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BIASED ATTENTION TO FACIAL EXPRESSIONS OF AMBIGUOUS EMOTIONS IN BORDERLINE PERSONALITY DISORDER: AN EYE-TRACKING STUDY

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Preliminary evidence suggests that biased attention could be crucial in fostering the emotion recognition abnormalities in borderline personality disorder (BPD). We compared BPD patients to Cluster-C personality disorder (CC) patients and non-patients (NP) regarding emotion recognition in ambiguous faces and their visual attention allocation to the eyes. The role of comorbid posttraumatic stress disorder (PTSD) in BPD regarding emotion recognition and visual attention was explored. BPD patients fixated the eyes of angry/happy, sad/happy, and fearful/sad blends longer than non-patients. This visual attention pattern was mainly driven by BPD patients with PTSD. This subgroup also demonstrated longer fixations than CC patients and a trend towards longer fixations than BPD patients without PTSD for the angry/happy and fearful/sad blends. Emotion recognition was not altered in BPD. Biased visual attention towards the eyes of ambiguous facial expressions in BPD might be due to trauma-related attentional bias rather than to impairments in facial emotion recognition.

Keywords: borderline personality disorder, emotion recognition, face perception, eye tracking, visual attention bias, posttraumatic stress disorder

Unstable interpersonal relationships are among the core features of borderline personality disorder (BPD) pathology (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004; Lis & Bohus, 2013). Abnormalities in interpersonal

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perception (e.g., facial emotion recognition) are believed to contribute to the severe impairment of interpersonal functioning in BPD patients (Daros, Zakzanis, & Ruocco, 2013; Domes, Schulze, & Herpertz, 2009).

Studies on facial emotion recognition in BPD are inconsistent with respect to their methodology and results. Several revealed superior performance among BPD patients in emotion recognition: BPD patients generally identified facial affect at lower intensity (Lynch et al., 2006), were more sensitive to perceiving fearful faces (Wagner & Linehan, 1999), and were more likely to detect facial expressions irrespective of valence in a rapid serial presentation paradigm (Schulze, Domes, Köppen, & Herpertz, 2013). Other studies, by contrast, revealed no enhanced detection of threatening faces (Hagenhoff et al., 2013; Hepp et al., 2016). Then again, others reported impaired accuracy in recognizing facial expressions of emotions (Domes et al., 2008; Dyck et al., 2009; Unoka, Fogd, Füzy, & Csukly, 2011) and that BPD patients underestimate the intensity of positive compared to negative facial expressions (Thome et al., 2015). A meta-analysis concluded that BPD patients have difficulty in general recognizing emotional expressions of anger and disgust presented in full emotional intensity, and tend to misinterpret neutral expressions as emotional (Daros et al., 2013). However, the majority of studies not included in the meta-analysis failed to reveal impaired accuracy of emotion recognition (Bertsch et al., 2017; Domes et al., 2008; Dyck et al., 2009; Jovev et al., 2011; Matzke, Herpertz, Berger, Fleischer, & Domes, 2014; Minzenberg, Poole, & Vinogradov, 2006). Finally, another group of studies reported biased face perception in BPD patients, namely that they tend to over-attribute emotions to neutral faces (Daros, Uliaszek, & Ruocco, 2014), arrive at biased appraisals of ambiguous facial expressions towards anger (Domes et al., 2008), and exhibit a markedly negative bias in facial emotion recognition (Fenske et al., 2015; Veague & Hooley, 2014). The inconsistency in these results so far may be in part explained by the studies' methodological differences (e.g., time pressure during task performance, the emotional intensity of stimuli) (Domes et al., 2009) and by high rates of comorbidity of axis I and II disorders in BPD patients (Lenzenweger, Lane, Loranger, & Kessler, 2007; Zanarini et al., 1998). Up to 30% of BPD patients in community samples (Lenzenweger et al., 2007; Pagura et al., 2010) and up to 60% of BPD inpatients (Zanarini et al., 1998; Zanarini, Frankenburg, Hennen, Reich, & Silk, 2004) fulfill criteria of a comorbid posttraumatic stress disorder (PTSD). Besides a significant overlap of core features (American Psychiatric Association, 2013), both BPD and PTSD have been highly associated with trauma (Harned & Linehan, 2008), in particular with childhood sexual abuse (Cutajar et al., 2010).

In short, although based on heterogeneous studies, facial emotion recognition abnormalities in BPD might be best described as being biased rather than generally faulty. Thus, the question arises as to which cognitive process is involved in biased interpersonal perception. One promising candidate as a cognitive process underlying the biased interpersonal perception in BPD is deviant attentional guidance and preference. BPD patients might exhibit biased attention towards negative stimuli in general or towards specific cues of threat (e.g., angry or fearful facial expressions). Results of a recent

meta-analysis (Kaiser, Jacob, Domes, & Arntz, 2017) of studies employing reaction time–based measures of visual attention suggest that BPD patients exhibit an attentional bias towards negative verbal stimuli (Arntz, Appels, & Sieswerda, 2000; Sieswerda, Arntz, Mertens, & Vertommen, 2007; Wingenfeld et al., 2009), but no consistent tendency for a threat bias in the facial dot-probe task (Jovev et al., 2012; von Ceumern-Lindenstjerna et al., 2010a, 2010b). Although both paradigms have been widely used to investigate group differences in attention, they only provide coarse estimates of attentional preferences. For example, the facial dot-probe task is unsuitable for detecting attentional preferences for specific parts of the face (e.g., the eyes) in comparison to the rest of the face.

The face's eye region conveys crucial information about someone's emotional state (Fertuck et al., 2009). People reveal early attentional orientation to the area surrounding the eyes, especially when an emotional expression is depicted (Alpers & Gerdes, 2007; Eisenbarth & Alpers, 2011; Yang, Zald, & Blake, 2007). When considering threat-related facial expressions, the area of the eyes provides the most salient cues (Eisenbarth & Alpers, 2011) and may thus be regarded as the most informative facial feature for recognizing facial threat cues (Adolphs, 2008). Eye-tracking can be used to measure overt visual attention by recording eye movements and by calculating fixation numbers and durations for specific areas of interest (AOI) on complex visual stimuli. To our knowledge, only two eye-tracking studies investigated visual attention to facial features in BPD (Bertsch et al., 2013, 2017). In a functional neuroimaging study, BPD patients exhibited exaggerated fixation toward the eyes of angry and fearful facial expressions, which was associated with increased reactivity of the amygdala (Bertsch et al., 2013). Enhanced amygdala reactivity and attention to facial cues of social threat are consistent with the amygdala's role in the brain circuitry. Being involved in emotion processing, amygdala activity reflects the motivational significance of a stimulus involved in regulating vigilance to environmental cues of potential threat (Davis & Whalen, 2001; Mogg, Garner, & Bradley, 2007). There is evidence of amplified amygdala responses to emotional (Hazlett et al., 2012) and neutral facial expressions in BPD patients (Donegan et al., 2003; Minzenberg et al., 2006). Excessive neural responding in the amygdala and associated cortical regions to facial emotional expressions (Schulze et al., 2011; Schulze, Schmahl, & Niedtfeld, 2016) might be interpreted as the neural correlate of hypervigilance to social threat that distorts social perception towards potential threat and thereby promotes the experience of social threat, rejection, and feelings of loneliness in social interactions (Domes et al., 2009). The results of a recent eye-tracking study by Bertsch and colleagues (2017) revealed accelerated saccades towards the region of the eyes of briefly displayed neutral facial expressions and decelerated saccades away from the eyes of fearful facial expressions. Further, BPD patients with high levels of trait aggressiveness exhibited initial visual attention towards angry and fearful eyes and a subsequent visual attentional avoidance in the further exploration of angry eyes (Bertsch et al., 2017). Moreover, there is accumulating evidence for a threat-related bias for trauma-associated words and threatening facial expressions in PTSD patients (e.g., Bryant & Harvey, 1997; Dalgleish et al.,

2003; Fani et al., 2012; McNally, Kaspi, Riemann, & Zeitlin, 1990; Pine et al., 2005; Schönenberg & Abdelrahman, 2013; Williams, Mathews, & MacLeod, 1996). In this context, PTSD is one of the factors potentially involved in the development or maintenance of observed biased interpersonal perception. In addition, experimental findings indicate that attentional bias in BPD patients is associated in particular with comorbid PTSD (e.g., Wingenfeld et al., 2009; Witthöft, Borgmann, White, & Dyer, 2015).

Collectively, studies on emotion recognition in BPD suggest that the impaired accuracy in recognizing emotions and the tendency to appraise ambiguous or neutral faces as angrier or more negative in general might reflect a threat-related bias. Initial evidence suggests that biased attention could be one of the factors fostering the aforementioned emotion recognition abnormalities in BPD, and that comorbid PTSD might be involved. The aim of the present study was to investigate the proposed bias in face perception and attention allocation to different facial regions in a large sample of BPD patients recruited at different centers. We chose a forced-choice emotion recognition task with ambiguous blends of facial expressions. Eye movements were recorded using remote eye-trackers to assess the duration of fixations on facial AOI. We hypothesized that BPD patients display a bias towards perceiving threatening faces. Correspondingly, we assumed a visual attentional bias in the form of longer fixations towards the eye region of threatening facial expressions in BPD patients. Finally, we explored the association between the assumed threat bias and comorbid PTSD.

METHOD

PARTICIPANTS

Three female groups (n_{total} = 136) were included in this study: 62 BPD patients, a clinical control group with 30 patients with Cluster-C personality disorder (CC), and 44 non-patients (NP), all matched for age (18–65 years) at the group level. Participants were enrolled in a multicenter study project at centers in Maastricht and Heerlen in The Netherlands and Lübeck, Hamburg, and Freiburg in Germany investigating emotional dysregulation and threat bias in BPD. BPD patients had a primary diagnosis of BPD and scored above 20 points on the BPD Severity Index (BPDSI; Arntz et al., 2003; Giesen-Bloo, Wachters, Schouten, & Arntz, 2010). CC fulfilled criteria for at least one of the Cluster-C personality disorders (PD), but did not meet full or sub-threshold Cluster-B PD and more than two criteria for BPD. NP had no lifetime diagnosis of mental illness. Exclusion criteria for all participants comprised: lifetime psychotic disorder, attention deficit hyperactivity disorder (ADHD), bipolar disorder type 1, dissociative identity disorder, current substance dependence, a full or sub-threshold narcissistic or antisocial PD, serious physical illness, inability to undergo eye-tracking, IQ < 80, and insufficient language proficiency to understand the study instructions. The ethics committees of the Universities of Maastricht, Lübeck, and Freiburg approved the study protocol. The CC were recruited at the clinical sites at the treatment centers; NPs were recruited by an advertisement placed in the

treatment centers and in the community. All participants gave written informed consent.

