were assessed using the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984), the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960), and the Young Mania Rating Scale (YMRS; Young et al., 1978). The clinical interview took approximately 2 hr. Upon completion of the interview, healthy volunteers were asked to provide a urine sample for a drug screen. The patients' current hospitalization medical laboratory results, including toxicology summary, were obtained through their inpatient charts. All but one of the BPD patients were receiving medication including: 17 on a mood stabilizer (68%), 13 on an antipsychotic (52%), 3 on an antidepressant (12%) and 9 on a benzodiazepine (36%).

Neuropsychological Tests

Two novel computerized forced choice tests were developed in order to examine facial affect recognition: a facial affect discrimination task and a facial affect identification task. Also, two forced-choice tests of facial recognition were utilized to examine how patients performed on non-affective facial tasks: the Benton Facial Recognition Test (Benton et al., 1978) and a novel computerized facial recognition task that was designed to be similar to the affect recognition tests. The American Modification of the National Adult Reading Test (ANART; Grober & Sliwinski, 1991) was chosen to estimate the participant's premorbid IQ. Finally, the Token Test (Benton et al., 1994) assessed participants' ability to comprehend and follow directions. Computer tasks were administrated in a fixed order: facial affect matching followed by facial affect labeling and then computerized facial recognition. A synopsis of each novel computer test follows.

Facial affect matching task

This is a novel discrimination task created by using 18 black-and-white photographs of White faces expressing standardized poses of basic emotions. The actors were two women and one man. These photographs were developed for facial affect studies and included angry, happy, sad, fearful, disgusted, and surprised expressions (Ekman & Friesen, 1976). The stimuli used for this test were presented using a Digital Ultra 2000 laptop computer. Participants sat approximately 6 m (2 ft) away from the computer screen. Participants were shown pairs of different actors and asked to decide after each pair whether or not both actors were displaying the same emotion. Participants were told the names of the six specific emotions that would be shown and were instructed to move a mouse attached to the computer to one of two buttons on the screen labeled "same" and "different" and click the button to indicate their response. The images were 11 × 17 cm and were positioned equidistant (0.3 cm) from the response buttons on the screen. The response buttons, presented in the middle of the screen, were 3 × 1.5 cm. The "same" response button was positioned above the "start" button and equidistant from the "different" response button, which was located below the "start" button. These buttons were 0.3 cm apart from the "start" button and only appeared after the pictures were presented.

After each trial, the participant had to move the mouse to the "start" button. When the participant was ready for the next trial, they pressed the "start" button for the ensuing set of pictures. Therefore, the intertrial intervals in the task were controlled by the participant. In order to help the participants focus their attention to the correct location when the stimulus appeared, each picture presentation was preceded by the word "Ready" being flashed in the middle of the area where the pictures were presented.

In order to use a carefully controlled stimulus that approximates the brief duration of spontaneous facial expression, presentation durations of 500 ms, 750 ms and 1000 ms were used. Eighteen trials (50%) of two actors showing the same emotion, with each of the six emotions presented as a *same* pair three times, once with Actors 1 and 2, once with Actors 2 and 3, and once with Actors 1 and 3. Each emotion was shown at all three time durations. In the remaining 18 trials (50%) the two actors showed different emotions from each other. Each emotion was presented once paired with each of the other emotions and shown at every duration presentation. These emotions were distributed equally and randomly across the actors, and the order of the 36 pictures was randomly assigned. Measures of reaction time (time from presentation of the recognition condition to the button press indicating selection) and response accuracy were recorded by the computer. Three practice trials were given preceding the test trials.

