

Perceptual Biases in Facial Emotion Recognition in Borderline Personality Disorder

Alexander R. Daros, Amanda A. Uliaszek, and Anthony C. Ruocco
University of Toronto Scarborough

Individuals with borderline personality disorder (BPD) have biases in facial emotion recognition, which may underlie many of the core features of this disorder. Although they are known to misperceive specific prototypic expressions of emotion (i.e., those displayed at full emotional intensity), patients with this disorder may also show biases in their perceptions of emotions that are expressed at lower levels of emotional intensity. Females with BPD ($n = 31$) and IQ- and demographically matched nonpsychiatric controls ($n = 28$) completed a task assessing the recognition of neutral as well as happy and sad facial expressions at mild, moderate, and prototypic emotional intensities. Whereas patients with BPD were more likely than controls to ascribe an emotion to a neutral facial expression, they did not consistently attribute a more negative or positive valence to these faces as compared with controls. Patients were also more likely to perceive mildly sad facial expressions as more intensely sad, and this finding could not be attributed to depressed mood. The results of this study suggest that perceptions of even subtle expressions of negative affect in faces may be subjectively magnified by individuals with BPD, although there was no consistent evidence for a negative perceptual bias for faces displaying a neutral expression. These biases in facial emotion perception for patients with BPD may contribute to difficulties understanding others' emotional states and to problems engaging effectively in social interactions.

Keywords: borderline personality disorder, emotion identification, emotion recognition, emotion sensitivity, mentalization

Borderline personality disorder (BPD) is a serious mental illness that affects 1–2% of adults, and its hallmark symptoms include emotional instability and unstable interpersonal relationships (Lenzenweger & Pastore, 2007; Torgersen, Kringlen, & Cramer, 2001). Emotion dysregulation is considered by many theorists as the core clinical feature of BPD and is thought to result from an interaction between a biological vulnerability toward a reactive mood and a social environment in which one's emotional reactions were invalidated by others (Linehan, 1993; Selby & Joiner, 2009). Accordingly, patients with this disorder are thought to have a heightened sensitivity to emotionally salient stimuli, a subjectively intensified experience of negative emotions, and a slow return to their baseline level of emotional arousal (Zanarini & Frankenburg, 2007). This emotional hypersensitivity has been linked to social-

cognitive perceptual biases, most notably, a heightened sensitivity to social cues that might signal threat or rejection (Linehan, 1995).

The majority of research investigating perceptual biases in BPD has centered on two aspects of emotion recognition: identification and sensitivity. Emotion *identification* requires patients to study faces of prototypic emotional expressions (i.e., those expressed at full emotional intensity) and provide a verbal label for that emotion (e.g., happy, sad, angry, fearful, or disgusted). Emotion *sensitivity* measures the lowest level of intensity at which an emotion can be correctly recognized in a face that is progressively morphed from neutral (i.e., no emotion) to a prototypic emotional expression. Daros, Zakzanis, and Ruocco (2013) carried out a meta-analysis of 11 studies evaluating facial emotion identification in patients with BPD. The results of this study revealed that individuals with this disorder were more likely than nonpsychiatric controls to have difficulties identifying prototypic facial expressions of anger and disgust, emotions that are particularly relevant to BPD because they may signify threat and rejection, respectively (Burklund, Eisenberger, & Lieberman, 2007; Chapman & Anderson, 2012). Indeed, sensitivity to rejection is considered a core interpersonal phenotype for BPD (Gunderson & Lyons-Ruth, 2008) that could influence patients' perceptions of socially salient stimuli, such as facial expressions. Perhaps surprisingly, however, patients had the greatest difficulty recognizing neutral facial expressions (i.e., those displaying no emotion). Given that the primary studies included in this meta-analysis typically did not report what emotions patients recognized when they misperceived specific emotions in faces, it was difficult to determine whether they showed a consistent perceptual bias for one specific emotion or emotional valence over another. The only studies that examined

Alexander R. Daros, Amanda A. Uliaszek, and Anthony C. Ruocco, Department of Psychology, University of Toronto Scarborough, Toronto, Ontario, Canada.

We thank Konstantine K. Zakzanis for comments on a draft of this article. This study was supported by an Operating Grant (Funding Reference Number: 123413) and a New Investigator Award (MSH-130177) from the Canadian Institutes of Health Research and a University of Toronto Scarborough (Vice Principal-Research) Research Competitiveness Grant awarded to Dr. Anthony C. Ruocco, and a Joseph-Armand Bombardier Canada Graduate Scholarship from the Social Sciences and Humanities Research Council of Canada to Mr. Alexander R. Daros.

Correspondence concerning this article should be addressed to Anthony C. Ruocco, Department of Psychology, University of Toronto Scarborough, Toronto, Ontario, Canada, M1C 1A4. E-mail: anthony.ruocco@gmail.com

this question found that patients with BPD tended to select emotions of a negative valence when they misperceived neutral faces (Dyck et al., 2009; Wagner & Linehan, 1999). These findings are consistent with other work that suggests that patients with BPD may have difficulties differentiating their emotional reactions to various BPD-relevant interpersonal situations (e.g., abandonment, rejection and abuse; Arntz & Veen, 2001) and to perceive that they are being rejected in an otherwise inclusive social interaction (Berenson et al., 2009; Gratz, Dixon-Gordon, Breetz, & Tull, 2013). Collectively, this research suggests that emotions relevant to BPD psychopathology may be more difficult for individuals with this disorder to identify and that they may ascribe negative emotions to faces in which healthy individuals perceive no emotion.

The findings of studies evaluating emotion sensitivity in patients with BPD are less consistent than for emotion identification. Some research suggests that these patients may have a generally lower threshold for detecting emotions in faces as compared with healthy individuals (Lynch et al., 2006), with perhaps an especially acute detection threshold for anger (Domes et al., 2008; Schulze, Domes, Koppen, & Herpertz, 2013). Other research, however, suggests that patients with BPD may have comparable or possibly higher emotion detection thresholds than healthy individuals, most notably for the emotions of fear, disgust, and happiness (Jovev et al., 2011; Robin et al., 2012). Based on these findings, Daros et al. (2013) articulated a model of facial emotion perception in BPD, which rests on the theory that individuals with this disorder experience higher levels of arousal than healthy persons when presented with emotionally salient stimuli (Arntz, Appels, & Sieswerda, 2000; Domes et al., 2006; Linehan, 1993). At lower levels of emotional expression in faces, higher arousal may serve to enhance the identification of these emotions, a hypothesis that is supported by studies that found a lower facial emotion detection threshold in BPD (Domes et al., 2008; Lynch et al., 2006; Schulze et al., 2013). Faces displaying more intense emotional expressions (i.e., prototypic displays of emotions), on the other hand, may provoke higher levels of arousal and deplete the cognitive resources necessary to disengage attention from emotionally salient stimuli, thereby reducing patients' accuracy in recognizing certain emotions (Domes, Schulze, & Herpertz, 2009; Linehan, 1993). Evidence from a visual dot probe experiment provides support for this supposition by showing that BPD psychopathology may be associated with difficulty directing attention away from faces displaying negatively valenced emotional expressions (von Ceumern-Lindenstjerna et al., 2010).