DIAGNOSTIC INSTRUMENTS

We used the Structural Clinical Interview for DSM-IV I (SKID-I; First, Gibbon, Spitzer, & Benjamin, 1997a; Groenestijn, Akkerhuis, Kupka, Schneider, & Nolen, 1999; Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997), and SCID-II (First, Gibbon, Spitzer, & Benjamin, 1997b; Fydrich, Renneberg, Schmitz, & Wittchen, 1997; Weertman, Arntz, Dreessen, Velzen, & Vertommen, 2003) to assess *DSM-IV* diagnoses. ADHD was screened with the SCID for childhood diagnoses (KID-SCID; Smith, Huber, & Hall, 2005), if the WHO Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005) was positive. Current severity of BPD symptoms was measured with the BPD Checklist (Giesen-Bloo, 2006) and in the BPD group also with the BPD Severity Index (BPDSI; Arntz et al., 2003; Giesen-Bloo et al., 2010). In the present study, the internal consistency of the BPD Checklist was very high (Cronbach's $\alpha = .922$); the internal consistency of the BPDSI within the BPD group was much lower (Cronbach's $\alpha = .551$). General psychopathology was measured with the Brief Symptom Inventory (BSI; Derogatis, 1993). In the current study, the internal consistency of the BSI subscales was very high (Cronbach's α: .957). The Interview for Traumatic Events in Childhood (ITEC; Lobbestael, Arntz, Harkema-Schouten, & Bernstein, 2009) was applied to assess childhood trauma. In our sample, the internal consistency of the five subscales was high (Cronbach's $\alpha = .872$). We employed the Wechsler Abbreviated Scale of Intelligence (WASI; The Psychological Corporation, 1999) to assess IQ. In all centers, raters were Ph.D. students in the field of clinical psychology.

EXPERIMENTAL TASK

Facial stimuli of two male and two female actors depicting basic emotions (anger, fear, sadness, happiness) were taken from the NIMStim Face Database (Tottenham et al., 2009). Pictures were transformed to grayscale images. Hair and clothes were removed using Photoshop. The remaining faces were aligned to match the eye region and put on a light gray background. Morphs of mixed emotions were generated using Winmorph 2.0, resulting in a series of 101 morphed faces in 1% steps (http://www.debugmode.com/winmorph/). Five blends were chosen from these series—70/30, 60/40, 50/50, 40/60, 30/70%—of two different emotions. Using all possible pairings of the four emotions resulted in six different emotion blends: fear/anger, fear/happiness, fear/sadness, anger/happiness, anger/sadness, and happiness/sadness. In all, six blocks were presented, each with 20 trials randomized within each block (four repetitions per blend). Each block began with the instruction to decide between two different emotions in the following block of trials (Calder, Young, Perrett, Etcoff, & Rowland, 1996). The two labels were presented as a reminder in each trial (Figure 1). Participants were asked to press a button on the side of the label describing the presented face most

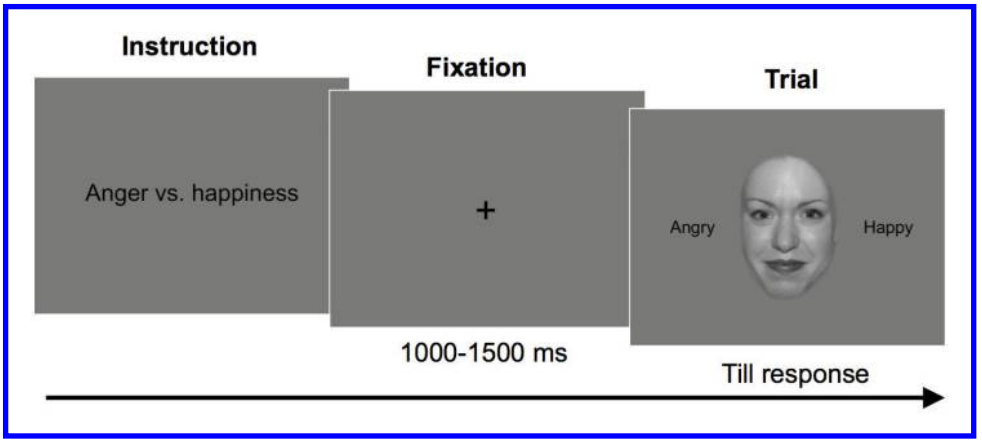

FIGURE 1. Trial structure of the experiment. Participants viewed an instruction before each block. A single trial started with a fixation cross presented for 1000–1500 ms. Then, a facial expression consisting of two emotions (e.g., anger/happiness) was displayed in five different intensity blends of the two emotions (70/30, 60/40, 50/50 40/60, 30/70 percent). Every trial was presented with two labels (two emotions) presented left and right of the faces until participants responded with a button press.

accurately and as quickly as possible, but only when they were sure. Button presses were recorded. This resulted in the experiment's total duration of approximately 10 minutes. Presentation 14.9 (Neurobehavioral Systems, Albany, California) was used for stimulus presentation and response registration.

EYE TRACKING

Participants were seated in a chair in front of the eye-tracking system in an indirectly and dimly illuminated room. Calibration (nine-point screen) was continued until eye-tracking revealed sufficient accuracy. Eye-tracking data were acquired with different infrared eye-tracking systems at the five study sites. In Maastricht, Heerlen, and Lübeck, data were recorded with an Eyelink infrared eye-tracker (Eyelink II, SR Research, Ottawa, Canada). In Freiburg and Hamburg, data were recorded with a RED250 remote infrared eye-tracker (Sensomotoric Instruments. Teltow, Germany). Since acquisition parameters at the various study sites differed slightly in terms of acquisition rate, viewing distance, screen size, and resolution, raw data were preprocessed using site-specific parameters and pooled afterwards for statistical analysis. Data processing was done with Matlab 2014a (Mathworks). Fixation durations for different facial parts were analyzed with the Matlab-based toolbox ILAB 3.6.8 (Gitelman, 2002). For each site, the specific parameters were used for preprocessing and fixation analysis. Preprocessing included blink detection and artifact rejection. Blinks were detected if pupil diameter was zero, and artifact rejections were detected by out of range values or high frequency noise as detected by the standard algorithms implemented in ILAB.

To analyze the fixation data, the data stream was segmented, with segments starting with the presentation of the facial stimulus and terminating with the participant's button press. Fixations were detected using the dispersion-based algorithm implemented in ILAB (Widdel, 1984). Fixations were coded if gaze data remained for 100 ms within a visual angle of 1 degree. Trials showing more than 30% invalid/missing data due to artifacts (e.g., blinks, noise) were disregarded from analysis. In all, 2.1% of the trials had to be excluded. AOI were created for the eyes. AOI were specifically sized for the different eye-tracking systems to create comparable AOI in terms of size of the AOI relative to the entire screen size. The cumulated fixation duration was calculated for each trial. To control for differences in trial length and have a comparable marker for visual attention to different parts of the faces, we calculated the relative duration of fixations as percentages for the AOI eyes to the total duration of fixations in a specific trial. Trial data were averaged and subject to further statistical analysis for each experimental condition. Subjects with invalid/missing data of more than 25% regarding the relative duration of fixations for the face were excluded from further analyses. In all, two participants were excluded from the behavioral and visual analyses due to missing eye-tracking data (both BPD), and 11 participants were excluded due to invalid eye-tracking data (n_{total} = 13 [8.72%], n_{BPD} = 8 [5.37%], n_{CC} = 2 [1.34%], n_{NP} = 3 [2.01%]).

STATISTICAL ANALYSIS

The study groups' demographics and clinical characteristics were analyzed via univariate analyses and Student's *t* test. We compared the anger/happiness blends to the emotional pairings composed of negative and positive emotions (i.e., fear/happiness, sadness/happiness) in an omnibus test to explore the specificity of the presumed threat-related bias regarding the emotion recognition performance. The probability of responding with "happy" and the mean response latencies were analyzed by using 3 × 3 × 5 mixed-design analyses of variance (ANOVAs), which included the between-subject factor group (BPD patients, CC, NP) and the within-subject factors emotion pair (anger/happiness, fear/happiness, sadness/happiness), and emotion intensity (70/30%, 60/40%, 50/50%, 40/60%, 30/70%). We then analyzed all six emotion pairs separately by examining the emotion recognition and response latencies. We used a 3 × 5 ANOVA with the between-subject factor group and the within-subject factor emotion intensity.

Also, using the eye-tracking data, we analyzed the mean duration of fixations on the eye relative to the mean of the total duration of fixations by using 3 × 6 × 5 mixed-design ANOVAs with the between-factor group (BPD patients, CC, NP), and the within-subject factors emotion pair (anger/happiness, fear/happiness, sadness/happiness, anger/fear, anger/sadness, fear/sadness) and emotion intensity (70/30%, 60/40%, 50/50%, 40/60%, 30/70%). It is standard practice to examine the duration of fixation on the eye region as an indicator for (biased) visual attention. As for the emotion recognition and response latencies, we also analyzed the duration of fixations on the eye region for all six emotion pairs separately.

As an exploratory approach, we analyzed BPD subgroups—BPD patients with PTSD and without PTSD—with regard to the emotion recognition and the eye-tracking data by using 4 × 3 × 5/4 × 6 × 5 mixed-design ANOVAs with the between-factor subgroups (BPD with and without PTSD, CC, NP) and the aforementioned within-subject factors. Additionally, we provide the descriptive data (*M*, *SD*) for all presented data, for the mean of the duration of fixations for mouth and face relative to the mean of the total duration of fixations, and the mean for the number of fixations for eye, mouth, and face in the supplemental tables for potential meta-analyses on visual attention in BPD.