Facial affect labeling task

This is a novel forced-choice identification task that also involved presenting the Ekman and Friesen (1976) faces on the laptop computer. The faces were presented on the left side of the computer screen, while the response buttons, which were circular with a diameter of 4 cm, appeared on the right side of the screen after the face disappeared. The response buttons were 0.5 cm apart from one another and were aligned equidistantly in a circular formation around the "start" button. The fixed order of the response choices from the top right moving clockwise were *sad*, *surprised*, *fearful*, *disgusted*, *angry*, and *happy*. Participants were told the names of the six specific emotions that would be shown and were instructed to indicated their response by using the mouse to press the button on the screen that corresponded to the emotion that was being displayed. Participants were presented with a single actor for 500 ms, 750 ms or 1000 ms. Each of the three actors (two men and one woman) portrayed all six emotions, and every emotion was shown once for the three different presentation durations. Also, each of the three actors was presented twice at each of the three

https://doi.org/10.1017/S1355617703940021 Published online by Cambridge University Press

different durations. Thus, there were 18 trials of emotion labeling, three trials for each of the six emotions. This task required both accurate perception of affect and linguistic labeling. Measures of reaction time and response accuracy were recorded by the computer. Three practice trials preceded the test trials.

Computerized facial recognition task

This is a novel recognition task that again used the Ekman and Friesen (1976) faces on the laptop computer. Participants were shown pairs of same sex actors and asked to decide after each pair if the actors (not their emotions) were the same or different. Participants pressed one of two buttons labeled "same" and "different" on the screen. The design of task in regard to the positions of the faces and buttons were identical to the Facial Affect Matching task. In order to be consistent with the other computer tasks, presentation times of 500 ms, 750 ms and 1000 ms were used. Twelve trials (50%) were of the same actor (six men, six women) and 12 trials (50%) showed different actors, with eight trials per stimulus duration. Different emotions were shown in the "same" condition, so that there were never two identical pictures. Measures of reaction time and the number of correct responses were recorded by the computer. Three practice trials preceded the test trials.

RESULTS

Statistical analyses of log transformed data were performed using Statistical Analysis System (SAS) for the PC (SAS Institute, Cary, NC, 2000). Although the assumption of normality for analysis of variance did not hold true after the log transformations were conducted for the various computer tasks, the distribution was improved. Further, the level of significance should only be slightly affected due to the robustness of the *F* test (Stevens, 1996). Also, since the assumption of normality was not met, all analysis of variance results were confirmed with nonparametric tests. The nonparametric results are not reported here because, in each case, they were essentially the same as the parametric results.

Analyses were conducted in order to examine whether the potential demographic variables of age, race, sex, and education were related to the different facial tasks. Further, when creating the models, all of the demographic variables were originally included in order to determine if they helped to explain the results. A step-wise procedure was conducted where the variable that accounted for the least amount of variance was removed and analyses were rerun. This procedure occurred repeatedly, removing one variable at a time, until the final model was created. Ultimately, none of the demographic variables were found to be significant in any of the models and thus were not included in the final analyses.

Analysis of Demographic and Clinical Characteristics

In order to compare the two groups on the demographic information, separate chi-square analyses were conducted for ethnicity and sex, and *t* tests were completed to compare age, years of education, estimated IQ, Token Test ability, SAPS, YMRS, and the HDRS. Further, to examine whether medications influenced performance on the different computer tasks, due to the small cell sizes, separate *t*-test analyses were conducted for patients who were on a specific medication (i.e., mood stabilizers, antipsychotics, antidepressants, and benzodiazepine anxiolytics) *versus* those who were off this class of medications. As shown in Table 1, there were no statistically significant differences between

Table 1. Demographic and clinical characteristics

Variable	BPD $N = 25$	HV $N = 25$	p*
Demographic			
Age, years (*SD*)	25.3 (8.4)	25.3 (7.4)	.99
Years of education, (*SD*)	12.3 (2.0)	12.6 (1.6)	.65
Sex, *N*, (%) Women	13 (52)	16 (64)	.33
Ethnicity, *N*, (%) White	19 (76)	21 (84)	.48
Estimated Verbal IQ (*SD*)	105.1 (9.2)	108.4 (6.7)	.15
Token Test (*SD*)	41.8 (2.4)	42.5 (1.9)	.29
Mood scale total score			
Young Mania Rating Scale	28.1 (10.8)	0.7 (1.6)	.0001
Hamilton Depression Rating Scale	13.9 (8.0)	0.4 (0.9)	.0001
SAPS global item scores			
Delusions, *M* (*SD*)	1.9 (1.8)	0	.0001
Thought Disorder, *M* (*SD*)	1.8 (1.5)	0	.0001
Hallucination, *M* (*SD*)	1.2 (1.6)	0	.0001
Bizarre Behavior, *M* (*SD*)	1.5 (1.4)	0	.0001