Whereas research evaluating facial emotion identification and sensitivity in BPD has largely supported this model, several questions about the nature of these perceptual biases remain. First, it is unclear whether patients with BPD show a heightened detection of negative emotions when alternative paradigms for evaluating emotion sensitivity are examined. In standard morphing tasks, examinees' recognition of specific emotions may benefit from comparisons of progressive changes in the relative positions of facial features from one morphed face to the next. An alternative task that displays static images of faces at varying intensities of emotional expressiveness and in a randomized sequence of presentation may provide unique insights into the nature of perceptual biases in patients with this disorder. Second, standard morphing tasks typically require partici-

pants to stop the morph when an emotional expression is clearly recognizable, providing a threshold for the detection of emotions in faces. It is difficult to ascertain, however, whether patients might show any systematic biases in emotion perception when they are asked to identify subtler emotional expressions which may be more ambiguous. Third, although mood-congruent biases in emotion perception are well documented in major depressive disorder (MDD; Bourke, Douglas, & Porter, 2010) and bipolar disorder (Derntl, Seidel, Kryspin-Exner, Hasmann, & Dobmeier, 2009), the extent to which mood state might impact performance on emotion perception tasks in BPD remains an important unanswered question. Finally, the relationships of psychiatric diagnostic comorbidity and psychotropic medication use to emotion perception biases have not been thoroughly examined in this patient group and warrant greater scrutiny.

The current study therefore sought to clarify these issues by simultaneously measuring emotion identification and sensitivity in patients with BPD using a novel emotion perception task that has been used in various psychiatric samples (Aigner et al., 2007; Gur et al., 2002; Sachs, Steger-Wuchse, Kryspin-Exner, Gur, & Katschnig, 2004; Schenkel, Pavuluri, Herbener, Harral, & Sweeney, 2007). Specifically, neutral faces as well as emotional faces at three levels of intensity (mild, moderate, and prototypical) for sad and happy expressions were individually presented to examinees in a pseudorandom sequence. The appeal of this task is that it incorporates facial emotions that may be considered symmetrical with respect to the mouth (i.e., smile vs. frown), and the intensity of happy and sad expressions as bipolar dimensions can be easily manipulated in this respect. Using this task, important information could be gathered about possible biases in perceptions of more subtle facial expressions of emotion that could not be obtained from standard morphing tasks for evaluating emotion sensitivity. Based on the findings of Daros et al. (2013), patients with BPD were expected to have greater difficulty recognizing neutral facial expressions, and could show a negative perceptual bias (i.e., perceiving neutral faces as negatively valenced; Dyck et al., 2009; Wagner & Linehan, 1999). With respect to the specific emotions, patients with BPD were anticipated to have greater difficulty recognizing emotional expressions of sadness but not happiness, and perhaps more difficulty recognizing prototypical expressions of sadness (Daros et al., 2013). Given that patients were comprehensively clinically characterized with respect to common diagnostic comorbidities, psychotropic medication use, and depressive symptom severity at the time of assessments, exploratory analyses examined the relationships between these clinical characteristics and emotion perception biases. Together, this research may improve understanding of facial emotion perception biases in BPD and identify important factors that may contribute to these biases.

Method

Participants

BPD patients. Thirty-one female patients with BPD were recruited from outpatient psychiatric clinics and online postings in Toronto, Canada, as part of a larger neurocognitive study of BPD. All patients had previously received a diagnosis of BPD through

inpatient and/or outpatient consultation and all met current criteria for BPD (i.e., past five years according to semi-structured clinical interviews). To be included in the study, participants were required to be 18–65 years old, fluent in English, capable to provide written informed consent, and have an estimated Full-Scale IQ ≥ 80 as determined by the Wechsler Test of Adult Reading (Wechsler, 2002). Exclusion criteria included the following: current or lifetime diagnosis of *Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV)* psychotic disorder, bipolar I disorder, lifetime eating disorder requiring hospitalization, or current or extensive history of alcohol or nonalcohol substance use disorder; significant head trauma (≥ 20 min loss of consciousness and/or >24 hours posttraumatic amnesia); developmental disorder (e.g., autism-spectrum disorder, Down's syndrome); neurological illness (e.g., seizure disorder, encephalitis, stroke); serious physical illness (e.g., myocardial infarction, viral hepatitis, hypothyroidism); and a significant manual, auditory, or hearing impairment.

The final patient sample ranged in age from 18 to 52 years ($M = 30.7$, $SD = 10.5$) with 14.1 ($SD = 2.7$) years of formal education. At the time of testing, 83.3% of patients reported a history of at least one inpatient psychiatric hospitalization and most (93.3%) had also been seen on an outpatient basis for psychiatric reasons. Comorbid psychiatric disorders were assessed using the Structured Clinical Interview for *DSM-IV* Axis I Disorders–Patient Edition (SCID-I/P; First, Spitzer, Gibbon, & Williams, 2002) and Structured Interview for *DSM-IV* Personality (SIDP-IV; Phofl, Blum, & Zimmerman, 1997). Patients met criteria for an average of 6.9 ($SD = 1.2$) BPD symptoms at the time of testing. Rates of comorbid Axis I disorders in the BPD patient sample were as follows: MDD (current: 51.2%, past: 38.7%), dysthymic disorder (6.5%), alcohol dependence in remission (29.0%), substance dependence in remission (16.1%), lifetime eating disorder (16.1%), posttraumatic stress disorder (PTSD; current: 16.1%, past: 19.4%), and other lifetime anxiety disorder (41.2%). Rates of comorbid personality disorders were as follows: paranoid (22.6%), dependent (22.6%), avoidant (19.4%), narcissistic (12.9%), obsessive–compulsive (9.7%), antisocial (6.5%), and histrionic (6.5%). Two-thirds of patients were medicated at the time of testing with the following psychotropic drugs (alone or in combination): antidepressants (61.3%), sedatives (32.2%), mood stabilizers (16.1%), stimulants (16.1%), antipsychotics (16.1%), and minor tranquilizers (9.7%).

Healthy controls. Twenty-eight healthy females with no personal or family history of psychiatric illness were recruited from the community using print and online postings. The SCID-I/P and SIDP-IV were used to evaluate *DSM-IV* disorders and they were excluded if they met criteria for any psychiatric disorder. Other exclusions included any medical or neurological illness that could affect brain functioning (e.g., hypothyroidism, seizure disorder, dementia), significant head trauma, or any history of a learning or developmental disorder (e.g., attention-deficit disorder, autism). Healthy controls ranged from 18 to 59 years of age ($M = 27.5$, $SD = 10.6$), and completed 15.1 ($SD = 1.9$) years of education. Patients and healthy controls did not differ by age, IQ, face recognition, or years of education (all $ps > 0.05$), although the former reported higher levels of depression on the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), $t(56) = 12.8$, $p < .001$.

