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Facial trustworthiness perception bias elevated in individuals with PTSD compared to trauma exposed controls

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ABSTRACT

Posttraumatic stress disorder (PTSD) research has focused largely on fear processing. However, interpersonal trauma exposure can also impact interpersonal functioning and the perception of the trustworthiness of others. The present study examined facial perceptions of fearfulness and trustworthiness in individuals with PTSD ($n=29$), trauma-exposed without PTSD ($n=19$), and healthy controls ($n=18$). The PTSD group was hypothesized to exhibit a bias to perceive more fear and untrustworthiness in faces relative to controls. Participants rated the level of fearfulness or trustworthiness of faces that were parametrically morphed along a fear or trustworthiness dimension. The PTSD group was biased to perceive faces as more trustworthy compared to the trauma-exposed healthy controls, yet there were no differences between groups in fear processing. A trustworthiness bias in PTSD may represent a vulnerability factor. Conversely, lower trustworthiness perception may represent a protective disposition in trauma-exposed individuals who do not develop PTSD. Differences in the perception of trustworthiness may be an aspect of social perception that is independent of the fear processing abnormalities observed in PTSD.

1. Introduction

Posttraumatic Stress Disorder (PTSD) can result from a variety of experiences that are threatening to one's life, including physical violence, sexual assault, natural disasters, wars, and transportation accidents (Breslau, 2009). Although most individuals recover from any initial symptoms (Westphal et al., 2011), those who develop PTSD become functionally impaired by anxiety, excessive physiological arousal, difficulty concentrating, and emotionally distressing reactivity to trauma reminders (Neria et al., 2013). PTSD is also characterized by symptoms of interpersonal dysfunction including the suspiciousness and avoidance of others and feelings of detachment from other people (Cloitre and Rosenberg, 2006). Experimental investigations of PTSD have typically focused on fear and threat processing abnormalities (Milad and Quirk, 2012). Given the prevalence of interpersonal trauma associated with PTSD, as well as symptoms of social impairment, experimental research examining how individuals with PTSD interpret and perceive the trustworthiness of others is notably sparse.

One common approach to the examination of fear processing in PTSD involves the presentation of fearful or threatening faces (Shvil et al., 2013). This method has helped elucidate differences in cognitive and emotional processes (Hayes et al., 2012), as well as underlying abnormalities in neural circuitry (Liberzon and Sripada, 2007). For example, in maltreated children, PTSD was associated with attentional bias to avoid threatening faces (Pine et al., 2005). In adults with PTSD, the degree of attentional bias towards threat was positively associated with impairments in fear extinction learning (Fani et al., 2011). Overt presentation of fearful faces was associated with amygdala hyperresponsivity and reduced activation of the medial prefrontal cortex (Shin et al., 2005), whereas nonconscious presentation of fearful stimuli has been associated with increased activation in both brain regions (Bryant et al., 2008; Rauch et al., 2000). Moreover, the neural processing of fearful faces among individuals with PTSD was moderated by sex (Felminham et al., 2010), in that men with PTSD exhibited relatively greater hippocampal activity to fear than women, while both men and women with PTSD exhibited greater amygdala activity to fear relative to controls. Another study found that women with intimate

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partner violence related-PTSD exhibited hyperactivity and disconnection among affective and limbic sensory systems when processing threat-related emotion compared to controls (Fonzo et al., 2010), highlighting heterogeneity within PTSD.

This fear processing research has been valuable in expanding the understanding of PTSD psychopathology, however, several limitations should be noted. First, studies have primarily relied on the most expressive poles of the emotional expression (e.g., extremely fearful faces compared with emotionally neutral or happy faces). Although some studies incorporate subjective ratings of the fearful stimulus, it remains unclear how the strength of the signal (i.e., intensity of fearful expression in the face) influences these ratings, and whether signal intensity and subjective rating of emotion and trustworthiness stimuli is biased or exhibits increased sensitivity or discriminability in those with a PTSD diagnosis relative to controls.

Moreover, the dimension of trustworthiness, which may be relevant in the perception of threat, has been relatively unexplored, and may provide a broader understanding of psychopathology. For example, in Borderline Personality Disorder (BPD), which is partly characterized by severe rejection sensitivity and a high prevalence of trauma exposure (Chesin et al., 2014; Goodman et al., 2014; Sauer et al., 2014), a bias towards untrustworthiness perception with longer response times has been reported (Miano et al., 2013; Fertuck et al., 2013). Among trauma survivors, interpersonal difficulties have been associated with sexual revictimization (Classen et al., 2001; Thomas et al., 2014) and functional impairment above and beyond PTSD symptom severity (Cloitre and Rosenberg, 2006).