*Separate chi-square analysis on sex and race; *t* tests conducted on remaining variables.
BPD = Patients with bipolar disorder; HV = healthy volunteers.

https://doi.org/10.1017/S1355617703940021 Published online by Cambridge University Press

the patient and the control groups in ethnicity [$\chi^2(1, N = 50) = .5$, $p = .48$], sex [$\chi^2(1, N = 50) = .94$, $p = .33$], age [$t(48) = .01$, $p = .99$], years of education [$t(48) = .46$, $p = .65$], estimated IQ [$t(48) = 1.45$, $p = .15$] or performance on the Token Test [$t(48) = 1.06$, $p = .29$]. Further, Table 2 indicates that none of the *t*-test comparisons between performances of patients on *versus* patients who were off the different medication types was significant for any of the computer tasks [$t(48) = .01$ to 1.67, $p = .21$ to .94].

As expected, the clinical measures such as the SAPS [$t(48) = 5.83$, $p = .0001$], HDRS [$t(48) = 8.4$, $p = .0001$] and YMRS [$t(48) = 12.56$, $p = .0001$] differed significantly between groups, with patients demonstrating greater symptomatology than healthy subjects.

Analysis of Overall Response Accuracy

To test the first hypothesis examining the differences between the accuracy scores (percentage of correct responses) of patients with BPD and healthy volunteers on the facial affect recognition tasks and the facial recognition tasks, a 2 (group: bipolar *vs.* healthy volunteers) × 4 (task: facial affect matching task *vs.* facial affect labeling task *vs.* Benton Facial Recognition *vs.* computerized facial recognition task) repeated measures analysis of variances (omnibus ANOVA) was conducted. Group assignment served as the between-subjects factor and the overall scores on the four tasks as the within-subjects factors. The main effect of group was significant [$F(1,48) = 4.74$, $p = .03$], suggesting that the groups differed in their overall performance across the four tasks, with the healthy volunteers performing better than the patients. The group by task interaction was also significant [$F(3,46) = 4.38$, $p = .009$], indicating that the pattern of performance on the tasks was different for the two groups. Separate repeated measures analyses of variance (ANOVAs), with a Bonferroni-type correction in which the level of significance was adjusted ($p = .01$) showed that the two groups did not differ significantly in terms of their overall accuracy on the facial affect matching [$F(1,48) = 2.85$, $p = .09$], the Benton Facial Recognition [$F(1,48) = 1.10$, $p = .30$], or the computerized facial recognition, [$F(1,48) = 2.48$, $p = .12$]. However, the patients did perform significantly more poorly than controls on the facial affect labeling task [$F(1,48) = 11.69$, $p = .001$]. As shown in Table 3, the controls demonstrated an unexpectedly strong performance at the 500 ms duration. In order to ensure that the obtained group differences in overall facial matching accuracy were not due to this pattern of performance in the control group, a separate ANOVA was conducted which included only the 750 and 1000 ms data from both groups. A near-significant difference remained between the BPD and HV groups [$F(1,48) = 4.04$, $p = .05$].

Group Comparisons Across Presentation Durations by Task

To test the second hypothesis, that patients would perform worse on the computer tasks than healthy volunteers at shorter presentation durations, but that both groups would perform similarly at longer presentation durations, separate 2 (group: BPD *vs.* healthy volunteers) × 3 (presentation duration: 500 ms *vs.* 750 ms *vs.* 1000 ms) repeated measures ANOVAs were conducted on each of the three computer tasks. The Benton Facial Recognition Task was not included in this analysis because it did not include varying presentation durations. On facial affect labeling there was a significant main effect of group [$F(1,48) = 11.69$, $p = .001$] and the Group × Presentation Duration interaction