Procedure

This study received approval from the Research Ethics Board at the Centre for Addiction and Mental Health and the Social Sciences, Humanities, and Education Research Ethics Board at the University of Toronto. Potential participants completed an initial phone screen to assess inclusion and exclusion criteria for this study. Eligible individuals were invited to visit the University of Toronto Scarborough, where all procedures took place. After a complete description of the study, individuals provided written informed consent to participate in the research protocol. Participants were required to provide a negative urine toxicology screen on the day of testing and before completing laboratory procedures. They were financially compensated up to \$100 for their participation in the larger study. All participants completed semistructured diagnostic interviews administered by bachelor- and graduate-level diagnostic interviewers trained to reliably administer these measures and were directly supervised by a licensed clinical psychologist (ACR). Interviews were conducted without knowledge of the status of the recruited individual (i.e., whether they were a patient or healthy control). Narratives for each participant were prepared based on all of the available information obtained from diagnostic interviews and medical record reviews and then discussed in a best estimate diagnostic meeting (Klein, Ouimette, Kelly, Ferro, & Riso, 1994).

Measures

General intellectual function. Participants completed the Wechsler Test of Adult Reading (WTAR; Wechsler, 2002) to estimate their Full-Scale IQ. The WTAR is an oral reading test which was conormed with the Wechsler Adult Intelligence Scale–Third Edition (Wechsler, 1997). The test contains 50 words of irregular pronunciation but does not require text comprehension or knowledge of word meanings. Participants were asked to read the words aloud at a self-paced rate, and a trained examiner then recorded their responses. The total number of words correctly articulated by the participant was tabulated, and an estimate of their overall intellectual functioning was derived according to regression-based tables provided in the test manual. The WTAR has excellent test–retest reliability and extensive research supporting its validity as a method for estimating general intellectual ability (Allen & Yen, 1979; Crawford, 1992).

Facial recognition. The Benton Facial Recognition Test–Short Form (BFRT; Benton, Sivan, Hamsher, Varney, & Spreen, 1983) evaluated facial recognition abilities. The BFRT requires participants to match a target face with up to three pictures of the same person in a six-stimulus array of faces that vary in terms of angles and lighting. Short form scores were transformed to full-scale age-corrected scores using normative data provided in Benton et al. (1983).

Symptom validity. The Victoria Symptom Validity Test (VSVT; Slick, Hopp, Strauss, & Thompson, 1997) is an extensively validated forced-choice recognition test that measures a participant's effort or compliance on performance-based tests. Poor performance on this task may reflect inconsistent effort, feigning, or exaggeration of cognitive deficits, or any combination of these. Participants with noncompliant or questionably compliant performances on the VSVT according to normative data provided

in Strauss, Sherman, and Spreen (2006) were excluded from this study.

Depression severity. Severity of current depressive symptoms was measured using the BDI-II (Beck et al., 1996). The BDI-II is a 21-item self-report scale that asks participants to rate the severity of their depressive symptoms over the two weeks before testing. This measure has strong reliability and validity in clinical samples (Beck, Steer, Ball, & Ranieri, 1996). In the present study, Cronbach's alpha for the BDI-II was .96.

Facial emotion recognition. The Penn Emotional Acuity Test (PEAT) is a component of the University of Pennsylvania's Computerized Neurocognitive Test Battery that measures facial emotion recognition at varying levels of intensity (Erwin et al., 1992; Gur et al., 1992). This task contains 40 faces that include neutral expressions as well as happy and sad expressions displayed at one of three levels of emotional intensity: mild, moderate, and full/prototypic. Participants are presented with one face at a time in a pseudorandom sequence and asked to rate the intensity of each emotional expression using a 7-point Likert scale: *Very sad, Moderately sad, Mildly sad, Neutral, Mildly happy, Moderately happy, and Very happy*. This self-paced task begins with a brief practice session of five faces to ensure that participants understand the instructions. Accuracy and response times (RT) are recorded for each trial.

Results

Plan of Analyses

Statistical analyses were performed in IBM SPSS Statistics (v.20.0; IBM, Chicago, IL). PEAT accuracy scores were examined for normality using the Shapiro-Wilk test and found to be non-normal. Differences between groups were initially tested under the assumption of non-normality using nonparametric tests (Mann-Whitney *U* and Kruskal-Wallis, where applicable). Because there were no differences in the patterns of results when using parametric versus nonparametric statistical tests, the results of parametric analyses are presented for the purposes of simplicity. First, group differences in accuracy collapsing across valence and intensity were carried out using an independent-samples *t* test. Second, the hypothesis that patients will differ in the recognition of neutral and sad faces (but not happy faces) was evaluated by collapsing across

intensity. Based on these results, follow-up analyses evaluated group differences in the recognition of faces for each of three intensities (mild, moderate, and prototypic) while collapsing across valence. This was not carried out for neutral faces because these faces contain no intensity. Type I error ($p = .05$) for these analyses were then subjected to correction for multiple comparisons using the False Discovery Rate approach (Benjamini & Hochberg, 1995). Responses on the PEAT were considered correct when the examinee recognized the facial expression as classified in the validation of the PEAT (i.e., correct responses were psychometrically determined based on normative information described in Erwin et al., 1992). Response patterns for misperceived faces were subsequently inspected to determine whether patients demonstrated any systematic biases in emotion perception as compared to healthy controls. To accomplish this, incorrect responses on neutral trials were collapsed across valence, providing a metric to determine whether patients showed a bias toward positive or negative emotions when misperceiving neutral faces. For mildly sad expressions, all errors (except for a single positive valence response) were misperceived as either neutral or more intensely sad. Therefore, errors on mild sad trials were categorized as either neutral or more negative in terms of valence. A 2 (Group) \times 2 (Error Type) repeated-measures ANOVA was then used to determine systematic biases in the recognition of neutral and mildly sad facial expressions. Ancillary multiple regression analyses were employed to determine the multivariate shared relationship of diagnostic status (i.e., BPD vs. healthy control) and current depressive symptoms with performance on the PEAT. Comparisons of patients with specific Axis I diagnostic comorbidities and those medicated at the time of testing were also evaluated using exploratory within-group *t* tests. RT data were normalized using a square-root transformation and three outliers were removed sample because their performances were more than three standard deviations above the mean (i.e., atypically slow).

Demographic and Illness-Related Information

Table 1 summarizes the demographic characteristics, general intellectual function, face recognition abilities, and depressive symptoms for patients with BPD and healthy controls. Both groups fell within the average range for general intellectual function and

Table 1
Demographic and Illness-Related Characteristics for Patients With Borderline Personality Disorder and Healthy Controls

Characteristic	BPD patients		Healthy controls		Test statistic	<i>df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Age	30.7	(10.5)	27.5	(10.6)	$t = 1.14$	57	.26
Years of education	14.1	(2.7)	15.1	(1.9)	$t = -1.74$	57	.09
FSIQ (WTAR) ^a	109.0	(8.1)	107.7	(18.3)	$t = .34$	56	.73
BFRT ^b	47.6	(3.5)	46.8	(6.7)	$t = -.59$	52	.56
BDI-II total	27.4	(10.5)	1.4	(2.1)	$t = 12.83$	56	<.001

Note. BDI-II = Beck Depression Inventory-II; BFRT = Benton Facial Recognition Test; FSIQ = Full-Scale IQ; *M* = mean; *SD* = standard deviation.