The present study employs a social cognitive assessment of both facial trustworthiness and fearfulness perception. Participants with PTSD were hypothesized to rate faces as exhibiting higher levels (i.e., bias) of both fear and untrustworthiness relative to trauma exposed individuals without PTSD and healthy controls. We explored the degree to which individuals with PTSD would exhibit increased sensitivity, discriminability, bias, and greater response time (RT) towards untrustworthy and fear faces relative to healthy controls.

2. Method

2.1. Participants

Recruitment was done via online and print advertisements. Participants had to be between the ages of 18–65 and have 20/20 natural or corrected vision. They were screened via telephone for trauma history, substance use history, demographics and other demographic information. If the participant was deemed likely to meet criteria for one of the three groups, they were invited to do an in person consent and phone screen. The Structured Clinical Interview for DSM-IV (SCID-IV; First et al., 2002) was used to formally assess other inclusion and exclusion criteria, which included substance use disorders, severe depression, suicidality, and current or history of psychosis or bipolar disorder. Borderline Personality Disorder (BPD) was assessed with the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997) but not grounds for exclusion in the PTSD group. Current PTSD diagnosis was assessed with the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995). The SCIDs were administered by doctoral level, advanced clinical psychology students under the supervision of a licensed clinical psychologist.

Participants in the PTSD group ($n=29$) met full DSM-IV-TR (APA, 1994) criteria for PTSD, or subthreshold criteria defined as a minimum CAPS total score of 20 and symptoms in each of the three clusters (i.e., intrusive recollections, avoidance and numbing, hyperarousal; Weathers et al., 2001). The Trauma Exposed Healthy Control group (TEHC; $n=19$) was composed of individuals with no Axis I diagnoses, who experienced a traumatic event that met Criterion A for PTSD (i.e., extreme threat or injury, experienced with horror or helplessness) but did not meet the full PTSD or subthreshold requirements outlined above. The No Trauma Healthy Control group (NTHC; $n=18$) participants had no Axis I diagnoses and did not experience any traumatic event that met Criterion A for PTSD. Table 1 provides details on the demographic characteristics of the sample. All participants provided written informed consent to participate in the study, and all procedures were approved by the Institutional Review Board of the City College of New York. Participants were compensated $100.00 and for public transportation to and from the site for participating in this study. Participants received payment on the first day regardless of whether or not they were eligible for the second phase of the study (a separate electroencephalogram [EEG] phase), and the second phase is not a focus of the current manuscript.

Table 1
Demographic and clinical characteristics of participants in each group.

	PTSD $N=29$		TEHC $N=19$		NTHC $N=18$	
	M or *n*	*SD* or %	*M* or *n*	*SD* or %	*M* or *n*	*SD* or %
Demographics						
Gender						
Male	$n=10$	34.5%	$n=9$	47.4%	$n=7$	38.9%
Female	$n=19$	65.5%	$n=10$	52.6%	$n=11$	61.1%
Age	33.2	10.3	41.2	13.2	36.0	10.2
Education	14.7	2.4	14.8	2.3	15.2	2.0
Race/Ethnicity						
Black	$n=10$	34.5%	$n=8$	42.1%	$n=10$	55.6%
Latino	$n=8$	27.6%	$n=1$	5.3%	$n=4$	22.2%
White	$n=5$	17.2%	$n=9$	47.4%	$n=2$	11.1%
Other	$n=6$	20.7%	$n=1$	5.3%	$n=2$	11.1%
Criterion A trauma type					–	–
Physical abuse/	$n=14$	48.3%	$n=10$	52.6%	–	–
Assault						
Sexual trauma	$n=12$	41.4%	$n=3$	15.8%	–	–
Other[a]	$n=18$	62.1%	$n=12$	63.2%	–	–
Multiple trauma	$n=18$	62.1%	$n=11$	57.9%	–	–
CAPS symptom severity					–	–
Re-experiencing	12.9	7.2	1.79	3.2	–	–
Avoidance/	19.2	11.0	1.53	2.5	–	–
numbing						
Hyperarousal	14.5	7.7	1.53	3.3	–	–
Total severity	46.5	22.9	4.84	6.6	–	–
Age at first trauma	10.21	7.37	10.11	7.27	–	–

Note. PTSD=posttraumatic stress disorder; TEHC=trauma exposed healthy controls; NTHC=no trauma healthy controls.