In case of heterogeneous variance, we applied the Greenhouse-Geisser correction. Statistical significance was set at $p < .05$. In addition, we reported trend-level significant group effects with $p < .1$. Effect sizes are provided as explained variances (partial eta squared [η^2]). In the case of significant group effects, we used simple contrasts (contrast 1: BPD patients vs. CC; contrast 2: BPD patients vs. NP). Calculations were conducted using SPSS for Windows (Version 22).

RESULTS

SAMPLE CHARACTERISTICS

Univariate ANOVA indicated no group differences in age ($p > .40$), but BPD patients revealed a lower IQ than the NP ($p = .011$) and less education ($p < .01$) (Table 1). We tested the influence of IQ on our results using ANCOVAs but refrained from doing so with education, as difficulty completing one's education is an inherent aspect of BPD. BPD patients reported more general psychiatric symptoms in the BSI ($p < .001$) and more BPD symptoms ($p < .001$). BPD patients reported more severe traumatic experiences than CC and NP ($p < .05$), except for the physical neglect scale, in which the BPD and CC patients did not differ. Aside from sexual abuse, the CC reported more severe traumatic experiences in the ITEC than the NP ($p < .05$). BPD patients with and without PTSD had comparable rates of comorbid PD (Table 2), which were higher than in CC, $F(2, 89) = 9.656$, $p < .001$. BPD patients and CC exhibited high rates of comorbid current disorders, especially regarding anxiety and mood disorders. BPD patients with PTSD had higher comorbidity rates than CC ($p = .011$), and took more medications than CC ($p = .026$).

COMPARISON BETWEEN BPD, CC, AND NP CONTROLS

Emotion Recognition of Mixed Emotions. In order to examine the presumed threat-related bias in emotion recognition, we compared the angry/happy blends to the emotion pairs composed of negative and positive emotions (fearful/happy, sad/happy) by using a 3 × 3 × 5 ANOVA. In contrast to our hypothesis, groups did not differ in their likelihood to respond with "happy" across the different emotion pairs and intensity levels, $F(2, 133) = 1.747$, $p = .178$, $\eta^2 = .026$. However, there was a significant group-by-intensity interaction, $F(6.621, 440.269) = 2.536$, $p = .016$, $\eta^2 = .037$, with the BPD patients

TABLE 1. Demographics and Clinical Characteristics of the Study Groups

	BPD total (n = 62)	BPD (n = 20)	BPD– (n = 42)	CC (n = 30)	NP (n = 44)	Statistics[a]			Statistics[b]		
	$M \pm SD$	$M \pm SD$	$M \pm SD$	$M \pm SD$	$M \pm SD$	F	df[c]	p	F	df[c]	p
Age	31.58 ± 9.95	32.65 ± 11.97	31.07 ± 8.95	33.13 ± 11.36	29.34 ± 10.13	1.28	2, 133	.281	0.95	3, 132	.417
WASI	96.55 ± 8.451	94.94 ± 6.342	97.29 ± 9.24	97.80 ± 9.64	102.12 ± 10.541,2	4.55	2, 130	.012	3.30	3, 129	.023
Years of education	11.89 ± 2.611,2	11.60 ± 2.503,4	12.02 ± 2.865	13.67 ± 2.281,3	13.86 ± 2.612,4,5	9.02	2, 132	< .001	6.10	3, 132	.001
BSI	1.74 ± 0.581,2	1.90 ± 0.623,4	1.66 ± 0.555,6	0.93 ± 0.481,3,5,7	0.14 ± 0.122,4,6,7	157.67	2, 133	< .001	108.45	3, 132	< .001
BPD-Checklist	117.15 ± 22.711,2	116.16 ± 24.593,4	117.61 ± 22.105,6	70.60 ± 16.741,3,5,7	51.50 ± 5.452,4,6,7	193.36	2, 133	< .001	128.04	3, 130	< .001
ITEC											
Sexual abuse	9.47 ± 9.601,2	13.20 ± 11.093,4	7.70 ± 8.385	3.31 ± 7.531,3	0.058 ± 0.302,4,5	15.14	2, 114	< .001	12.90	3, 113	< .001
Physical abuse	16.94 ± 11.4011,2	23.32 ± 12.043,4,5	13.90 ± 9.833,6	8.79 ± 12.251,4,7	1.58 ± 3.712,5,6,7	21.71	2, 114	< .001	19.97	3, 113	< .001
Emotional abuse	19.61 ± 8.471,2	23.42 ± 9.573,4,5	17.80 ± 7.343,6	14.06 ± 9.101,4,7	2.54 ± 3.602,5,6,7	44.98	2, 114	< .001	34.16	3, 113	< .001
Emotional neglect	10.70 ± 6.811,2	12.75 ± 6.783,4	9.72 ± 6.685	6.82 ± 6.951,3,6	0.72 ± 1.922,4,5,6	25.45	2, 114	< .001	18.47	3, 113	< .001
Physical neglect	8.93 ± 8.261	14.50 ± 10.343,4,5	6.28 ± 10.253,6	6.70 ± 10.252,4	0.81 ± 2.871,2,5,6	9.49	2, 114	< .001	12.63	3, 113	< .001

Note. BPD = patients with borderline personality disorder. BPD+ = BPD with posttraumatic stress disorder (PTSD). BPD– = BPD without PTSD. CC = clinical controls with cluster-C personality disorder. NP = non-patient controls. WASI = Wechsler Abbreviated Scale of Intelligence. BSI = Brief Symptom Inventory. ITEC = Interview for Traumatic Events in Childhood. [a]Three-group ANOVA: BPD vs. CC vs. NP. [b]Four-group ANOVA: BPD+ vs. BPD– PTSD vs. CC vs. NP. [c]Degrees of freedom vary because of missing data. Post-hoc single comparisons were carried out using t tests with Bonferroni correction for multiple testing at $p < .05$. Numeric superscript indices indicate significant differences.

TABLE 2. Axis I and II Diagnoses and Medication of BPD Patients and CC

	BPD total (n = 62) n (%)	BPD+ (n = 20) n (%)	BPD– (n = 42) n (%)	CC (n = 30) n (%)
SCID-I				
Substance[a]	7 (11.3)	2 (10.0)	5 (11.9)	1 (3.3)
Mood[a]	49 (79.0)	19 (95.0)	30 (71.4)	20 (66.7)
Anxiety[a]	38 (61.3)	16 (80)	22 (52.4)	12 (40.0)
PTSD[a,b]	20 (32.3)	20 (100)	0 (0)	2 (7)
Somatoform[a]	5 (8.1)	1 (5.0)	4 (9.5)	6 (20.0)
Eating[a]	22 (35.5)	7 (35.0)	15 (35.7)	8 (26.7)
M (SD) no. of current disorders[1,2]	2.03 (0.92)	2.45 (0.76)	1.83 (0.93)	1.63 (1.07)
SCID-II				
Paranoid	16 (25.8)	7 (35.0)	9 (21.4)	0 (0)
Schizoid	2 (3.2)	0 (0)	2 (4.8)	0 (0)
Borderline	62 (100)	20 (100)	42 (100)	0 (0)
Avoidant	27 (43.5)	11 (55.0)	16 (38.1)	21 (70.0)
Dependent	6 (9.7)	1 (5.0)	5 (11.9)	3 (10.0)
Obsessive-compulsive	13 (21)	4 (20.0)	9 (21.4)	11 (36.7)
M (SD) no. of PDs[3,4]	2.03 (1.06)	2.15 (0.99)	1.98 (1.09)	1.17 (0.38)
Medication				
Number of medications n = 1	27 (43.5)	6 (30.0)	21 (50.0)	9 (30.0)
Number of medications $n \geq 2$	8 (13.0)	5 (25.0)	3 (7.1)	1 (3.3)
M (SD) no. of medications[5,6]	0.71 (0.73)	.80 (0.83)	0.67 (0.69)	0.37 (0.56)

Note. BPD = Borderline personality disorder. BPD+ = BPD with posttraumatic stress disorder (PTSD). BPD– = BPD without PTSD. CC = Clinical controls (patients with cluster-C personality disorder). All post-hoc tests using Bonferroni t tests. [a]Presence of at least one disorder in corresponding category. [b]PTSD not included. 1BPD total vs. CC, $t(90) = 1.85$, $p = .032$ (single-sided Student's t test). 2BPD+ vs. BPD– vs. CC, $F(2, 89) = 4.67$, $p = .012$; BPD+ vs. CC, $p = .011$; BPD+ vs. BPD–, $p = .056$. [3]BPD total vs. CC, $t(85.134) = 1.85$, $p < .001$ (two-tailed Student's t test). [4]BPD+ vs. BPD– vs. CC, $F(2, 89) = 9.66$, $p < .001$; BPD+/– vs. CC, $p < .01$. 5BPD total vs. CC, $t(90) = 2.27$, $p = .026$ (two-tailed Student's t test). 6BPD+ vs. BPD– vs. CC, $F(2, 89) = 2.81$, $p = .066$.

tending to respond with "happy" less often than CC controls for 50%/50% blends ($p = .056$) (Figures 2a–2c). In addition, we analyzed all six emotional pairs separately using 3 × 5 ANOVAs for each emotional blend. None of the group effects reached statistical significance, Fs$(2, 133) \leq .432$, ps $\geq .650$, η^2s $\leq .006$. However, for two emotional blends, we found statistical trends: For angry/happy facial blends, there was a marginal significant main effect of group, $F(2, 133) = 2.870$, $p = .060$, $\eta^2 = .041$ (Figure 2a), with the BPD patients being more likely to respond with "angry" than CC controls ($p = .018$) and for sad/happy expressions, $F(2, 133) = 2.617$, $p = .077$, $\eta^2 = .038$, with NP controls tending to report sadness more often than CC controls ($p = .071$) (Figure 2c). For the sad/happy expressions, the analyses also indicated a significant group-by-intensity level interaction, $F(7.100, 472.166) = 2.846$, $p < .01$, $\eta^2 = .041$, which was mainly due to group differences in the 50%/50% blends, $F(2, 133) = 6.332$, $p = .002$, $\eta^2 = .087$, while BPD patients were less likely to respond with "sadness" than NP ($p = .039$). For the other