Table 2. Percentage correct and (*SD*) of BPD patients on *versus* BPD patients off different medications

Medication and Task	Off medication	On medication	*p*
Mood stabilizer			
Affect Matching Task	69 (4)	67 (3)	.47
Affect Labeling Task	62 (3)	69 (3)	.27
Computer Facial Recognition Task	81 (2)	76 (2)	.21
Antidepressant			
Affect Matching Task	67 (3)	72 (4)	.35
Affect Labeling Task	67 (3)	62 (3)	.65
Computer Facial Recognition Task	78 (2)	75 (2)	.51
Antipsychotic			
Affect Matching Task	69 (3)	67 (4)	.73
Affect Labeling Task	69 (3)	64 (3)	.38
Computer Facial Recognition Task	78 (2)	78 (2)	.94
Benzodiazepine anxiolytic			
Affect Matching Task	67 (4)	66 (3)	.55
Affect Labeling Task	66 (3)	67 (3)	.88
Computer Facial Recognition Task	79 (2)	76 (3)	.55

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Table 3. Scores and (*SD*) between groups on facial tasks

	BPD $N = 25$		HV $N = 25$		
Measures	*M*	(*SD*)	*M*	(*SD*)	*p**
Facial affect recognition tasks					
Affect Matching Task (max 36)	24.5	(3.6)	26.1	(3.4)	.09
% correct for 500 ms	65	(1.5)	73	(1.0)	.05
% correct for 750 ms	73	(1.2)	77	(1.2)	.25
% correct for 1000 ms	65	(1.3)	69	(1.4)	.50
Affect Labeling Task (max 18)	12.0	(2.6)	14.1	(1.6)	.001
% correct for 500 ms	63	(2.5)	85	(1.5)	.0001
% correct for 750 ms	68	(1.8)	76	(1.4)	.08
% correct for 1000 ms	69	(2.1)	74	(1.3)	.29
Facial recognition tasks					
Computer Facial Recognition Task (max 24)	18.8	(2.2)	19.7	(1.9)	.12
% correct for 500 ms	75	(1.6)	76	(1.2)	.80
% correct for 750 ms	87	(1.4)	89	(1.2)	.41
% correct for 1000 ms	74	(1.7)	81	(1.4)	.09
Benton's Facial Recognition (max 27)	22.6	(2.3)	22.2	(1.4)	.51

*Multiple repeated measures ANOVAs conducted on the tasks, with Tukey HSD follow-up procedures for the individual presentation durations.

was statistically significant [$F(2,47) = 3.88$, $p = .03$], suggesting that the groups differed in the pattern of performance across the presentation durations.

Multiple comparison procedures using Tukey HSD, with a Bonferroni-type correction in which the level of significance was adjusted ($p = .01$) demonstrated a statistically significant group difference at the 500 ms duration [$t(49) = 3.85$, $p = .001$]. However, as previously noted, this result appears to be due to the unexpectedly strong performance by the controls (i.e., superior to their scores at longer presentation durations), rather than to a disproportionate performance decrement in the patients. This interpretation of the 500 ms data is supported by the finding that the patients' scores did not differ in a within group analysis of their performance at the 500 ms and 750 ms durations [$t(24) = 1.0$, $p > .05$].

With regard to facial affect matching, an ANOVA indicated that the Group × Duration Interaction was not significantly different [$F(2,47) = .62$, $p = .54$] suggesting that the patterns across durations were similar between groups. When comparing the two groups on computerized facial recognition across the different time intervals, the Group × Duration Interaction was not significantly different [$F(2,47) = .70$, $p = .50$].

Analysis of Reaction Time

A series of 2 (group: BPD *vs.* healthy volunteers) × 3 (presentation duration: 500 ms *vs.* 750 ms *vs.* 1000 ms) repeated measures ANOVAs were conducted on reaction time measures for each of the three computer tasks in order to test the third hypothesis that patients would take longer to respond than would healthy volunteers. The main effect of group was significant for facial affect matching [$F(1,48) = 5.94$, $p = .02$], facial affect labeling [$F(1,48) = 11.78$, $p = .001$], and computerized facial recognition [$F(1,48) = 9.29$, $p = .004$], with the patients taking longer to respond than the healthy volunteers on each of the three tasks.