[a] Other trauma includes natural disasters, transportation accidents, and witnessing/learning about sudden or violent death.

2.2. Experimental procedure

Participants performed a computerized task involving the perception of trustworthiness or fear in faces of varying emotional expressions as previously described (Fertuck et al., 2013). The task was programmed using Matlab (www.mathworks.com) and Psychtoolbox (www.psychtoolbox.org). A Windows XP laptop was used to present stimuli, and to record ratings and response time (RT). The task was split into two conditions that varied in facial expressiveness along two dimensions: trustworthy to untrustworthy, or neutral to fearful. Two faces at each extreme (high trust vs. low trust, and fearful vs. neutral). The trustworthiness block utilized trustworthiness stimuli developed by Todorov and colleagues (http://tlab.princeton.edu/databases/trustworthinessfaces/) (Oosterhof and Todorov, 2008; Todorov et al., 2008). For the trustworthiness stimuli there were eight male identities from the

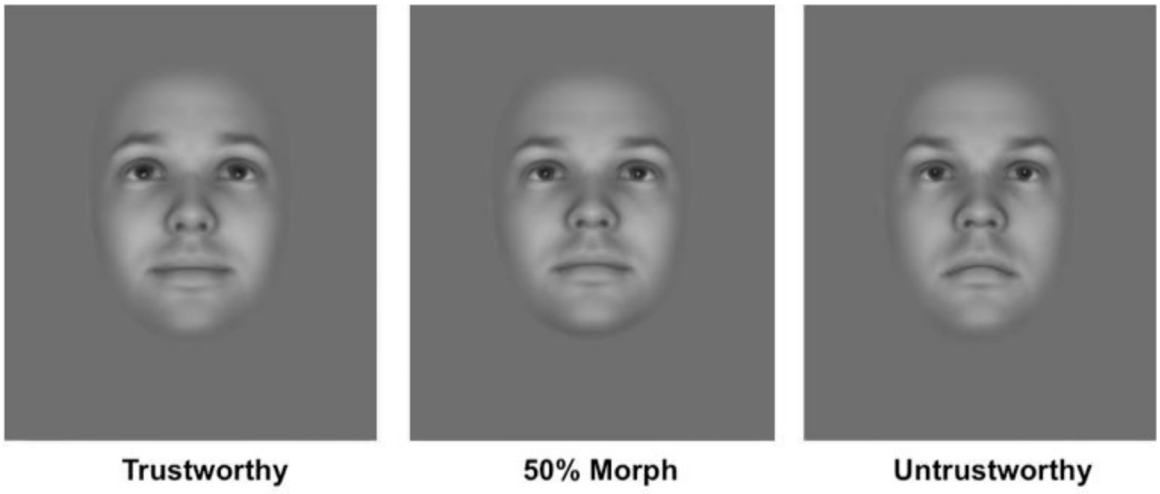

Fig. 1. Sample of Facial Trustworthiness Stimuli.

Todorov stimuli and eight morph sets. For the fear stimuli there were eight identities and eight morph sets, two female and four male. For both the fear and trustworthiness tasks, the morphs were made within identity and gender that were selected from the NimStim Face database (Tottenham et al., 2009). To maintain homogeneity in ethnicities, we included only White faces in both the trustworthiness and fear conditions. All facial stimuli were registered to a standard face image and gray-scaled. A gradient mask was applied to the periphery of the face in order to occlude non-facial features. Intensity normalization was performed so that stimuli differed in phase, while maintaining constant intensity. Morphing software for Windows (Version 3.1, M. Fujimiya) was used to nonlinearly morph the images in 10% increments from the extreme ends (0% to 100%) of trustworthiness or fearfulness. Fig. 1 illustrates a sample facial identity morphed from low (0%), to medium (50%), to high (100%) levels of untrustworthiness. The Fear block had 132 trials and the trustworthiness block had 176 trials. Facial stimuli were presented until response, and an inter-stimulus interval of 2-s. Participants indicate their perception of intensity of either fearfulness or trustworthiness of the face they were apprasing on a 5-point Likert scale by pressing numerical keys. Participants were instructed to respond quickly based on their first impression of the face.