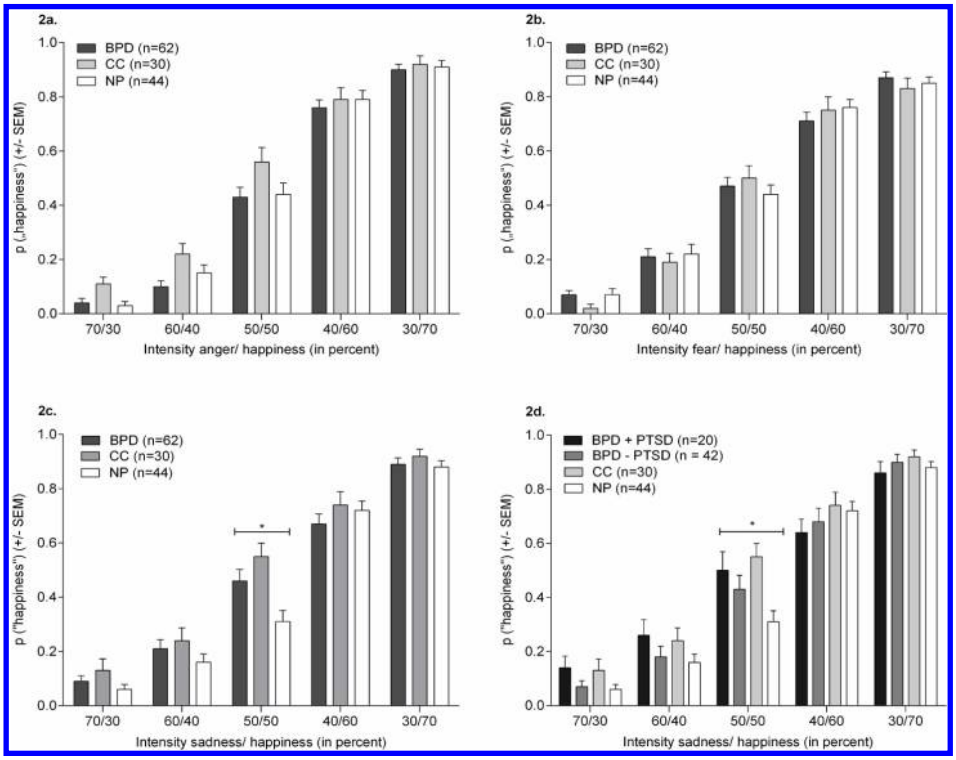

FIGURE 2. Responses in the forced-choice task. (2a) For anger/happiness blends, patients with borderline personality disorder (BPD) were generally more likely to respond with "angry" than patients with Cluster-C personality disorder (CC), but not than non-patient controls (NP), $p < .05$ (two-sided, simple planned contrasts). (2b) For fear/happiness blends, groups did not differ in their emotion recognition performance. (2c) For the 50%/50% sadness/happiness blends, BPD patients were more likely to respond with "happy" than NP. (2d) This effect was mainly driven by BPD patients with posttraumatic stress disorder (PTSD). BPD+ = BPD patients with PTSD. BPD– = BPD patients without PTSD. *$p < .05$ (two-sided, simple planned contrasts).

sad/happy blends, there was no significant group effect, Fs(2, 133) ≤ 1.519, ps ≥ .223, η^2s ≤ .022.

Response Latency. Possible effects on response latency were tested using a 3 × 5 × 3 ANOVA. Despite a main effect of emotional blend, $F(1.886, 250.831) = 3.492$, $p < .035$, η^2s = .026, the group effect, $F(2, 133) = .738$, $p = .480$, η^2s = .011, was not significant. The same was true for the different interactions, Fs < .827, ps > .655, η^2s < 012.

Visual Attention: Fixation Duration. The 3 × 6 × 5 ANOVA revealed a marginally significant main effect group, $F(2, 133) = 2.436$, $p = .091$, $\eta^2 = .035$. BPD patients demonstrated longer fixations than NP ($p = .031$), but not compared to CC ($p = .255$), regardless of emotion displayed and intensity. Using separate exploratory 3 × 5 ANOVAs to test the six emotional blends separately regarding the relative duration of fixations on the eyes, the only

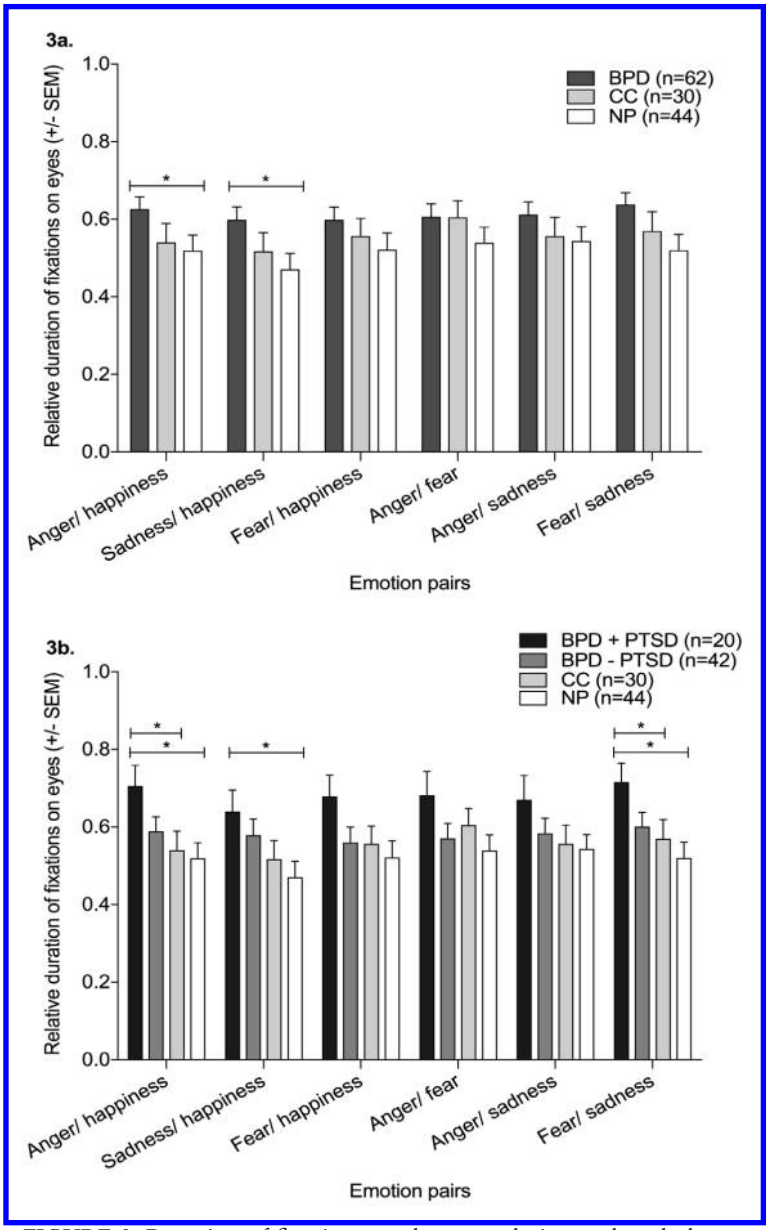

FIGURE 3. Duration of fixations on the eyes relative to the whole screen as a function of emotional facial blends and group membership. (3a) For anger/happiness and sadness/happiness blends, patients with borderline personality disorder (BPD) demonstrated longer fixations on the eye region than non-patient controls (NP) regardless of emotion displayed and intensity, $*p < .05$ (two-sided, simple planned contrasts). (3b) For fear/sadness and anger/happiness blends, BPD patients with posttraumatic stress disorder (PTSD) showed longer fixations on the eye region than NP controls and patients with Cluster C personality disorder, $*p < .05$. For the sadness/happiness blends, BPD patients with PTSD demonstrated longer fixations on the eye region than NP controls. BPD+ = BPD patients with PTSD. BPD– = BPD patients without PTSD.

significant group difference was found for faces displaying sadness/happiness, $F(2, 133) = 3.118$, $p = .048$, $\eta^2 = .045$, with the BPD patients showing longer fixations to the eyes than NP controls ($p = .016$). In addition, statistical trends were found for anger/happiness facial expressions, $F(2, 133) = 2.550$, $p = .082$, $\eta^2 = .037$, and fear/sadness expressions, $F(2, 133) = 2.829$, $p = .063$, $\eta^2 = .041$, again with the BPD patients showing longer fixation duration on the eyes than NP controls ($p = .036$ and $p = .020$) (Figure 3a). All other group effects, Fs$(2, 133) < 1.109$, ps $> .333$, η^2s $< .016$, or group-by-intensity interaction, $F(8, 532) < 1.298$, $p > .242$, $\eta^2 < .019$, were not significant.

EFFECTS OF COMORBID PTSD

Emotion Recognition of Mixed Emotions. In order to test for the effect of comorbid PTSD in BPD patients, we divided the whole group of BPD patients into BPD with PTSD and BPD without PTSD and used a 4 × 3 × 5 ANOVA to test for group differences in emotion recognition. Results resembled the previous analyses with three groups: We found a significant group-by-intensity interaction, $F(9.928, 436.839) = 2.000$, $p = .032$, $\eta^2 = .043$, which was mainly due to group differences for the 50%/50% blends, $F(3, 132) = 3.515$, $p = .017$, $\eta^2 = .074$, while BPD patients with PTSD were more likely to respond with "happy" than NP controls ($p = .069$). Groups did not differ in their emotion recognition regarding the other intensity levels, Fs$(3, 132) < .863$, ps $> .462$, η^2s $< .019$. The group effect was not significant, $F(3, 132) = 1.247$, $p = .295$, $\eta^2 = .028$. Examining the sadness/happiness blends separately by using a 4 × 5 ANOVA revealed a significant group-by-intensity interaction, $F(10.678, 469.830) = 2.409$, $p = .007$, $\eta^2 = .052$, which was mainly due to group differences for the 50%/50% blends, $F(3, 132) = 4.424$, $p = .005$, $\eta^2 = .091$, while BPD with PTSD were more likely to respond with "sadness" than NP ($p = .019$) (Figure 2d). No other effects, including the 5 other remaining emotion blends, were significant, Fs$(3, 132) \leq 1.730$, ps $\geq .164$, η^2s $\leq .38$.