^a Estimated using the Wechsler Test of Adult Reading (Wechsler, 2002). ^b Short-form scores were converted to age-corrected long-form scores.

face recognition abilities based on normative data provided in the respective test manuals.

Emotion Recognition Accuracy

As expected, patients with BPD were less accurate than healthy controls in recognizing emotions, collapsing across all emotion categories, $t(57) = -3.10$, $p = 0.01$, $d = 0.81$, particularly for expressions that were neutral (i.e., displaying no emotion), $F(1, 57) = 5.45$, $p = .048$, $d = 0.61$. Compared to healthy controls, patients with BPD also had more difficulty recognizing sad facial expressions, $F(1, 57) = 2.67$, $p = 0.22$, $d = 0.43$, compared with happy expressions, $F(1, 57) = 0.63$, $p = 0.42$, $d = 0.21$. Examining the recognition of sad expressions across three intensities, patients with BPD had the most difficulty recognizing mildly sad facial expressions $F(1, 57) = 5.76$, $p = 0.048$, $d = 0.63$, compared with moderate, $F(1, 57) = 0.12$, $p = .83$, $d = 0.09$, or prototypically (i.e., very sad) sad expressions, $F(1, 57) = 0.14$, $p = .83$, $d = 0.10$ (see Figure 1).

The patterns of responses on misperceived neutral and mildly sad facial expressions were subsequently examined to determine whether patients with BPD showed any systematic biases in their perceptions of these emotions. When examining the patterns of responses for misperceived neutral faces, there was no main effect of Error Type ($p = .51$) and no Group \times Error Type interaction ($p = .83$; Figure 2A), suggesting that patients showed no systematic biases in emotion perception for neutral faces. For misperceived mildly sad facial expressions, there was a Group \times Error Type interaction, $F(1, 57) = 11.40$, $p = .01$, with patients being three times more likely than controls to perceive these faces as more intensely sad, $t(57) = 3.65$, $p = 0.01$ (Figure 2B). There was no main effect of Error Type ($p = .83$) for mildly sad faces.

Ancillary Analyses

Relationship with mood state. For patients with BPD, severity of depression at the time of testing was not significantly

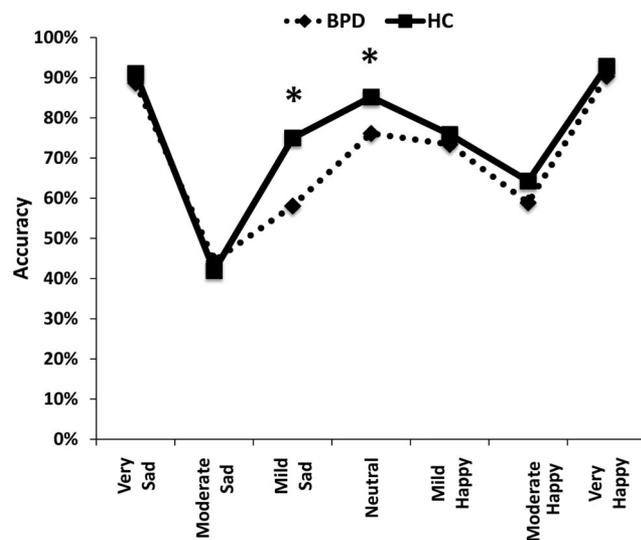


Figure 1. Emotion recognition accuracy on the Penn Emotional Acuity Test for patients with borderline personality disorder (BPD) and healthy controls (HC). * $p < .05$.

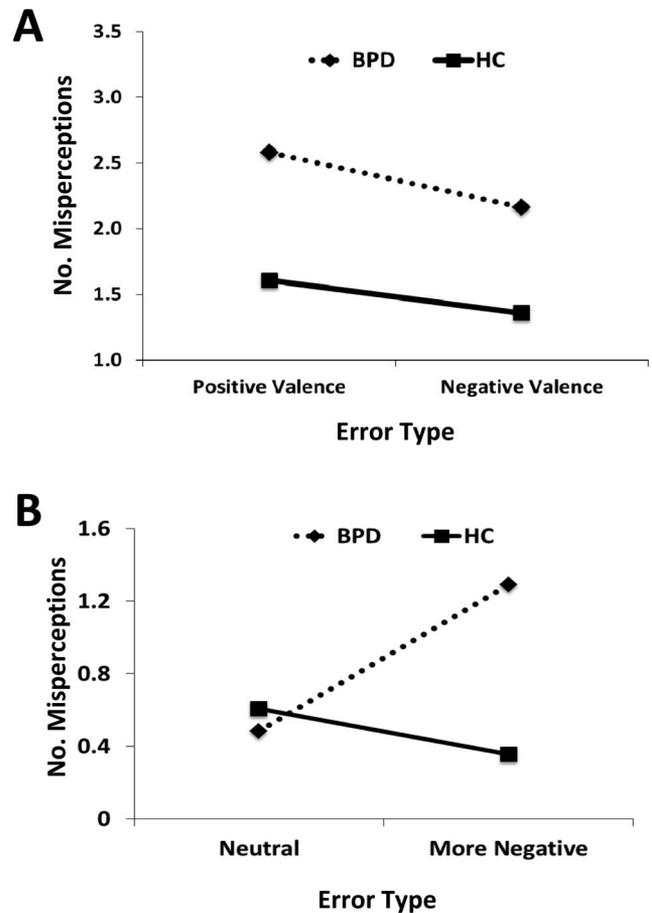


Figure 2. Mean number of misperceptions on neutral (A) and mildly sad (B) emotional facial expressions for patients with borderline personality disorder (BPD) and healthy controls (HC) on the Penn Emotional Acuity Test.

associated with difficulties recognizing neutral ($r = -0.20$, $p = .30$) or mildly sad facial expressions ($r = -0.13$, $p = .51$), suggesting no influence of depressive mood state on emotion perception biases. Collapsing across all emotion categories, there also was not a significant relationship between severity of depressive symptoms and emotion recognition accuracy for patients with BPD ($r = -0.19$, $p = .32$).

Response times. Univariate ANOVA indicated that patients with BPD were not faster at recognizing emotions collapsed across all categories, $F(1, 54) = 0.12$, $p = .74$, $d = 0.09$. Compared with healthy controls, patients with BPD were somewhat slower at recognizing neutral expressions, $F(1, 54) = 0.04$, $p = .84$, $d = 0.05$, and somewhat faster at recognizing sad, $F(1, 54) = 1.40$, $p = .24$, $d = -0.32$, and happy expressions, $F(1, 54) = 0.13$, $p = .72$, $d = -0.09$, although none of these comparisons reached statistical significance. In addition, reduced accuracy recognizing mildly sad faces in patients with BPD was associated with faster RTs but this effect was small and nonsignificant, $F(1, 54) = 0.20$, $p = .66$, $d = -0.12$; see Table 2). Poorer recognition of mildly sad ($r = .10$, $p = .65$) and neutral facial expressions ($r = -0.03$, $p = .88$) were not associated with slower RTs for patients with BPD, suggesting that they did not trade accuracy for speed.