2.3. Data analyses

The first 11 trials (i.e., one presentation of each morph level) were excluded from analyses to minimize learning effects. Reaction times were concatenated and log transformed, and means were calculated by condition. When the RT of a trial exceeded three standard deviations from the mean, it was excluded from analyses. Two trained research assistants who were blind to group assignment reviewed graphical plots of participant data. When the judges assessed the participants' ratings as not related to the stimuli (e.g., inconsistent or random ratings or a flat rating across all stimuli) that participant's data for that run was excluded. When research assistants disagreed on the data quality, one of the authors (also blind to group assignment) made the final decision as to whether to include that run. In the trustworthiness condition, this resulted in the exclusion of nine out of 29 PTSD participants, three out of 19 TEHC participants, and one out of 18 NTHC participants. In the fear condition, this resulted in the exclusion of two out of 29 PTSD participants, two out of 19 TEHC participants, and two out of 18 NTHC participants.

Ratings across morphs were modeled with Weibull functions that were fit to each group for each condition. The Weibull function is the standard sigmoidal function used in most psychometric research (Wichmann and Hill, 2001). The slope of this function is related to the subject's ability to discriminate the stimuli as a function of the stimulus parameters that are being varied. Generally, the slope is maximal when crossing categorical boundaries and minimal within categorical boundaries. We define discriminability as the slope of the steepest part of the curve or (stimulus intensity at 75%) – (stimulus intensity at 25%) where the percentage refers to the area under the curve. The sensitivity is defined as the point of subjective equivalence (PSE). As the PSE shifts to the left, the subject is able to detect a smaller percentage of the signal (e.g. the fearful face) in the stimulus. The bias is the mean offset of the psychometric function. It assesses whether a participant responds consistently higher or lower than a control group independent of their ability to detect stimulus differences and is operationalized as the mean response across all trials. Properties of the functions (i.e., sensitivity, discriminability, and bias) were compared between the three groups in one-way between groups ANOVAs. Specific differences were only assessed when ANOVA results were significant at the $p \leq 0.05$ level, and *post hoc* analyses were conducted with Tukey–Kramer tests for unequal sample sizes ($p \leq 0.05$ level, applying Bonferroni adjustment for multiple comparisons).

3. Results

Demographic and clinical characteristics of the groups are presented in Table 1. There were no significant differences between the groups in age, education, gender, or racial/ethnic distributions. Compared to TEHC and NTHC, the PTSD group had significantly higher symptom levels across total and all PTSD cluster scores (all $ps < 0.001$). Only two participants with PTSD met criteria for BPD. Table 1 presents frequency of different types of trauma in the PTSD and TEHC groups. There were no significant differences between the PTSD and TEHC groups on four different types of trauma: physical abuse/assault, sexual trauma, other (natural disasters, transportation accidents, and witnessing/learning about sudden or violent death), or multiple traumas (all $x^2 > 0.05$). Additionally, age of first trauma was not different between the PTSD and TEHC groups.

To examine differences in trustworthiness perception across groups, ratings were plotted against morph percentage (i.e., level of untrustworthiness) and psychometric functions were fit to the data (Fig. 2). There were no significant differences in reaction

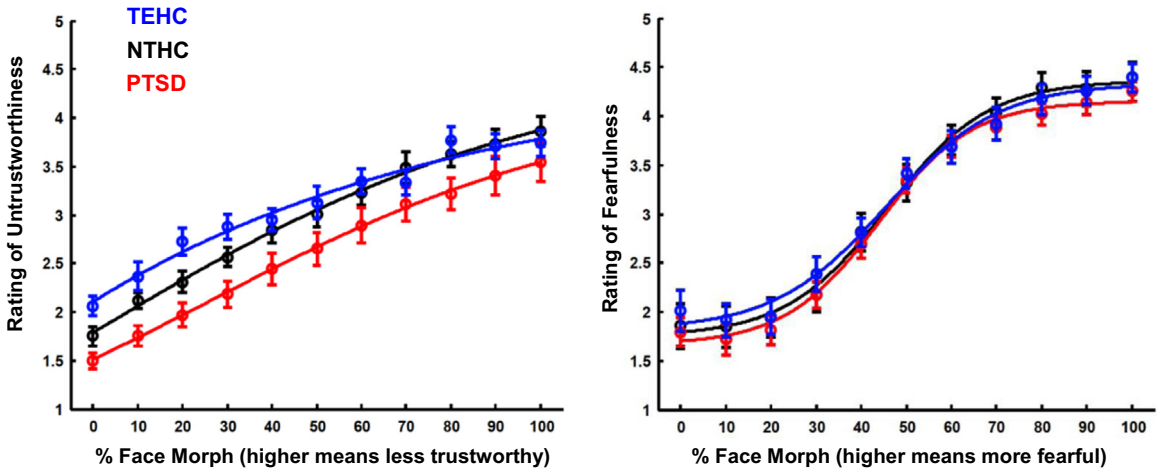

Fig. 2. Ratings by morph percentage and group.