Response Latency. The corresponding 4 × 3 × 5 ANOVA to test for group differences on response latencies revealed no significant group effect, $F(3, 132) = 1.464$, $p = .227$, $\eta^2 = .032$, or interaction effect, Fs $< .806$, ps $> .732$, η^2s $< .018$.

Visual Attention: Fixation Duration. To inspect the presumed threat-related biased visual attention in BPD patients with PTSD, we used a 4 × 6 × 5 ANOVA. The findings demonstrated that groups differed from each other regarding their duration of fixation on the eye region regardless of emotion displayed and intensity (marginal significant main effect of group, $F[3, 132] = 2.627$, $p = .053$, $\eta^2 = .056$). BPD with PTSD had longer fixations on the eye region than NP controls ($p = .006$). In addition, there was a trend towards longer fixations on the eye region in BPD patients with PTSD compared to CC controls ($p = .050$) and BPD patients without PTSD ($p = .089$). Separate exploratory post-hoc ANOVAs for the different emotional blends revealed

a significant group effect for fear/sadness, $F(3, 132) = 2.838$, $p = .041$, $\eta^2 = .061$, and similar statistical trends for sadness/happiness, $F(3, 132) = 2.310$, $p = .079$, $\eta^2 = .050$, and anger/happiness, $F(3, 132) = 2.674$, $p = .050$, $\eta^2 = .057$ (Figure 3b). All other group effects, Fs(2, 133) < 1.678, ps > .175, η^2s < .037, or group-by-intensity interactions, Fs < 1.144, ps > .324, η^2s < .025, were not significant.

CONTROL FOR POTENTIALLY CONFOUNDING VARIABLES

BPD patients had a significant lower IQ than both control groups. Therefore, we recalculated all analyses using intelligence (WASI) as a covariate. ANCOVAs revealed no significant effect of IQ on the results reported above.

DISCUSSION

The present study aimed to extend previous research on emotion recognition in BPD in terms of examining visual attention to ambiguous social cues and, in this context, explore the role of comorbid PTSD in BPD patients performing a mixed-emotion, forced-choice task. Consistent with our hypothesis, the present findings suggest a visual attention bias to angry facial expressions in BPD, or more specifically, mainly in BPD patients with PTSD. This finding is reflected by increased visual attention in BPD patients with PTSD to the eye region compared to that of the NP and CC patients. However, biased attention was not specific for facial expressions showing anger, as BPD patients showed a general tendency to fixate longer to the eye region regardless of the emotion the faces were displaying. This tendency was, however, pronounced for faces showing anger or sadness blended with happiness. This pattern of increased attention to the eye region was even more obvious in the subgroup of BPD patients with comorbid PTSD. Few studies to date have investigated the influence of a comorbid PTSD diagnosis on emotion-related processes (e.g., Dyck et al., 2009; Wingenfeld et al., 2009). Our findings demonstrate that BPD with comorbid PTSD could be a subgroup more likely to exhibit a visual attention bias towards negative or threatening facial expressions within the whole population of BPD patients.

A visual attention bias to faces showing signals of negative affect and especially to subtle cues of anger could be interpreted as biased visual attention towards threat. This is in line with assumptions of anticipation or sensitivity towards threat and rejection in a social context in BPD patients (Arntz & Veen, 2001; Linehan, 1993). Two previous eye-tracking studies supported this assumption: BPD patients demonstrated more reflexive fixation changes on the eyes of angry faces than NP and exaggerated initial fixation changes toward the eyes of angry and fearful facial expression, which were in turn related to emotional hyperarousal in the amygdala, interpreted as reflexive hyperactivity to social threat in BPD (Bertsch et al., 2013). Further, BPD revealed accelerated saccades towards the eye region of briefly displayed neutral faces and decelerated saccades away from the eye region of fearful faces (Bertsch et al., 2017). However, our results extend other trials examining

visual attention to social signals of threat in BPD using eye-tracking methodology, as our results suggest that the proposed attention bias might be more generalized than specific for threat and could be related to factors other than threat sensitivity.

In addition, the present data suggest that BPD patients pay greater attention to the eyes of faces exhibiting high levels of sadness, which were pronounced in patients with comorbid PTSD. This might reflect a depression-related effect, since the BPD patients tended to report higher levels of depressive symptoms than the control groups. This aligns with previous studies, which have demonstrated a more intense response to sad faces in depressed patients (Fu et al., 2008; Suslow et al., 2010). We thus tested the association between depressive symptoms assessed with the respective subscale in the BSI and visual attention effect towards sad faces. Our bivariate correlation analyses within the BPD patient group revealed no significant association between depressive symptoms and the tested variables. To sum up, our findings provide evidence for biased visual attention towards especially angry and sad, but not frightened facial expressions in BPD patients with PTSD—a pattern that is inconsistent with a general negativity bias.

Our results suggest that BPD patients are not generally impaired in accurately recognizing threatening facial expressions when the faces display highly ambiguous blends. BPD patients revealed normal accuracy in recognizing ambiguous facial expressions, which is reflected by accuracy in emotion recognition comparable to the control groups. Hence, biased attention to facial cues of anger cannot be explained by mere differences in recognition performance, and thus appears to be independent of recognition performance. Our findings extend previous findings (Domes et al., 2008) that suggested biased recognition of anger when the faces displayed highly ambiguous blends of basic emotions. Such divergent findings might be due to sample characteristics (e.g., inpatients vs. outpatients) and/or subtle differences in the experimental setup (e.g., facial stimuli, levels of affect intensity).

To our knowledge, this is the first eye-tracking study examining emotion recognition of ambiguous facial expressions in BPD patients with and without a comorbid diagnosis of PTSD. Our sample size was large enough to divide the BPD patient group into subgroups of BPD patients with and without PTSD. We also included a clinical control group with CC patients who presented overlapping symptoms characteristic of BPD, such as feelings of inadequacy or hypersensitivity to rejection and negative evaluation. In the present study, CC patients revealed no visual attention bias to threat, unlike BPD patients.

LIMITATIONS

The present study has some limitations. First, we do not provide an additional group with PTSD. It therefore remains unclear whether the visual attention bias we report is due to a comorbid diagnosis of PTSD in BPD patients and whether the effect on visual attention is specific for PTSD. To our knowledge, there is no study reported in the literature investigating visual attention during face perception processing in PTSD using eye-tracking. Further

studies including BPD patients with and without PTSD—and participants diagnosed with PTSD exclusively—might yield better understanding of the association between BPD and PTSD. Second, we included only female participants in our sample. Therefore, we cannot draw any conclusion for emotion recognition and visual attention in male BPD patients, CC, or NP. Third, we did not control for medication *a priori*. The BPD patients in this study were taking significantly more psychotropic drugs than the clinical controls were. Fourth, we used standardized static pictures of emotional facial expressions despite the fact that social interaction in everyday life is more complex and dynamic. Further studies should apply eye-tracking methodology in a more naturalistic setting to expand upon our findings. Fifth, no state measures of mood were obtained in the present study. Hence, we cannot rule out that the unimpaired emotion recognition of highly angry facial expressions is due to state influence of mood during the experiment. Further research addressing the question of state-related biases in emotion recognition is needed (e.g., Daros et al., 2013). Sixth, we analyzed BPD subgroups according to the emotion recognition and visual attention pattern by using multiple comparisons in an exploratory multiway ANOVA. This procedure is associated with an increased likelihood of a heightened rate of false positives (Cramer et al., 2016). Hence, the results of the present results of the BPD subgroup analyses have to be interpreted cautiously. Finally, although we endeavored to parallelize the experimental setup and procedures at the different study sites, we did not attain perfect comparability due to slight differences regarding eye-tracking hardware. Although the effects above did not depend on a specific study site, we cannot rule out that study site differences added additional variance to the data and thus rendered subtle effects undetected.

CONCLUSIONS

In sum, the present study provides evidence for enhanced visual attention towards the eye region of emotional faces displaying different emotional blends, especially in BPD patients with comorbid PTSD. Emotion recognition in patients with BPD was unimpaired and unbiased compared to non-patient and patient controls in general. From a clinical perspective, further studies should address the question as to how visual attention to faces and facial regions is associated with an interpersonal evaluation bias as illustrated in a negative evaluation of others and oneself (Arntz & Veen, 2001; Arntz, Weertman, & Salet, 2011; Barnow et al., 2009), which in turn might reflect maladaptive schemas due to negative experiences in early childhood. From a cognitive perspective, these maladaptive schemas affect the perception and evaluation of others and behavior in a social context (Pretzer, 1990). Decoding emotional expressions in the face is crucial for social interaction to infer the mental state of others (Eisenbarth & Alpers, 2011). Regarding severe interpersonal problems in BPD, the question can be raised as to whether BPD patients are more vigilant to potentially threatening, ambiguous information in a social context because of the aforementioned maladaptive schemas. Finally, in light of the present results, it is worth considering extending existing BPD–specific treatment approaches (e.g., Bateman & Fonagy, 2004; Bohus

et al., 2013; Giesen-Bloo et al., 2006) with respect to specifically tailored interventions for patients exhibiting both BPD and PTSD. They should focus more intensively on social cognition, in order to reduce interpersonal perceptual biases, which may strongly interfere with interpersonal functioning in everyday life.