Table 2
Response Time in Milliseconds for Correct Trials on the Penn Emotional Acuity Test for Patients With Borderline Personality Disorder and Healthy Controls

Emotion	BPD		HC		$F(1, 41)^a$	p	d
	M	SD	M	SD			
Very sad	1781	502	2219	760	5.00	.03	-.68
Moderately sad	2848	1212	2873	1167	.01	.92	-.03
Mildly sad	2200	773	2223	736	.01	.92	-.03
Neutral	2044	634	2043	664	.001	.98	.01
Mildly happy	1939	717	1945	524	.02	.88	-.04
Moderately happy	2066	694	2163	799	.17	.68	-.13
Very happy	1549	325	1692	365	1.84	.18	-.41

Note. BPD = borderline personality disorder; HC = healthy control; M = mean; SD = standard deviation; d = Cohen's standardized effect size; RT = response time.

^a Response time analyses are based on square-root transformed values.

Diagnostic comorbidity. Consistent with correlation analyses examining severity of currently depressed mood and emotion recognition accuracy, patients with BPD in a major depressive episode at the time of testing ($n = 16$) did not differ from nondepressed patients ($n = 15$) in recognition accuracy when collapsing across all emotion categories, $t(29) = 0.42$, $p = .66$, $d = 0.15$. Currently depressed patients were somewhat less accurate recognizing mildly sad expressions, $t(29) = -0.39$, $p = .74$, $d = -0.27$, and slightly more accurate recognizing neutral expressions, $t(29) = 0.25$, $p = .80$, $d = 0.29$, although these differences did not reach statistical significance. With respect to RT, currently depressed and nondepressed patients did not differ from each other when collapsing across all emotion categories, $t(27) = 0.55$, $p = .59$, $d = 0.21$, nor for mildly sad, $t(24) = 1.51$, $p = .15$, $d = 0.84$, or neutral expressions, $t(27) = 0.39$, $p = .70$, $d = 0.26$. Patients with current PTSD ($n = 5$) were comparable with those without this disorder ($n = 26$) in recognizing emotions across all categories, $t(29) = 1.89$, $p = .07$, $d = 0.92$. Unexpectedly, patients with a history of alcohol/nonalcohol substance dependence ($n = 10$) were somewhat more accurate than patients without such a history ($n = 21$) when collapsing across emotion categories, $t(29) = 1.45$, $p = .16$, $d = 0.56$, although this difference did not reach statistical significance.

Psychotropic medications. Patients who were medicated at the time of testing ($n = 23$) were less accurate recognizing happy faces (across all intensities) than those who were not medicated ($n = 7$), $t(28) = -2.53$, $p = .02$, $d = -1.09$. This difference could not be attributed to severity of depression, $t(28) = 0.37$, $p = .73$, $d = 0.16$, or number of BPD symptoms, $t(28) = -0.45$, $p = .65$, $d = -0.19$, between medicated and nonmedicated patients. There were no differences between medicated and nonmedicated patients with respect to RT for happy, sad, or neutral expressions, and no differences between those taking antidepressants versus those who were not medicated (all $ps > 0.05$).

Discussion

The present study used a novel task designed to measure emotion identification and sensitivity with the aim of determining whether patients with BPD show any systematic biases in their

perceptions of facial expressions of emotion. Patients' overall performances on this task were less accurate as compared with adults without a personal or family history of psychiatric illness, although they showed the greatest difficulties recognizing neutral (i.e., no emotion) and mildly sad facial expressions. Patients with BPD were more likely to misperceive mildly sad faces as more intensely sad, whereas healthy individuals tended to perceive no emotions in these faces. On the other hand, healthy individuals and patients with BPD were comparably accurate in their recognition of prototypic facial expressions of happiness and sadness.

These results are consistent with meta-analytic findings indicating that patients with BPD have no difficulties identifying prototypic happy and sad facial expressions but considerable problems recognizing neutral faces (Daros et al., 2013). Whereas a small number of studies have suggested that patients with BPD may show a bias toward ascribing negative emotions to neutral faces (Dyck et al., 2009; Wagner & Linehan, 1999), these studies did not incorporate options for milder intensities of emotions. Instead, they required participants to select a specific prototypic emotional expression (i.e., sadness, anger, disgust, fear or happiness) or no emotion. Therefore, prior work in this area was unable to determine whether patients might perceive milder intensities of emotions in neutral faces. Unexpectedly, as compared with healthy individuals, patients with BPD were not more likely to perceive a negative emotion (i.e., sadness) when they misidentified a neutral face. The task used in the present study, however, precluded the selection of alternative emotions which may be more relevant to BPD (e.g., anger, disgust). Nevertheless, the tendency of BPD patients to more frequently misidentify neutral facial expressions than healthy individuals, regardless of the emotion that they subjectively perceived, highlights a potentially significant social information processing deficit. Also, given that patients with BPD may subjectively magnify mild expressions of sadness in faces, it is possible that their reactions to even subtle displays of sadness in others' faces may be perceived as disproportionate to the emotional display and could lead to interpersonal problems.

Mood state is an important factor that could conceivably bias emotion perception for patients with BPD in the manner observed in the present study for mildly sad facial expressions. Surprisingly little is known about the relationship between depressive symptoms and emotion perception in BPD. Indeed, prior studies of emotion recognition did not characterize the relationship between negative biases in emotion perception and severity of depressed mood for patients with this disorder. Research with depressed individuals (and presumably no personality disorder) has typically revealed mood-congruent biases in emotion perception whereby neutral facial expressions are perceived as negative (see Bourke et al., 2010, for a review). Gur et al. (1992) used the PEAT with depressed individuals and found that they were more likely to misperceive happy facial expressions as neutral, and neutral expressions as sad, when compared with healthy individuals. Another study that displayed faces at varying emotional intensities but for different durations of time revealed that depressed individuals tended to misperceive happy facial expressions as neutral, although this was only found for happy expressions displayed at greater than 50% intensity and at a longer (2000-ms) stimulus presentation time (Surguladze et al., 2004). In the present study, patients with BPD were moderately depressed at the time of testing and more than half were experiencing a major depressive episode;

however, their response bias departed significantly from that which would be expected based on research with depressed individuals. First, patients with depression have difficulties recognizing prototypic facial expressions of happiness as compared with healthy individuals (Mandal & Palchoudhury, 1985; Mikhailova, Vladimirova, Iznak, Tsusulkovskaya, & Sushko, 1996). Patients with BPD in the present study, however, recognized these faces with near perfect accuracy, and there were no differences in recognizing prototypic happy expressions between currently depressed and nondepressed patients. Second, individuals with MDD tend to show a negative bias in emotion perception across most emotional expressions (Bourke et al., 2010), but this was not consistently the case in the present study. Whereas patients with BPD tended to perceive mildly sad faces as more intensely sad, their misperceptions of neutral facial expressions were commensurate with healthy individuals, tending toward ascribing a positive valence (i.e., happiness) to these faces. Therefore, individuals with BPD did not reliably show the typical negative bias in emotion perception that would be expected based on research on depressed individuals. Furthermore, severity of depressive symptoms for patients with BPD at the time of testing was not related to difficulties in emotion recognition for any of the individual emotional intensities or neutral facial expressions. It is possible that current mood in BPD may only be associated with biases in facial emotion recognition when that mood is associated with heightened arousal (consistent with the theory outlined by Daros et al., 2013). Depressed mood is associated with reduced arousal and thus may not be likely to interfere with facial emotion recognition in patients with BPD.