Tukey HSD follow-up procedures indicated that healthy volunteers performed faster than patients across all presentation durations for all tasks. Further, the main effect of duration was significant for facial affect matching [$F(2,47) = 8.06$, $p = .001$], facial affect labeling [$F(2,47) = 10.37$, $p = .001$] and the computer facial recognition task [$F(2,47) = 8.86$, $p = .001$], with faster reaction times occurring at longer presentation durations. The Diagnosis × Presentation Duration interaction term was not significant for any of the three tasks [$F(2,47) < .70$, $p > .5$ for all cases].

Intercorrelations of Tasks

As illustrated in Table 5, Pearson product-moment correlations were conducted to examine the relationships between the different neuropsychological tests and the clinical measures (SAPS, HDRS, and YMRS). These analyses were conducted for two reasons: to examine the relationship between the symptom measures and affective processing, and to explore the validity of the novel tasks by examining the intercorrelations among the cognitive measures.

In terms of correlations between the affective processing and symptom measures for the bipolar patient group, poor facial affect matching was significantly related to higher SAPS scores ($r = -.51$, $p < .01$). However, there were no other significant correlations among the different cognitive tests and the clinical measures for either of the groups (in absolute value terms, the range of $r = .01$–$.34$).

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Table 4. Reaction time and (*SD*) among computerized tasks between groups

Task and duration	BPD *M*	BPD (*SD*)	HV *M*	HV (*SD*)	*p**
Facial affect recognition tasks					
Affect Matching Task					
500 ms	2.38	(1.76)	1.9	(1.26)	.02
750 ms	2.25	(1.9)	1.85	(1.2)	.05
1000 ms	2.05	(1.54)	1.65	(1.12)	.02
Affect Labeling Task					
500 ms	3.47	(2.46)	2.55	(1.90)	.01
750 ms	3.24	(2.65)	2.43	(1.72)	.01
1000 ms	2.59	(2.3)	2.03	(1.65)	.05
Facial recognition tasks					
Computerized Facial Recognition Task					
500 ms	2.11	(1.28)	1.59	(.84)	.01
750 ms	1.80	(1.28)	1.30	(.93)	.01
1000 ms	1.85	(1.51)	1.43	(1.16)	.04

*Tukey HSD *t* tests.

Within the patient group, the intercorrelations among the cognitive measures indicated that the computerized facial recognition task and the Benton Facial Recognition task were significantly correlated ($r = .62$, $p < .01$). Facial affect matching was significantly correlated with both facial recognition tasks ($r > .47$, $p < .05$ for both cases), but the facial affect labeling task was not significantly correlated with the facial recognition tasks ($r < .31$, $p > .05$ for both cases). In the healthy volunteer group, the facial affect matching task was not significantly related to either facial recognition task ($r < .30$, $p > .05$ for both cases). Also, although the facial affect labeling task was significantly correlated with the computer facial recognition task ($r = .52$, $p < .01$), it was not significantly correlated with the Benton Facial Recognition task ($r = .22$, $p > .05$).

DISCUSSION

The results of the Token Test, ANART, and facial recognition tasks from this study support the notion that manic

Table 5. Pearson product-moment correlations among measures by group

Measures	Percent correct on Affect Matching Task	Percent correct on Affect Labeling Task	Percent correct on Computer Facial Recognition Task
BPD patients			
Affect Matching Task	1.00		
Affect Labeling Task	.34	1.00	
Computer Facial Rec.	.52**	.31	1.00
Benton's Facial Rec.	.47*	.27	.62**
Token Test	.28	.06	.38*
YMRS	−.34	−.33	−.04
HDRS	−.19	.17	.17
SAPS Global	−.51**	−.26	−.30
Healthy volunteers			
Affect Matching Task	1.00		
Affect Labeling Task	.12	1.00	
Computer Facial Rec.	.30	.52**	1.00
Benton's Facial Rec.	.13	.22	.23
Token Test	.17	.32	.24
YMRS	−.19	.18	−.12
HDRS	.11	−.01	.14

*$p < .05$.
**$p < .01$.

https://doi.org/10.1017/S1355617703940021 Published online by Cambridge University Press

patients with BPD are not globally cognitively impaired. Patients with BPD who were matched to healthy volunteers in terms of demographic features performed normally on tasks of verbal comprehension, verbal intelligence, and facial recognition. However, manic patients with BPD were selectively impaired on a task of facial affect labeling, in the presence of spared facial recognition ability.