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SUPPLEMENTAL TABLE S1. Mean Probability of Responding "Anger" as a Function of Different Emotional Blends and Group Membership

	Total (n = 62)		BPD PTSD+ (n = 20)		BPD PTSD– (n = 42)		CC (n = 30)		NP (n = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.96	(.13)	.98	(.08)	.95	(.15)	.89	(.14)	.97	(.10)
60–40%	.90	(.17)	.91	(.15)	.90	(.18)	.78	(.21)	.85	(.20)
50–50%	.57	(.29)	.49	(.29)	.61	(.29)	.44	(.29)	.56	(.28)
40–60%	.24	(.23)	.21	(.20)	.26	(.24)	.21	(.24)	.21	(.22)
30–70%	.10	(.16)	.10	(.17)	.10	(.16)	.08	(.17)	.09	(.16)
Anger to sadness										
70–30%	.79	(.19)	.79	(.15)	.79	(.20)	.70	(.30)	.73	(.20)
60–40%	.64	(.24)	.60	(.24)	.65	(.25)	.56	(.24)	.60	(.23)
50–50%	.48	(.24)	.49	(.25)	.47	(.24)	.46	(.19)	.51	(.23)
40–60%	.36	(.21)	.38	(.22)	.35	(.20)	.36	(.21)	.38	(.27)
30–70%	.28	(.22)	.23	(.20)	.30	(.22)	.30	(.22)	.28	(.24)
Anger to fear										
70–30%	.89	(.16)	.85	(.22)	.91	(.12)	.85	(.20)	.89	(.17)
60–40%	.74	(.26)	.75	(.28)	.73	(.25)	.72	(.24)	.76	(.20)
50–50%	.49	(.26)	.51	(.26)	.48	(.26)	.43	(.25)	.48	(.23)
40–60%	.23	(.21)	.21	(.23)	.23	(.20)	.31	(.30)	.24	(.18)
30–70%	.12	(.15)	.10	(.15)	.13	(.15)	.15	(.18)	.13	(.18)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S2. Mean Probability of Responding "Fear" and "Happiness" as a Function of Different Emotional Blends and Group Membership

	Total (n = 62)		BPD PTSD+ (n = 20)		BPD PTSD– (n = 42)		CC (n = 30)		NP (n = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Fear to happiness										
70–30%	.93	(.12)	.91	(.15)	.94	(.11)	.98	(.08)	.93	(.15)
60–40%	.79	(.23)	.79	(.23)	.80	(.23)	.81	(.18)	.78	(.24)
50–50%	.53	(.26)	.54	(.27)	.52	(.26)	.50	(.25)	.56	(.23)
40–60%	.29	(.26)	.30	(.26)	.28	(.25)	.25	(.27)	.24	(.20)
30–70%	.13	(.17)	.15	(.21)	.13	(.16)	.17	(.21)	.15	(.15)
Fear to sadness										
70–30%	.67	(.22)	.71	(.20)	.66	(.22)	.66	(.21)	.66	(.24)
60–40%	.58	(.20)	.60	(.19)	.57	(.21)	.60	(.20)	.57	(.21)
50–50%	.50	(.26)	.46	(.27)	.52	(.25)	.49	(.19)	.49	(.19)
40–60%	.41	(.24)	.46	(.26)	.38	(.22)	.33	(.20)	.39	(.24)
30–70%	.35	(.23)	.38	(.25)	.34	(.23)	.28	(.18)	.31	(.18)
Sadness to happiness										
70–30%	.91	(.16)	.86	(.19)	.93	(.14)	.88	(.23)	.94	(.12)
60–40%	.79	(.26)	.74	(.26)	.82	(.25)	.76	(.26)	.84	(.20)
50–50%	.54	(.33)	.50	(.31)	.57	(.34)	.45	(.27)	.69	(.27)
40–60%	.34	(.29)	.36	(.22)	.32	(.32)	.26	(.27)	.28	(.23)
30–70%	.11	(.19)	.14	(.19)	.10	(.19)	.8	(.14)	.13	(.15)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S3. Mean Reaction Time of Responding "Anger" as a Function of Different Emotional Blends and Group Membership

			BPD				CC		NP	
	Total (n = 62)		PTSD+ (n = 20)		PTSD– (n = 42)		(n = 30)		(n = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	1334.14	(518.93)	1173.20	(402.30)	1410.73	(554.10)	1571.79	(1263.84)	1524.33	(531.38)
60–40%	1644.16	(880.82)	1552.11	(738.62)	1687.99	(946.25)	1991.88	(1696.11)	1842.13	(1090.05)
50–50%	2072.75	(1029.02)	1854.25	(950.60)	2176.79	(1059.38)	2156.80	(1293.76)	2119.74	(1010.38)
40–60%	1803.56	(1042.53)	1527.96	(647.47)	1934.79	(1169.65)	1935.74	(1827.33)	1942.38	(1034.80)
30–70%	1426.78	(705.94)	1380.45	(1000.63)	1448.85	(525.26)	1460.03	(656.66)	1499.19	(772.09)
Anger to sadness										
70–30%	1620.36	(832.51)	1409.03	(485.13)	1720.99	(943.37)	1742.07	(826.97)	1670.57	(720.66)
60–40%	1688.29	(670.29)	1672.59	(568.85)	1695.76	(719.94)	1873.83	(1228.25)	1829.60	(789.63)
50–50%	1925.16	(1010.36)	1947.41	(1332.17)	1914.57	(834.28)	1929.98	(964.64)	1912.75	(848.21)
40–60%	1979.32	(912.26)	1777.19	(539.35)	2075.58	(1036.31)	2135.90	(1353.22)	2037.91	(958.78)
30–70%	1939.45	(782.94)	1787.14	(729.87)	2011.98	(805.27)	2244.57	(1397.70)	1896.42	(673.05)
Anger to fear										
70–30%	1644.80	(652.10)	1667.60	(710.32)	1633.94	(631.24)	1639.03	(670.43)	1987.34	(1017.76)
60–40%	1838.36	(818.79)	1682.61	(619.85)	1912.52	(895.51)	1929.26	(861.72)	2135.93	(989.92)
50–50%	2041.93	(864.88)	1909.53	(810.22)	2104.98	(892.22)	2229.10	(1425.72)	2525.23	(1249.41)
40–60%	1838.20	(694.49)	1834.00	(802.88)	1840.20	(647.20)	2112.65	(968.87)	2276.81	(1125.21)
30–70%	1857.25	(1308.42)	1817.70	(786.41)	1876.08	(1503.11)	1913.29	(934.64)	1881.53	(883.29)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S4. Mean Reaction Time of Responding "Fear" and "Happiness" as a Function of Different Emotional Blends and Group Membership

			BPD				CC		NP	
	Total (n = 62)		PTSD+ (n = 20)		PTSD– (n = 42)		(n = 30)		(n = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Fear to happiness										
70–30%	1672.29	(879.17)	1403.76	(448.55)	1800.17	(1002.41)	1577.53	(474.20)	1613.87	(628.26)
60–40%	1921.18	(1120.91)	1650.41	(525.08)	2050.12	(1299.52)	1852.22	(912.62)	1805.45	(568.76)
50–50%	1883.63	(1165.91)	1520.28	(570.00)	2056.66	(1332.96)	2173.72	(1225.17)	2199.82	(896.99)
40–60%	1586.81	(739.60)	1567.45	(841.45)	1596.03	(696.75)	1838.03	(1139.52)	1885.47	(936.58)
30–70%	1605.90	(1738.08)	1175.30	(469.76)	1810.95	(2063.68)	1580.55	(1914.12)	1461.05	(713.49)
Fear to sadness										
70–30%	1846.23	(822.49)	1587.56	(673.43)	1969.40	(864.95)	1904.91	(953.04)	2144.97	(1075.21)
60–40%	1879.10	(1082.87)	1650.76	(687.85)	1987.83	(1219.76)	1887.70	(790.49)	2317.03	(1646.86)
50–50%	1969.22	(988.04)	1691.53	(569.96)	2101.45	(1116.40)	1894.90	(600.41)	1980.53	(730.00)
40–60%	1974.17	(1403.43)	1636.86	(584.42)	2134.79	(1640.18)	2119.41	(935.63)	2118.60	(1031.27)
30–70%	1869.71	(750.75)	1837.64	(668.09)	1884.98	(794.34)	2041.35	(979.31)	1927.40	(826.53)
Sadness to happiness										
70–30%	1661.48	(849.38)	1505.78	(599.76)	1735.63	(942.99)	1842.63	(706.88)	1618.99	(540.64)
60–40%	1781.21	(787.38)	1630.65	(641.80)	1852.91	(845.69)	1958.12	(803.39)	1989.47	(872.33)
50–50%	1909.01	(890.84)	1649.41	(503.97)	2032.63	(1007.21)	2282.31	(1349.39)	2218.60	(1027.91)
40–60%	1830.53	(1040.32)	1634.34	(924.23)	1923.95	(1089.33)	2078.65	(1188.97)	2076.18	(1225.90)
30–70%	1585.10	(1006.03)	1302.96	(654.27)	1719.45	(1118.08)	1786.58	(1420.55)	1879.51	(1240.46)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S5. Number of Fixations on Eyes Relative to the Total Number of Fixations

	BPD						CC		NP	
	Total (n = 62)		PTSD+ (n = 20)		PTSD– (n = 42)		(n = 30)		(n = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.61	(.29)	.72	(.28)	.55	(.28)	.55	(.31)	.46	(.30)
60–40%	.61	(.26)	.68	(.22)	.57	(.27)	.52	(.30)	.48	(.27)
50–50%	.58	(.26)	.65	(.32)	.55	(.23)	.53	(.27)	.45	(.25)
40–60%	.62	(.26)	.69	(.28)	.59	(.24)	.53	(.28)	.53	(.27)
30–70%	.59	(.28)	.63	(.31)	.58	(.27)	.51	(.28)	.53	(.27)
Anger to sadness										
70–30%	.59	(.30)	.66	(.35)	.56	(.27)	.56	(.28)	.51	(.26)
60–40%	.58	(.29)	.65	(.25)	.55	(.30)	.53	(.28)	.55	(.23)
50–50%	.57	(.28)	.60	(.33)	.56	(.25)	.56	(.27)	.53	(.25)
40–60%	.60	(.27)	.63	(.32)	.58	(.25)	.53	(.26)	.52	(.26)
30–70%	.58	(.28)	.64	(.30)	.55	(.26)	.52	(.26)	.46	(.23)
Anger to fear										
70–30%	.59	(.29)	.65	(.29)	.56	(.29)	.59	(.25)	.52	(.29)
60–40%	.60	(.28)	.68	(.30)	.57	(.27)	.60	(.23)	.50	(.24)
50–50%	.59	(.27)	.65	(.28)	.56	(.26)	.60	(.22)	.49	(.27)
40–60%	.57	(.28)	.66	(.32)	.53	(.25)	.58	(.26)	.52	(.28)
30–70%	.56	(.29)	.63	(.30)	.53	(.29)	.55	(.25)	.53	(.25)
Fear to happiness										
70–30%	.57	(.27)	.66	.26	.52	.26	.52	(.28)	.46	(.26)
60–40%	.57	(.28)	.66	.29	.53	.26	.56	(.24)	.49	(.27)
50–50%	.57	(.27)	.62	.27	.54	.26	.54	(.24)	.51	(.26)
40–60%	.56	(.28)	.64	.27	.53	.29	.52	(.25)	.50	(.31)
30–70%	.58	(.30)	.65	.35	.55	.27	.57	(.28)	.46	(.30)
Fear to sadness										
70–30%	.61	(.26)	.68	(.27)	.69	(.25)	.56	(.29)	.47	(.27)
60–40%	.59	(.26)	.69	(.25)	.55	(.26)	.59	(.28)	.49	(.25)
50–50%	.61	(.26)	.68	(.28)	.58	(.25)	.54	(.30)	.50	(.26)
40–60%	.61	(.27)	.70	(.26)	.57	(.26)	.56	(.30)	.49	(.25)
30–70%	.61	(.25)	.65	(.23)	.59	(.25)	.54	(.27)	.51	(.27)
Sadness to happiness										
70–30%	.59	(.26)	.63	(.30)	.56	(.24)	.48	(.26)	.45	(.28)
60–40%	.57	(.27)	.59	(.28)	.56	(.27)	.51	(.28)	.45	(.27)
50–50%	.56	(.27)	.60	(.25)	.54	(.28)	.48	(.25)	.44	(.26)
40–60%	.61	(.28)	.67	(.26)	.58	(.28)	.52	(.27)	.44	(.30)
30–70%	.57	(.30)	.61	(.31)	.56	(.29)	.54	(.28)	.45	(.29)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLES 6. Duration of Fixations on Eyes Relative to the Total Duration of Fixations