times between groups (all $ps > 0.05$). Neither perceptual sensitivity nor discriminability were significantly different between groups, suggesting comparable perception of trustworthiness, and discrimination between varying levels of facial expressions. However, a significant difference in trustworthiness rating bias was observed (PTSD: $M=2.61$, $SD=0.63$; TEHC: $M=3.05$, $SD=0.48$; NTHC: $M=2.97$, $SD=0.44$; $F_{(2,49)}=3.52$, $p=0.04$). *Post hoc*, Bonferroni-adjusted Tukey–Kramer tests indicated that on average, the PTSD group rated faces as more trustworthy relative to the TEHC (M difference$=0.44$, $p=0.05$). Additionally, Cohen's $d=0.8$, a "large" effect size between PTSD and TEHC groups in trustworthiness bias. There were sex differences in the PTSD group in trustworthiness bias, with women having a trustworthiness bias greater than men (Men: $N=8$; $M=3.06$, $SD=0.63$; Women: $N=15$; $M=2.47$, SD$=0.63$; $t=-2.35$; $p=.03$). In the TEHC group there were found no significant differences between men and women in trustworthiness bias, though the direction was in the opposite direction as for the PTSD group (Men: $N=8$; $M=2.84$, $SD=0.63$; Women: $N=7$; $M=3.23$, $SD=0.35$; $t=-1.80$; $p=.010$). Similarly, in the NTHC group we found no significant differences between men and women in trustworthiness bias (Men: $N=8$; $M=3.09$, $SD=0.33$; Women: $N=7$; $M=2.86$, $SD=0.49$; $t=1.15$; $p=0.27$). No other significant differences in rating bias were observed (see Table 2).

The same analytic procedure was followed for the fear condition (Fig. 2). There were no significant differences in reaction times between groups (all $ps > 0.05$). Moreover, no significant differences emerged in perceptual sensitivity, discriminability, or response bias, therefore no *post hoc* tests were conducted (see Table 2). Fearfulness rating bias was not associated with trustworthiness bias, $r=0.003$, $p > 0.98$.

Table 2
Descriptive statistics, *t*-tests and effect sizes of PTSD, TEHC and NTHC Groups

	PTSD		TEHC		NTHC				
	M	*SD*	*M*	*SD*	*M*	*SD*	*Cohen's d*	*F*	*p*
Fear									
RT	1.27	0.39	1.24	0.24	1.25	0.36	0.09	0.03	0.97
BIAS	3.00	0.55	3.19	0.47	3.10	0.52	−0.37	0.68	0.51
DISC	21.72	8.52	24.68	8.93	20.88	6.50	−0.34	1.04	0.36
PSE	43.88	5.34	45.43	5.62	45.86	6.98	−0.28	0.65	0.53
Trustworthiness									
RT	1.39	0.45	1.31	0.36	1.37	0.53	0.20	0.13	0.88
BIAS	2.61	0.63	3.05	0.48	2.97	0.44	−0.79	3.52	0.04
DISC	34.05	14.11	33.69	13.68	40.79	7.79	0.03	1.81	0.17
PSE	45.77	15.34	39.34	14.13	40.56	9.52	0.44	1.19	0.31

Note: Cohen's *d* were calculated based on comparison of the PTSD and TEHC group comparison.

4. Discussion

The present study compared trustworthiness and fear perception in participants with PTSD, trauma-exposed controls without PTSD, and controls without trauma exposure. The TEHC group perceived faces as less trustworthy compared to participants with PTSD, without a difference in sensitivity or discriminability, suggesting comparable perception of facial stimuli between the two groups. Neither group with trauma history was significantly different than the controls without trauma history on trustworthiness perception. In the perception of fearfulness, the groups were not different in sensitivity, discriminability, or bias. Across conditions, no significant differences in reaction times emerged. Further, there were no significant differences in the types of traumas experienced between the PTSD and TEHC groups, indicating that the type of trauma is not implicated in differential trustworthiness bias.