The hypothesis that patients would perform worse than the healthy volunteers on the facial affect recognition task, but perform normally on the facial recognition tasks was partially supported in that the patients showed overall reduced accuracy on the facial affect labeling task, but similar performance to healthy participants on the two facial recognition tasks. Further, the ability to discriminate between faces appears to remain intact even when the stimulus exposure duration is quite brief (500 ms). Thus, this study supports the notion that patients diagnosed with BPD accurately recognize faces but fail to accurately label facial affect. Perhaps the ability to discriminate faces indicates that patients are attending to facial cues but are unable to properly identify affective cues.

The hypothesis that patients would be impaired at the shorter but not the longer presentation durations was not supported. While facial affect labeling differences occurred between the two groups at the 500 ms presentation duration, it appears that this difference was due to the unexpectedly strong performance of the healthy volunteers at the 500 ms presentation duration. While it is possible that this reflects a mechanism by which healthy subjects may analyze facial affect differently at shorter presentation durations as compared to longer durations, such an effect has never been documented and most likely reflects chance variation. However, it is also possible that there may not have been enough trials administered in any of the computerized tasks to properly examine accuracy as a function of exposure duration. Future studies of facial affect recognition and facial recognition need to consider presentation duration carefully.

Furthermore, the patients performed significantly more slowly on all three tasks. Their reaction time was significantly longer across the different presentation durations when compared to healthy volunteers. These results are consistent with the Wilder-Willis et al. (2001) finding that patients with BPD are impaired in fine motor skills and reaction time, even after accounting for psychiatric symptoms and medication effects.

Although the three computer tasks that were used in this study are novel, the correlations conducted among the tasks and the other measures support the construct validity of these measurements. The high correlation between the computer facial recognition task and the previously validated facial recognition task developed by Benton (1978) supports the convergent validity of this new measure. Further, since the facial affect tasks are only moderately related to the facial recognition tasks it appears that these measures are examining a construct that is partially independent of facial perception, specifically facial affect processing.

One possible reason that the BPD patients are not showing the same facilitation on facial affect identification as compared to healthy volunteers is that patients diagnosed with BPD have abnormalities in neural networks that are specific for controlling emotional processing. A recent functional magnetic resonance imaging study conducted by Strakowski et al. (2000) compared euthymic bipolar patients with healthy volunteers on a facial emotion identification task presented at 750 ms duration. They found differences between the groups in patterns of brain activation. BPD patients demonstrated decreased activation in structures of the anterior limbic network, specifically amygdala, thalamus, caudate and anterior cingulate. In contrast, the current study indicates that patients and healthy volunteers have similar abilities in facial recognition even at the faster presentation duration. It should be noted that there have been no imaging studies implicating the fusiform face recognition region, which plays a large role in recognizing faces, in the expression of BPD. It is plausible, therefore, that the brain regions subserving face recognition are not affected in bipolar disorder.

It is also possible that the observed differences may be due to the patients' known deficits in attention (Sax et al., 1999; Wilder-Willis et al., 2001). Specifically, subtle attentional problems may have affected performance on the labeling emotions task, particularly at the 500 ms duration. The patients in our study performed most tasks similarly to healthy participants, which argues against the contention that a general deficit in sustained attention significantly contributed to these group differences. Moreover, the subjects controlled the pace of the presentations, thereby increasing the likelihood that they were attending to the tasks. However, this study did not administer a task specifically measuring attention and, thus, the precise impact of sustained attentional abilities on the results remain unclear.