			BPD				CC		NP	
	Total		PTSD+		PTSD–					
	(*n* = 62)		(*n* = 20)		(*n* = 42)		(*n* = 30)		(*n* = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.63	(.29)	.74	(.28)	.57	(.28)	.56	(.31)	.49	(.33)
60–40%	.63	(.27)	.71	(.22)	.59	(.29)	.53	(.31)	.51	(.29)
50–50%	.60	(.27)	.67	(.31)	.57	(.24)	.54	(.27)	.48	(.28)
40–60%	.65	(.28)	.73	(.27)	.60	(.27)	.55	(.30)	.55	(.29)
30–70%	.63	(.28)	.67	(.28)	.60	(.28)	.52	(.29)	.57	(.29)
Anger to sadness										
70–30%	.62	(.31)	.69	(.35)	.59	(.29)	.56	(.31)	.54	(.29)
60–40%	.61	(.30)	.70	(.26)	.56	(.31)	.55	(.29)	.58	(.26)
50–50%	.59	(.28)	.62	(.33)	.58	(.26)	.57	(.29)	.54	(.28)
40–60%	.63	(.28)	.66	(.32)	.61	(.27)	.56	(.28)	.57	(.29)
30–70%	.61	(.28)	.68	(.29)	.58	(.27)	.54	(.27)	.49	(.26)
Anger to fear										
70–30%	.61	(.29)	.68	(.28)	.58	(.30)	.61	(.27)	.55	(.30)
60–40%	.62	(.29)	.71	(.30)	.58	(.28)	.62	(.25)	.52	(.27)
50–50%	.61	(.28)	.66	(.27)	.59	(.29)	.62	(.24)	.52	(.30)
40–60%	.60	(.29)	.70	(.33)	.56	(.27)	.61	(.26)	.55	(.30)
30–70%	.59	(.30)	.66	(.29)	55	(.29)	.56	(.25)	.57	(.28)
Fear to happiness										
70–30%	.60	(.29)	.71	(.26)	.55	(.29)	.54	(.30)	.50	(.29)
60–40%	.59	(.29)	.67	(.29)	.55	(.28)	.58	(.25)	.54	(.30)
50–50%	.60	(.28)	.68	(.24)	.57	(.29)	.56	(.26)	.54	(.29)
40–60%	.59	(.29)	.66	(.26)	.55	(.30)	.53	(.26)	.53	(.33)
30–70%	.61	(.30)	.68	(.34)	.58	(.28)	.58	(.29)	.49	(.31)
Fear to sadness										
70–30%	.58	(.30)	.72	(.27)	.61	(.25)	.58	(.30)	.51	(.31)
60–40%	.62	(.26)	.72	(.24)	.58	(.27)	.59	(.29)	.51	(.28)
50–50%	.64	(.27)	.71	(.27)	.61	(.27)	.55	(.31)	.53	(.29)
40–60%	.64	(.28)	.73	(.25)	.60	(.28)	.57	(.31)	.51	(.29)
30–70%	.64	(.26)	.70	(.21)	.61	(.28)	.55	(.29)	.54	(.30)
Sadness to happiness										
70–30%	.61	(.27)	.66	(.30)	.58	(.26)	.49	(.27)	.48	(.30)
60–40%	.59	(.30)	.60	(.30)	.59	(.30)	.53	(.29)	.47	(.30)
50–50%	.57	(.29)	.62	(.27)	.55	(.29)	.49	(.26)	.47	(.29)
40–60%	.63	(.29)	.68	(.28)	.60	(.30)	.53	(.29)	.46	(.32)
30–70%	.59	(.30)	.64	(.30)	.57	(.30)	.55	(.30)	.48	(.31)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S7. Number of Fixations on Face Relative to the Total Duration of Fixations

			BPD				CC		NP	
	Total		PTSD+		PTSD–					
	(*n* = 62)		(*n* = 20)		(*n* = 42)		(*n* = 30)		(*n* = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.94	(.10)	.97	(.07)	.92	(.11)	.93	(.10)	.92	(.09)
60–40%	.94	(.10)	.96	(.08)	.92	(.11)	.94	(.08)	.92	(.09)
50–50%	.95	(.08)	.96	(.08)	.94	(.08)	.93	(.10)	.89	(.15)
40–60%	.95	(.09)	.94	(.13)	.96	(.06)	.93	(.10)	.94	(.07)
30–70%	.93	(.10)	.94	(.10)	.92	(.10)	.91	(.09)	.92	(.10)
Anger to sadness										
70–30%	.94	(.08)	.93	(.10)	.94	(.07)	.93	(.08)	.94	(.06)
60–40%	.92	(.15)	.94	(.09)	.90	(.17)	.87	(.19)	.92	(.09)
50–50%	.95	(.07)	.94	(.10)	.95	(.06)	.91	(.11)	.95	(.07)
40–60%	.95	(.08)	.94	(.09)	.95	(.07)	.92	(.09)	.92	(.10)
30–70%	.93	(.09)	.94	(.09)	.93	(.10)	.91	(.09)	.91	(.08)
Anger to fear										
70–30%	.93	(.10)	.93	(.10)	.92	(.10)	.91	(.08)	.91	(.11)
60–40%	.91	(.16)	.93	(.10)	.90	(.18)	.92	(.10)	.91	(.13)
50–50%	.92	(.10)	.92	(.11)	.91	(.09)	.92	(.08)	.91	(.09)
40–60%	.92	(.09)	.92	(.10)	.92	(.08)	.92	(.09)	.89	(.15)
30–70%	.92	(.11)	.94	(.11)	.91	(.10)	.91	(.09)	.91	(.09)
Fear to happiness										
70–30%	.92	(.08)	.94	(.10)	.91	(.08)	.93	(.11)	.91	(.16)
60–40%	.93	(.09)	.94	(.09)	.92	(.10)	.93	(.08)	.90	(.15)
50–50%	.91	(.15)	.94	(.09)	.90	(.16)	.93	(.09)	.90	(.17)
40–60%	.92	(.11)	.92	(.13)	.93	(.10)	.94	(.10)	.90	(.16)
30–70%	.94	(.09)	.96	(.09)	.93	(.09)	.92	(.10)	.92	(.17)
Fear to sadness										
70–30%	.92	(.10)	.93	(.11)	.92	(.09)	.90	(.11)	.88	(.13)
60–40%	.91	(.10)	.91	(.10)	.91	(.10)	.90	(.13)	.89	(.13)
50–50%	.92	(.09)	.92	(.10)	.93	(.08)	.87	(.19)	.87	(.16)
40–60%	.92	(.10)	.92	(.11)	.93	(.09)	.88	(.19)	.89	(.13)
30–70%	.92	(.10)	.93	(.10)	.91	(.10)	.86	(.20)	.90	(.13)
Sadness to happiness										
70–30%	.92	(.11)	.93	(.13)	.92	.11	(.94)	(.07)	.90	(.15)
60–40%	.93	(.10)	.96	(.09)	.92	.10	(.91)	(.07)	.89	(.15)
50–50%	.94	(.09)	.95	(.09)	.93	.09	(.93)	(.09)	.88	(.15)
40–60%	.96	(.08)	.96	(.08)	.96	.08	(.93)	(.09)	.89	(.16)
30–70%	.93	(.15)	.96	(.07)	.91	.17	(.93)	(.08)	.89	(.16)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S8. Duration of Fixation on Face Relative to the Total Duration of Fixation