The relative propensity towards greater trust of novel faces among the PTSD participants seems, on the surface, to be counterintuitive. The accurate perception of others' trustworthiness may be particularly important in environments where the risk for interpersonal trauma is still present. Interpersonal traumas such as physical abuse/assault and sexual trauma were reported at high rates in the present PTSD and TEHC samples. Additionally multiple traumas were reported by approximately 60% of the PTSD and TEHC groups. A consideration of the high rates of these traumas among those with PTSD suggests that a bias towards trustworthiness may not be adaptive.

In contrast, relative bias in the perception of fearfulness was not significantly different between the groups. This suggests that differences observed along the dimension of trustworthiness are not necessarily attributable to differences in the perception of fearfulness. Although other studies have found differences in attentional bias and neurophysiological reactivity to fearful faces, these findings suggest that subjective perception and rating of fearful expressions is not different from healthy controls in PTSD. The social cognitive perception of trustworthiness may occur independently of fear processing, and may be informative in the study of interpersonal functioning in PTSD.

Taken together, this pattern of findings point towards the possibility that individuals with these traits have a bias to perceive more trustworthiness in neutral faces, and that this may reflect a

vulnerability to entering into destructive interpersonal relations that could be potentially traumatic. Anticipation of malevolent intentions of others may be necessary to avoid and avert risky interpersonal interactions. One puzzling dimension of many of those with PTSD is the high likelihood of multiple traumas with revictimization over time, particularly among women (Messman et al., 2010). The present study may provide tentative clues as to a mechanism for such revictimization. Those women who are vulnerable to PTSD and revictimization may be prone to trust others whom others would be likely to mistrust. This may be the consequence of a deficit in reinforcement learning, wherein some women with PTSD are reluctant to leave abusive relationships, as they may over-value the positive aspects of others, while underappreciating their risks and untrustworthy qualities (Pechtel and Pizzagalli, 2013). Such impairments in reinforcement learning may be rooted in interpersonal and self-schemas that reinforce an avoidant and passive orientation towards potential interpersonal threats, and a sense of shame that interferes with self-assertion (Cloitre and Rosenberg, 2006). Conversely, the relative bias away from trustworthiness in the trauma-exposed group without PTSD may represent an adaptive disposition that prevents engagement with potentially risky individuals. Future research is warranted to identify if there is an association between a trustworthiness bias in women with PTSD and their appraisal of risky situations that could lead to revictimization.

The present findings offer a contrast with a prior study applying the same paradigm to participants with Borderline Personality Disorder (BPD), which identified a negative trustworthiness bias and longer RT to trustworthiness perceptions that were ambiguous. This points to potential differences between BPD and PTSD. PTSD and BPD co-occurrence was 30% in one US epidemiological study (Grant et al., 2008). BPD is a personality disorder with trait-like impairments in interpersonal domains that arise from early adversity and dispositional vulnerabilities such as rejection sensitivity (Chesin et al., 2014; Goodman et al., 2014). A prior study found that the untrustworthiness bias was not present in those with BPD and childhood abuse (Fertuck et al., 2013), suggesting that trauma history is less relevant to trustworthiness perception than rejection sensitivity among individuals with BPD. A study of undergraduates supports the mediating role of rejection sensitivity in the positive relationship between BPD symptoms and the perception of facial untrustworthiness (Miano et al., 2013).

The developmental period during which traumas occur is an important consideration in PTSD, BPD, and facial perception. Our findings with the trustworthiness fear task suggest that PTSD and BPD may represent different psychopathological trajectories in response to early trauma. Generally concordant with the present study, one report addressed the role of early abuse and facial processing in children with PTSD symptoms and found an attentional bias to direct attention away from threatening faces (Pine et al., 2005). Similarly, in adult survivors of childhood maltreatment with and without PTSD, an attentional bias to happy faces was a mediator that increased the likelihood of trauma symptoms as sequelae from childhood abuse and trauma (Fani et al., 2011). Though these studies focused on attentional mechanisms, they are broadly consistent with the present finding that those with PTSD exhibit a rating bias to perceive neutral faces as more trustworthy. Focusing on positive cues may be an attentional strategy that characterizes a trajectory from childhood abuse leading to PTSD. This trajectory may be in contrast to a developmental pathway that leads to BPD, which is characterized by an untrustworthiness bias that appears in the absence of childhood abuse status (Fertuck et al., 2013). One protective factor in these trajectories may be the quality of attachment with primary caregivers in childhood (Ensink et al., 2015), so future studies could investigate attachment as a mediator between childhood trauma and forms of psychopathology such as PTSD and BPD. In this context, it is noteworthy that while a greater percentage of those with PTSD reported a sexual trauma, this did not reach statistical significance. However, it is possible that a greater trustworthiness bias may be particularly salient for sexual abuse relative to other forms of abuse and this warrants further study.