Current psychiatric diagnostic comorbidity (MDD, PTSD, alcohol/substance use disorders) and psychotropic medication use could not account for difficulties in emotion recognition encountered by patients with BPD, consistent with previous work on this topic (Bland, Williams, Scharer, & Manning, 2004; Domes et al., 2008; Dyck et al., 2009; Robin et al., 2012; Unoka, Fogd, Fuzy, & Csukly, 2011). Because depression could potentially account for many of the emotion perception biases observed in prior studies, some research excluded currently depressed patients to avoid this confound altogether and revealed remarkable difficulties with emotion recognition in nondepressed patients with BPD (Merkl et al., 2010; Minzenberg, Poole, & Vinogradov, 2006). Although not statistically significant, patients with a history of alcohol/substance dependence had better recognition (collapsing across valence and intensity) than patients without a history of these disorders, with an effect size difference in the large range. This result could not be accounted for by differences in depression severity and should be further investigated to determine whether this result is reliable. Whereas medications did not appear to be related to emotion recognition accuracy in the current study, a cross-sectional study of depressed patients (presumably with no personality disorder) found that those taking antidepressant medications showed more accurate emotion recognition than unmedicated but similarly depressed individuals (Anderson et al., 2011). Additionally, an antidepressant treatment study that tracked depressed patients over several weeks found that early improvements in emotion recognition predicted subsequent resolution of clinical symptoms (Tranter et al., 2009). Whether this phenomenon may also be observed in patients with BPD is an important unanswered question requiring

prospective research designs, possibly incorporating medications, psychotherapy, or combined treatments.

With respect to treatment implications, the results of this study may inform specific psychotherapies for individuals with BPD. For example, the ability to accurately perceive another persons' mental state, often referred to as "mentalizing," is an important component of mentalization-based treatment for individuals with this disorder (Bateman & Fonagy, 2004). An important focus of this treatment is to enhance mentalization capacities, including the emotional states of others. The results of this study suggest that individuals with BPD may be more likely to misperceive ambiguous facial expressions of emotion and could misattribute positive or negative emotions to others in the absence of clear emotional cues. Importantly, these misattributions appear to occur independently of mood state, suggesting that these skewed facial emotion perceptions may be trait-like. Given the persistence of these difficulties, specific instruction on how to accurately identify neutral facial expressions may form an important component of any psychotherapy for this disorder. In addition, psychoeducation for BPD may incorporate information about these perceptual biases to increase awareness of their tendencies to misperceive emotions in others, perhaps encouraging them to be more mindful of their reactions to ambiguous emotional expressions in others' faces.

An important observation should also be made regarding the incorporation of emotional facial expressions as stimuli in neuroimaging studies of BPD. Passive viewing of faces displaying a variety of emotional expressions is among the most commonly used paradigms for evaluating emotion processing in this disorder (e.g., Donegan et al., 2003; Minzenberg, Fan, New, Tang, & Siever, 2007). Research using these paradigms has revealed a network of neural structures which may underlie emotion dysregulation in BPD (for a review, see Ruocco, Amirthavasagam, Choi-Kain, & McMains, 2013). This includes higher levels of activity in brain regions involved in the perceived subjective intensity of negative emotions (i.e., insular cortex) and less activity in structures which support the regulation of emotions (i.e., anterior cingulate, dorsolateral prefrontal cortex). The majority of this research is based on studies that presume that both patients with BPD and healthy individuals perceive no emotions in neutral faces, and contrast levels of neural activation associated with negatively valenced versus neutral facial expressions. The results of the present study suggest that patients with BPD may not consistently perceive an absence of emotion in neutral faces, thereby calling into question the validity of findings drawn from this research. Future neuroimaging studies should consider these biases in facial emotion perception among patients with BPD so as to improve the precision of findings resulting from this work.

Several limitations should be considered when interpreting the results of the present study. First, the PEAT solely evaluates the perception of happy, sad, and neutral facial expressions, which excludes emotions that may be especially relevant to BPD, such as anger and disgust (Daros et al., 2013). By evaluating happy and sad facial expressions at varying levels of intensity in a pseudorandom order of presentation, however, the task of recognizing these more subtle displays of emotion is more difficult, thereby reducing the ceiling effects commonly observed on traditional emotion recognition tasks. Second, the specificity of these findings to BPD versus other disorders of mood regulation (e.g., MDD, bipolar disorder) was not evaluated. Comparisons of currently depressed and nondepressed patients with BPD and correlations of depression severity with emotion recognition

accuracy, however, suggested that difficulties recognizing neutral faces and tendencies to perceive subtle sad expressions as more intense could not be attributed to depressed mood. Third, the potential effects of medication on emotion perception in the current study could only be examined in a nonrandomized and cross-sectional manner; therefore, whatever preliminary findings were obtained in this study should be interpreted with caution. Future randomized controlled trials are necessary to evaluate the possible effects of psychotropic medications on emotion perception in BPD. Fourth, it should be noted that although the sample was comparable with most prior studies on this topic in BPD, it may be considered relatively small and it was composed almost entirely of women. Fifth, mood state was evaluated using the BDI-II assessing depression severity over the previous two weeks, which does not provide a precise quantification of state affect at the time of assessments. Future research may consider using other measures of state affect (e.g., Positive and Negative Affect Schedule; Watson, Clark, & Tellegen, 1988) or mood induction procedures to evaluate the contributions of state mood to the current findings. Finally, the emotion recognition task used in the current study used a limited set of static images of faces in a controlled laboratory setting. It is possible that more pronounced biases in facial emotion perception might arise during naturalistic interpersonal interactions involving a range of emotional expressions.

In summary, accurate emotion recognition serves as a cognitive cornerstone for appropriate social functioning and is important for promoting empathy, trust, and prosocial behaviors (Marsh, Kozak, & Ambady, 2007). In turn, BPD patients' enduring misinterpretations of others' emotional states are likely to result in confusing reactions to subtle or ambiguous emotional cues in others' faces, which could lead to unexpected and seemingly inappropriate interpersonal behaviors. The results of the present study therefore contribute to the emerging finding that individuals with BPD may misperceive emotions in the faces of other people, and that these social-cognitive biases may operate independently of mood state, comorbid psychiatric disorders, and possibly treatment with psychotropic medications.