			BPD				CC		NP	
	Total		PTSD+		PTSD–					
	(*n* = 62)		(*n* = 20)		(*n* = 42)		(*n* = 30)		(*n* = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.95	(.09)	.98	(.05)	.94	(.10)	.94	(.09)	.95	(.06)
60–40%	.95	(.08)	.97	(.05)	.94	(.09)	.96	(.07)	.94	(.08)
50–50%	.96	(.07)	.97	(.06)	.96	(.07)	.94	(.11)	.92	(.15)
40–60%	.97	(.06)	.96	(.09)	.97	(.09)	.94	(.09)	.95	(.06)
30–70%	.95	(.09)	.96	(.07)	.94	(.09)	.92	(.09)	.94	(.09)
Anger to sadness										
70–30%	.96	(.06)	.95	(.07)	.96	(.06)	.94	(.09)	.96	(.05)
60–40%	.93	(.15)	.96	(.07)	.92	(.17)	.89	(.18)	.94	(.07)
50–50%	.95	(.07)	.95	(.09)	.96	(.06)	.91	(.12)	.96	(.06)
40–60%	.96	(.06)	.96	(.06)	.97	(.05)	.93	(.07)	.95	(.08)
30–70%	.95	(.07)	.95	(.07)	.95	(.07)	.93	(.07)	.95	(.06)
Anger to fear										
70–30%	.94	(.09)	.94	(.08)	.94	(.09)	.93	(.06)	.93	(.09)
60–40%	.92	(.15)	.95	(.09)	.91	(.18)	.93	(.09)	.93	(.12)
50–50%	.93	(.08)	.93	(.11)	.94	(.07)	.93	(.07)	.93	(.08)
40–60%	.94	(.07)	.94	(.09)	.95	(.06)	.94	(.07)	.91	(.14)
30–70%	.94	(.09)	.95	(.09)	.93	(.09)	.93	(.08)	.93	(.08)
Fear to happiness										
70–30%	.94	(.07)	.95	(.07)	.94	(.06)	.94	(.09)	.94	(.15)
60–40%	.94	(.08)	.94	(.09)	.95	(.08)	.94	(.07)	.93	(.15)
50–50%	.94	(.14)	.96	(.07)	.92	(.16)	.94	(.07)	.92	(.16)
40–60%	.94	(.09)	.93	(.12)	.95	(.06)	.95	(.08)	.92	(.16)
30–70%	.95	(.08)	.96	(.08)	.95	(.08)	.94	(.08)	.94	(.15)
Fear to sadness										
70–30%	.94	(.08)	.94	(.10)	.94	(.07)	.92	(.09)	.91	(.12)
60–40%	.94	(.07)	.94	(.07)	.94	(.06)	.92	(.11)	.92	(.14)
50–50%	.94	(.08)	.93	(.10)	.95	(.06)	.88	(.19)	.90	(.16)
40–60%	.95	(.08)	.95	(.07)	.94	(.08)	.90	(.19)	.91	(.14)
30–70%	.94	(.07)	.94	(.07)	.88	.20)	.88	(.20)	.92	(.13)
Sadness to happiness										
70–30%	.94	(.09)	.96	(.08)	.94	(.10)	.95	(.06)	.93	(.15)
60–40%	.95	(.08)	.97	(.06)	.94	(.09)	.93	(.06)	.92	(.15)
50–50%	.95	(.07)	.96	(.07)	.95	(.08)	.95	(.06)	.91	(.15)
40–60%	.97	(.06)	.97	(.06)	.97	(.06)	.94	(.09)	.92	(.16)
30–70%	.93	(.14)	.97	(.06)	.92	(.17)	.94	.(08)	.92	(.16)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S9. Number of Fixations on Mouth Relative to the Total Number of Fixations

			BPD				CC		NP	
	Total		PTSD+		PTSD–					
	(*n* = 62)		(*n* = 20)		(*n* = 42)		(*n* = 30)		(*n* = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.11	(.14)	.06	(.09)	.13	(.15)	.12	(.12)	.12	(.13)
60–40%	.11	(.13)	.11	(.12)	.11	(.13)	.18	(.19)	.13	(.12)
50–50%	.13	(.14)	.10	(.12)	.14	(.14)	.16	(.15)	.14	(.13)
40–60%	.13	(.13)	.10	(.11)	.14	(.13)	.16	(.16)	.12	(.10)
30–70%	.12	(.14)	.14	(.18)	.10	(.12)	.15	(.20)	.10	(.11)
Anger to sadness										
70–30%	.13	(.15)	.11	(.14)	.15	(.15)	.15	(.11)	.12	(.13)
60–40%	.12	(.17)	.07	(.10)	.15	(.19)	.13	(.14)	.10	(.11)
50–50%	.13	(.16)	.11	(.14)	.14	(.17)	.14	(.11)	.10	(.10)
40–60%	.13	(.12)	.11	(.11)	.14	(.12)	.15	(.12)	.13	(.13)
30–70%	.13	(.14)	.11	(.13)	.15	(.15)	.16	(.12)	.12	(.12)
Anger to fear										
70–30%	.09	(.15)	.10	(.19)	.09	(.13)	.11	(.12)	.09	(.12)
60–40%	.10	(.13)	.08	(.13)	.11	(.13)	.13	(.09)	.11	(.11)
50–50%	.11	(.13)	.10	(.17)	.12	(.11)	.14	(.12)	.11	(.10)
40–60%	.11	(.15)	.10	(.17)	.12	(.14)	.13	(.11)	.12	(.11)
30–70%	.11	(.16)	.11	(.18)	.11	(.15)	.15	(.12)	.10	(.10)
Fear to happiness										
70–30%	.11	(.13)	.07	(.09)	.13	(.14)	.13	(.13)	.11	(.11)
60–40%	.12	(.15)	.08	(.12)	.13	(.16)	.14	(.11)	.13	(.13)
50–50%	.12	(.14)	.12	(.15)	.12	(.14)	.17	(.11)	.11	(.09)
40–60%	.13	(.19)	.10	(.15)	.14	(.21)	.13	(.13)	.11	(.14)
30–70%	.10	(.14)	.09	(.13)	.11	(.14)	.10	(.08)	.09	(.10)
Fear to sadness										
70–30%	.11	(.14)	.05	(.09)	.14	(.15)	.13	(.11)	.12	(.13)
60–40%	.12	(.15)	.08	(.13)	.13	(.16)	.13	(.12)	.12	(.14)
50–50%	.10	(.14)	.07	(.10)	.11	(.15)	.12	(.10)	.10	(.13)
40–60%	.11	(.14)	.07	(.10)	.14	(.15)	.12	(.11)	.10	(.12)
30–70%	.10	(.15)	.07	(.08)	.12	(.17)	.11	(.12)	.10	(.10)
Sadness to happiness										
70–30%	.13	(.15)	.08	(.09)	.15	(.17)	.20	(.16)	.14	(.15)
60–40%	.13	(.14)	.10	(.11)	.14	(.16)	.19	(.16)	.16	(.15)
50–50%	.15	(.16)	.11	(.13)	.17	(.17)	.19	(.17)	.13	(.13)
40–60%	.12	(.16)	.08	(.11)	.15	(.17)	.17	(.15)	.14	(.19)
30–70%	.11	(.16)	.08	(.12)	.12	(.17)	.16	(.20)	.10	(.12)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

SUPPLEMENTAL TABLE S10. Duration of Fixation on Mouth Relative to the Total Number of Fixations

			BPD				CC		NP	
	Total		PTSD+		PTSD–					
	(*n* = 62)		(*n* = 20)		(*n* = 42)		(*n* = 30)		(*n* = 44)	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Anger to happiness										
70–30%	.09	(.14)	.04	(.06)	.11	(.16)	.11	(.12)	.11	(.14)
60–40%	.09	(.13)	.08	(.10)	.10	(.15)	.16	(.19)	.12	(.14)
50–50%	.11	(.13)	.08	(.10)	.13	(.13)	.14	(.13)	.12	(.12)
40–60%	.10	(.12)	.07	(.09)	.12	(.13)	.14	(.15)	.10	(.10)
30–70%	.09	(.12)	.11	(.16)	.08	(.10)	.13	(.19)	.07	(.08)
Anger to sadness										
70–30%	.11	(.15)	.08	(.14)	.12	(.16)	.12	(.09)	.10	(.12)
60–40%	.11	(.17)	.06	(.09)	.13	(.19)	.12	(.12)	.08	(.10)
50–50%	.11	(.17)	.09	(.11)	.13	(.19)	.11	(.10)	.09	(.10)
40–60%	.11	(.13)	.10	(.13)	.12	(.13)	.13	(.11)	.10	(.13)
30–70%	.12	(.15)	.09	(.11)	.13	(.17)	.13	(.10)	.10	(.12)
Anger to fear										
70–30%	.08	(.14)	.08	(.18)	.07	(.13)	.09	(.11)	.07	(.11)
60–40%	.09	(.12)	.06	(.12)	.09	(.12)	.10	(.09)	.09	(.10)
50–50%	.10	(.13)	.09	(.16)	.10	(.11)	.12	(.11)	.09	(.09)
40–60%	.10	(.15)	.08	(.16)	.10	(.14)	.12	(.10)	.09	(.11)
30–70%	.09	(.16)	.09	(.18)	.10	(.16)	.13	(.12)	.07	(.10)
Fear to happiness										
70–30%	.09	(.12)	.05	(.08)	.11	(.14)	.11	(.12)	.09	(.10)
60–40%	.10	(.13)	.07	(.10)	.12	(.15)	.13	(.11)	.10	(.13)
50–50%	.10	(.14)	.09	(.12)	.11	(.15)	.14	(.12)	.08	(.07)
40–60%	.11	(.20)	.08	(.14)	.13	(.22)	.11	(.13)	.09	(.14)
30–70%	.09	(.14)	.07	(.12)	.10	(.14)	.08	(.07)	.07	(.08)
Fear to sadness										
70–30%	.09	(.13)	.03	(.05)	.12	(.15)	.11	(.10)	.10	(.15)
60–40%	.10	(.16)	.07	(.12)	.12	(.18)	.11	(.11)	.11	(.16)
50–50%	.09	(.14)	.05	(.06)	.11	(.17)	.11	(.11)	.08	(.12)
40–60%	.09	(.14)	.06	(.08)	.11	(.16)	.11	(.10)	.09	(.14)
30–70%	.09	(.16)	.05	(.07)	.11	(.18)	.10	(.10)	.09	(.14)
Sadness to happiness										
70–30%	.11	(.15)	.06	(.06)	.13	(.17)	.18	(.14)	.13	(.15)
60–40%	.12	(.16)	.08	(.09)	.14	(.18)	.17	(.16)	.14	(.16)
50–50%	.13	(.16)	.10	(.12)	.15	(.18)	.18	(.17)	.11	(.12)
40–60%	.11	(.16)	.07	(.09)	.13	(.18)	.16	(.16)	.13	(.19)
30–70%	.09	(.14)	.07	(.10)	.10	(.16)	.14	(.20)	.08	(.12)

Note. BPD = Borderline personality disorder. PTSD = Posttraumatic stress disorder. CC = Clinical controls (patients with cluster-C personality disorder). NP = Non-patient controls.

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