Finally, neurobiological factors may also shape these developmental trajectories. Neuroimaging studies comparing PTSD to BPD are lacking according to a recent review (Krause-Utz et al., 2014). In BPD, a reactive limbic system and an impaired executive control mediated by frontal regions may underlie core features of BPD such as impulsivity and interpersonal disturbances that may also underlie some subtypes of PTSD. Trustworthiness perception is also mediated by amygdala activity (Said et al., 2008) and other neural mechanisms that also inform the development of psychopathology as well (Erbe et al., 2012). Facial fear processing has been extensively studied in basic and clinical research, and in PTSD in particular, so it is noteworthy that there were non-significant results in fear processing in the present study. One possibility is that amygdala reactivity was not assessed in present study, and that is a common index of hyper-reactivity in BPD with fear stimuli. Another possibility is that fearful faces are relatively low arousal stimuli that may not have elicited a strong enough arousal to detect group differences in fear processing. In general, given the high percentage of interpersonal trauma in the present sample (as contrasted with combat, terrorism and natural disasters which may be more germane to fear processing) trustworthiness perception may be a more salient process for some with PTSD. Future investigations could assess more specifically whether the type of index trauma influences trustworthiness vs. fear processing in a more focused fashion.

Several limitations must be noted. Data from several subjects could not be included due to their non-task related responses on the experimental task. However, the exclusion of invalid data improved the signal to noise ratio in the experimental task. Although the inclusion of both trauma-exposed and non-exposed control groups is a methodological strength, the relatively small sample size may have limited the power to detect small or medium effect size differences between the three groups. However, our sample size was adequate to detect the large effect size difference between PTSD and both control groups. One advantage of the facial morphing task is that it compares three parameters of psychophysical performance—discriminability, sensitivity, and response bias—to show that the perceptual mechanisms used to assess whether fear or trust in particular, are impaired in PTSD. Signal detection theory (Green and Swets, 1974) is a framework that may aid in resolving the nature of psychophysical differences between groups. By parametrically manipulating the intensity of a stimulus, it is possible to determine whether differences between groups are due to perceptual (sensitivity or discriminability) or response (bias) properties of the decision. Thus, we could identify if there was a general “numbing” of perception as represented by low sensitivity and discriminabilty, or, a general shift in the ratings across intensities of the stimulus. The only difference we found was in the bias of trustworthiness, suggesting that numbing was not a likely consequence of trauma, even for the fear condition. The main disadvantage would be if we had identified a limit in the dynamic range (difference between the highest and lowest ratings across morphs), which we did not observe in the present study. If there was a limit in the dynamic range, then it may have been difficult to detect group differences at the most and least extreme intensities of trustworthiness or fear.

Future studies with larger samples can evaluate how race, sex, and other properties of the facial stimuli, as well as demographic and trauma characteristics of the participants, moderate any differences between the groups. In particular, early trauma in the

context of a relationship with a caregiver may be particularly important to consider with regard to trustworthiness perception, as the dependent child is more reliant on attachment figures, even if they are abusive or neglectful. It is possible that bias towards or against trustworthiness perception is part of a complex set of factors that distinguish the trajectories of PTSD from recovery after trauma, but whether these biases are pre-existing or develop alongside each respective trajectory cannot be determined from the current study.

5. Conclusion

Individuals with PTSD, trauma-exposed controls, and controls without trauma history rated stimuli that varied in the intensity of facial expression along the dimensions of fearfulness and trustworthiness. Although there were no differences between the groups in their mean perception of fearfulness, the PTSD group rated faces as more trustworthy relative to the trauma-exposed controls. Further research is necessary to examine whether these differences are a vulnerability factor in the PTSD group, or an adaptive response among individuals who are resilient or recover from traumatic experiences.

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