Another possibility for the observed difference in the facial affect labeling task is the design of the task. While the participants had two response alternatives on the facial affect matching and computerized facial recognition tasks, the facial affect labeling task presented six response alternatives. The deficits in fine motor skill, along with slower reaction times likely contributed to the decrease in performance on this particular task. Further, since the stimuli for this task were all presented on the left side of the screen, it is possible that the differences may be due to a laterality effect. It is difficult, however, to interpret how the design of this specific computer task impacted the results.

In terms of the effect of medication, we did not find significant performance differences between patients who were or were not receiving mood stabilizers, antipsychotics, antidepressants and benzodiazepine anxiolytics. We acknowledge, however, that with the limited sample size, we were not able to evaluate the impact that multiple medications may have on ability. Furthermore, although there is little reason to expect medications to exert an extensive effect on task performance, the sample size is insufficient

to explore medication effects more thoroughly. Testing patients prior to medication treatment would address these issues more directly, but the severity of manic symptoms raises ethical concerns about this approach.

There are several aspects of our study design that are important to emphasize. The large number of statistical comparisons increases the likelihood of spurious results (Stevens, 1996), although we applied Bonferroni corrections to minimize this possibility. Also, this study only examined manic or mixed BPD patients. It would be useful to determine if facial recognition deficits persist in BPD patients who are depressed or euthymic. This type of experimental design would also extend the report by Addington and Addington (1998) of facial affect recognition impairments in euthymic patients, thus suggesting that this deficit may be a trait of the disorder. By conducting a longitudinal study across different mood states, one might also clarify the uncertain results previously found in depressed patients (Bellack et al., 1996; Feinberg et al., 1986). Also, since we collapsed data across the different emotions, it remains uncertain as to whether manic patients are selectively deficient in identifying and labeling specific emotions.

The possibility exists that the BPD patients are able to discriminate identity on the computer facial recognition tasked based on different peripheral features of the Ekman faces, such as hair type. However, the results obtained from this task are also supported by the Benton Facial Recognition task, on which faces alone are shown and the patients perform similar to healthy volunteers on facial recognition tasks. Further, hair is often used as a cue for identifying different people outside of a laboratory. Taken together, along with previous research with this population, we feel that there is strong evidence against the notion of a facial recognition deficit in this patient population, even at brief exposure durations.

To our knowledge this is the first study manipulating different exposure durations while examining facial affect recognition ability differences between a clinical group and healthy volunteers. Such an approach can help determine the stage of processing at which group differences occur. This study suggests that patients with BPD have a facial affect labeling deficit across different brief ($\leq$ 1 s) exposure durations. Just as patients diagnosed with BPD have problems with mood regulation, they also have deficits in effectively processing emotional cues. The inability of patients diagnosed with an affective disorder to combine emotional cues with previous experience in order to modify behavior and alter self-perception has been documented elsewhere for depressed patients (Rubinow & Post, 1992). The current study extends these findings to the affective state of mania.

Affective recognition deficits in BPD may be related to an inability to recognize and resolve many interpersonal problems. Deficits in social perception are important predictors of inadequate social functioning (Penn et al., 1995; Wallace, 1986). Therefore, if individuals currently symptomatic with BPD cannot identify affective cues displayed by other people, they may have difficulty recognizing interpersonal problems. Although the current study did not examine the relationship between facial affect deficits and the patients' social interaction abilities, this will be an interesting area for future research.

ACKNOWLEDGMENTS

We are grateful to Dr. Jeffrey Kneile for his assistance in programming the computer tasks. We would like to acknowledge Dr. David Fleck, Dr. Melissa DelBello, Michael Schweirs and the Bipolar and Psychotic Disorders Research Program Neuropsychology Group for their assistance in collecting and analyzing the data. In addition, we would like to thank the anonymous reviewers of this submission who contributed substantially to our interpretation of the findings. The work presented in the paper was supported in part by The Stanley Medical Research Institute (SMS), and NIMH Grant MH-58170(SMS) and MH-56352(SMS).

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