References

- Aigner, M., Sachs, G., Bruckmuller, E., Winklbaur, B., Zitterl, W., Kryspin-Exner, I., . . . Katschnig, H. (2007). Cognitive and emotion recognition deficits in obsessive-compulsive disorder. *Psychiatry Research, 149*, 121–128. doi:10.1016/j.psychres.2005.12.006
- Allen, M. J., & Yen, W. M. (1979). *Introduction to measurement theory*. Monterey, CA: Brooks/Cole.
- Anderson, I. M., Shippen, C., Juhasz, G., Chase, D., Thomas, E., Downey, D., . . . Deakin, J. F. (2011). State-dependent alteration in face emotion recognition in depression. *The British Journal of Psychiatry, 198*, 302–308. doi:10.1192/bjp.bp.110.078139
- Arntz, A., Appels, C., & Sieswerda, S. (2000). Hypervigilance in borderline disorder: A test with the emotional Stroop paradigm. *Journal of Personality Disorders, 14*, 366–373. doi:10.1521/pedi.2000.14.4.366
- Arntz, A., & Veen, G. (2001). Evaluations of others by borderline patients. *Journal of Nervous and Mental Disease, 189*, 513–521. doi:10.1097/00005053-200108000-00004
- Bateman, A. W., & Fonagy, P. (2004). Mentalization-based treatment of BPD. *Journal of Personality Disorders, 18*, 36–51. doi:10.1521/pedi.18.1.36.32772
- Beck, A. T., Steer, R. A., Ball, R., & Ranieri, W. (1996). Comparison of Beck Depression Inventories -IA and -II in psychiatric outpatients. *Journal of Personality Assessment, 67*, 588–597. doi:10.1207/s15327752jpa6703_13
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the beck depression inventory-II*. San Antonio, TX: Psychological Corporation.
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society Series B (Methodological), 57*, 289–300.
- Benton, A. L., Sivan, A. B., Hamsher, K. S., Varney, N. R., & Spreen, O. (1983). *Contribution to neuropsychological assessment*. New York, NY: Oxford University Press.
- Berenson, K. R., Gyurak, A., Ayduk, O., Downey, G., Garner, M. J., Mogg, K., . . . Pine, D. S. (2009). Rejection sensitivity and disruption of attention by social threat cues. *Journal of Research in Personality, 43*, 1064–1072. doi:10.1016/j.jrp.2009.07.007
- Bland, A. R., Williams, C. A., Scharer, K., & Manning, S. (2004). Emotion processing in borderline personality disorders. *Issues in Mental Health Nursing, 25*, 655–672. doi:10.1080/01612840490486692
- Bourke, C., Douglas, K., & Porter, R. (2010). Processing of facial emotion expression in major depression: A review. *Australian and New Zealand Journal of Psychiatry, 44*, 681–696. doi:10.3109/00048674.2010.496359
- Burklund, L. J., Eisenberger, N. I., & Lieberman, M. D. (2007). The face of rejection: Rejection sensitivity moderates dorsal anterior cingulate activity to disapproving facial expressions. *Social Neuroscience, 2*, 238–253. doi:10.1080/17470910701391711
- Chapman, H. A., & Anderson, A. K. (2012). Understanding disgust. *Annals of the New York Academy of Science, 1251*, 62–76. doi:10.1111/j.1749-6632.2011.06369.x
- Crawford, J. R. (1992). Current and premorbid intelligence measures in neuropsychological assessment. In J. R. Crawford, D. M. Parker, & W. W. McKinlay (Eds.), *A handbook of neuropsychological assessment* (pp. pp. 21–49). Hillsdale, NJ: Erlbaum.
- Daros, A. R., Zakzanis, K. K., & Ruocco, A. C. (2013). Facial emotion recognition in borderline personality disorder. *Psychological Medicine, 43*, 1953–1963. doi:10.1017/S0033291712002607
- Derntl, B., Seidel, E. M., Kryspin-Exner, I., Hasmann, A., & Dobmeier, M. (2009). Facial emotion recognition in patients with bipolar I and bipolar II disorder. *British Journal of Clinical Psychology, 48*, 363–375. doi:10.1348/014466509X404845
- Domes, G., Czieschnek, D., Weidler, F., Berger, C., Fast, K., & Herpertz, S. C. (2008). Recognition of facial affect in borderline personality disorder. *Journal of Personality Disorders, 22*, 135–147. doi:10.1521/pedi.2008.22.2.135
- Domes, G., Schulze, L., & Herpertz, S. C. (2009). Emotion recognition in borderline personality disorder—a review of the literature. *Journal of Personality Disorders, 23*, 6–19. doi:10.1521/pedi.2009.23.1.6
- Domes, G., Winter, B., Schnell, K., Vohs, K., Fast, K., & Herpertz, S. C. (2006). The influence of emotions on inhibitory functioning in borderline personality disorder. *Psychological Medicine, 36*, 1163–1172. doi:10.1017/S0033291706007756
- Donegan, N. H., Sanislow, C. A., Blumberg, H. P., Fulbright, R. K., Lacadie, C., Skudlarski, P., . . . Wexler, B. E. (2003). Amygdala hyperactivity in borderline personality disorder: Implications for emotional dysregulation. *Biological Psychiatry, 54*, 1284–1293. doi:10.1016/S0006-3223(03)00636-X
- Dyck, M., Habel, U., Slodczyk, J., Schlummer, J., Backes, V., Schneider, F., & Reske, M. (2009). Negative bias in fast emotion discrimination in borderline personality disorder. *Psychological Medicine, 39*, 865–874. doi:10.1017/S0033291708004273
- Erwin, R. J., Gur, R. C., Gur, R. E., Skolnick, B., Mawhinney-Hee, M., & Smailis, J. (1992). Facial emotion discrimination: I. Task construction and behavioral findings in normal subjects. *Psychiatry Research, 42*, 231–240. doi:10.1016/0165-1781(92)90115-J
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. (2002). *Structured clinical interview for DSM-IV Axis I disorders-patient ed. (SCID-I/P,*

- 11/2002 revision). New York, NY: Biometrics Research Department, New York Psychiatric Institute.
- Gratz, K. L., Dixon-Gordon, K. L., Breetz, A., & Tull, M. (2013). A laboratory-based examination of responses to social rejection in borderline personality disorder: The mediating role of emotion dysregulation. *Journal of Personality Disorders, 27*, 157–171. doi:10.1521/pedi.2013.27.2.157
- Gunderson, J. G., & Lyons-Ruth, K. (2008). BPD's interpersonal hypersensitivity phenotype: A gene-environment-developmental model. *Journal of Personality Disorders, 22*, 22–41. doi:10.1521/pedi.2008.22.1.22
- Gur, R. C., Erwin, R. J., Gur, R. E., Zwil, A. S., Heimberg, C., & Kraemer, H. C. (1992). Facial emotion discrimination: II. Behavioral findings in depression. *Psychiatry Research, 42*, 241–251. doi:10.1016/0165-1781(92)90116-K
- Gur, R. C., Sara, R., Hagendoorn, M., Marom, O., Hughett, P., Macy, L., . . . Gur, R. E. (2002). A method for obtaining 3-dimensional facial expressions and its standardization for use in neurocognitive studies. *Journal of Neuroscience Methods, 115*, 137–143. doi:10.1016/S0165-0270(02)00006-7
- Jovev, M., Chanen, A., Green, M., Cotton, S., Proffitt, T., Coltheart, M., & Jackson, H. (2011). Emotional sensitivity in youth with borderline personality pathology. *Psychiatry Research, 187*(1–2), 234–240. doi:10.1016/j.psychres.2010.12.019
- Klein, D. N., Ouimette, P. C., Kelly, H. S., Ferro, T., & Riso, L. P. (1994). Test-retest reliability of team consensus best-estimate diagnoses of Axis I and II disorders in a family study. *The American Journal of Psychiatry, 151*, 1043–1047.
- Lenzenweger, M. F., & Pastore, R. E. (2007). On determining sensitivity to pain in borderline personality disorder. *Archives of General Psychiatry, 64*, 747–748. doi:10.1001/archpsyc.64.6.747
- Linehan, M. M. (1993). *Cognitive-behavioral treatment for borderline personality disorder*. New York, NY: Guilford Press.
- Linehan, M. M. (1995). *Understanding borderline personality disorder: The dialectical approach*. New York, NY: Guilford Press. doi:10.1037/e545822004-001
- Lynch, T. R., Rosenthal, M. Z., Kosson, D. S., Cheavens, J. S., Lejuez, C. W., & Blair, R. J. (2006). Heightened sensitivity to facial expressions of emotion in borderline personality disorder. *Emotion, 6*, 647–655. doi:10.1037/1528-3542.6.4.647
- Mandal, M. K., & Palchoudhury, S. (1985). Responses to facial expression of emotion in depression. *Psychological Reports, 56*, 653–654. doi:10.2466/pr0.1985.56.2.653
- Marsh, A. A., Kozak, M. N., & Ambady, N. (2007). Accurate identification of fear facial expressions predicts prosocial behavior. *Emotion, 7*, 239–251. doi:10.1037/1528-3542.7.2.239
- Merkl, A., Ammelburg, N., Aust, S., Roepke, S., Reinecker, H., Trahms, L., . . . Sander, T. (2010). Processing of visual stimuli in borderline personality disorder: A combined behavioural and magnetoencephalographic study. *International Journal of Psychophysiology, 78*, 257–264. doi:10.1016/j.ijpsycho.2010.08.007
- Mikhailova, E. S., Vladimirova, T. V., Iznak, A. F., Tsulsul'kovskaya, E. J., & Sushko, N. V. (1996). Abnormal recognition of facial expression of emotions in depressed patients with major depression disorder and schizotypal personality disorder. *Biological Psychiatry, 40*, 697–705. doi:10.1016/0006-3223(96)00032-7
- Minzenberg, M. J., Fan, J., New, A. S., Tang, C. Y., & Siever, L. J. (2007). Fronto-limbic dysfunction in response to facial emotion in borderline personality disorder: An event-related fMRI study. *Psychiatry Research, 155*, 231–243. doi:10.1016/j.psychres.2007.03.006
- Minzenberg, M. J., Poole, J. H., & Vinogradov, S. (2006). Social-emotion recognition in borderline personality disorder. *Comprehensive Psychiatry, 47*, 468–474. doi:10.1016/j.comppsy.2006.03.005
- Phofl, B., Blum, N., & Zimmerman, M. (1997). *Structured interview for DSM-IV personality*. Washington, DC: American Psychiatric Press.
- Robin, M., Pham-Scottez, A., Curt, F., Dugre-Le Bigre, C., Speranza, M., Sapinho, D., . . . Kedia, G. (2012). Decreased sensitivity to facial emotions in adolescents with borderline personality disorder. *Psychiatry Research, 200*, 417–421. doi:10.1016/j.psychres.2012.03.032
- Ruocco, A. C., Amirthavasagam, S., Choi-Kain, L. W., & McMain, S. F. (2013). Neural correlates of negative emotionality in borderline personality disorder: An activation-likelihood-estimation meta-analysis. *Biological Psychiatry, 73*, 153–160. doi:10.1016/j.biopsych.2012.07.014
- Sachs, G., Steger-Wuchse, D., Kryspin-Exner, I., Gur, R. C., & Katschnig, H. (2004). Facial recognition deficits and cognition in schizophrenia. *Schizophrenia Research, 68*, 27–35. doi:10.1016/S0920-9964(03)00131-2
- Schenkel, L. S., Pavaluri, M. N., Herbener, E. S., Harral, E. M., & Sweeney, J. A. (2007). Facial emotion processing in acutely ill and euthymic patients with pediatric bipolar disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*, 1070–1079. doi:10.1097/chi.0b013e3180600fd6
- Schulze, L., Domes, G., Koppen, D., & Herpertz, S. C. (2013). Enhanced detection of emotional facial expressions in borderline personality disorder. *Psychopathology, 46*, 217–224. doi:10.1159/000341730
- Selby, E. A., & Joiner, T. E., Jr. (2009). Cascades of emotion: The emergence of borderline personality disorder from emotional and behavioral dysregulation. *Review of General Psychology, 13*, 219–229. doi:10.1037/a0015687
- Slick, D., Hopp, G., Strauss, E., & Thompson, G. (1997). *The Victoria symptom validity test*. Odessa, FL: Psychological Assessment Resources.
- Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). New York, NY: Oxford University Press.
- Surguladze, S. A., Young, A. W., Senior, C., Brebion, G., Travis, M. J., & Phillips, M. L. (2004). Recognition accuracy and response bias to happy and sad facial expressions in patients with major depression. *Neuropsychology, 18*, 212–218. doi:10.1037/0894-4105.18.2.212
- Torgersen, S., Kringlen, E., & Cramer, V. (2001). The prevalence of personality disorders in a community sample. *Archives of General Psychiatry, 58*, 590–596. doi:10.1001/archpsyc.58.6.590
- Tranter, R., Bell, D., Gutting, P., Harmer, C., Healy, D., & Anderson, I. M. (2009). The effect of serotonergic and noradrenergic antidepressants on face emotion processing in depressed patients. *Journal of Affective Disorders, 118*, 87–93.
- Unoka, Z., Fogd, D., Fuzy, M., & Csukly, G. (2011). Misreading the facial signs: Specific impairments and error patterns in recognition of facial emotions with negative valence in borderline personality disorder. *Psychiatry Research, 189*, 419–425. doi:10.1016/j.psychres.2011.02.010
- von Ceumern-Lindenstjerna, I. A., Brunner, R., Parzer, P., Mundt, C., Fiedler, P., & Resch, F. (2010). Attentional bias in later stages of emotional information processing in female adolescents with borderline personality disorder. *Psychopathology, 43*, 25–32. doi:10.1159/000255960
- Wagner, A. W., & Linehan, M. M. (1999). Facial expression recognition ability among women with borderline personality disorder: Implications for emotion regulation? *Journal of Personality Disorders, 13*, 329–344. doi:10.1521/pedi.1999.13.4.329
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070. doi:10.1037/0022-3514.54.6.1063
- Wechsler, D. (1997). *Wechsler adult intelligence scale-third ed.* San Antonio, TX: The Psychological Corporation.
- Wechsler, D. (2002). *WTAR: Wechsler test of adult reading. Manual.* San Antonio, TX: The Psychological Corporation.
- Zanarini, M. C., & Frankenburg, F. R. (2007). The essential nature of borderline psychopathology. *Journal of Personality Disorders, 21*, 518–535. doi:10.1521/pedi.2007.21.5.518