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Emotional, cognitive and physiological correlates of abuse-related stress in borderline and antisocial personality disorder

Jill Lobbestael*, Arnoud Arntz

Department of Clinical Psychological Science, Maastricht University, PO Box 616, 6200 MD Maastricht, The Netherlands

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ABSTRACT

Childhood abuse is an important precursor of borderline personality disorder (BPD) and antisocial personality disorder (ASPD). The current study compared the emotional reactivity to abuse-related stress of these patients on a direct and an indirect level. Changes in self-reported affect and schema modes, psychophysiology and reaction time based cognitive associations were assessed following confrontation with an abuse-related film fragment in patients with BPD ($n = 45$), ASPD ($n = 21$), Cluster C personality disorder ($n = 46$) and non-patient controls ($n = 36$). Results indicated a hyperresponsivity of BPD-patients on self-reported negative affect and schema modes, on some psychophysiological indices and on implicit cognitive associations. The ASPD-group was comparable to the BPD group on implicit cognitions but did not show self-reported and physiological hyper-reactivity. These findings suggest that BPD and ASPD-patients are alike in their implicit cognitive abuse-related stress reactivity, but can be differentiated in their self-reported and physiological response patterns.

Introduction

One of the main common etiological precursors of borderline personality disorder (BPD) and antisocial personality disorder (ASPD) is childhood trauma. Both BPD and ASPD have been linked to a broad range of abusive events but sexual and emotional abuse seem to stand out in BPD-patient's history (Battle et al., 2004; Johnson, Cohen, Brown, Smailes, & Bernstein, 1999; Lobbestael, Arntz, & Bernstein, in press) and physical abuse in ASPD-patients (Bernstein, Stein, & Handelsman, 1998; Bierer et al., 2003; Lobbestael, Arntz, & Bernstein, in press; Lobbestael, Arntz, Harkema-Schouten, & Bernstein, 2009; Lobbestael, Arntz, Löbbes, & Cima, in press). Although quite a lot is known about maltreatment precursors of BPD and ASPD, the influence of abuse-related stressful stimuli on these patients has hardly been studied. Schmahl, Elzinga, et al. (2004) compared the physiological reactivity to abandonment and abuse-related scripts of BPD-patients with post-traumatic stress disorder patients but did not found any difference between these groups. Brain imaging studies indicated that over- versus under-reactivity in different areas of dorsolateral and medial prefrontal cortex correlated to traumatic memory in BPD-patients (Schmahl, Vermetten et al., 2004), while abandonment memories caused a greater increase in bilateral dorsolateral prefrontal cortex activity in women with BPD compared to women without BPD (Schmahl et al., 2003). To our best knowledge, the impact of abuse-related stress on ASPD-patients has not been studied yet. In fact, little is known about the biological, emotional and cognitive sequelae of BPD and ASPD in general, including how these disorders differ from each other and from other forms of psychopathology. The current study tests whether salient and prolonged reminders of mixed childhood abuse are responsible for emotional, psychophysiological, and cognitive dysregulation in BPD and ASPD. Comparing abuse-related reactivity between BPD and ASPD-patients could contribute to the understanding of the differences between these two closely related personality disorders. Furthermore, the current study can contribute to the ongoing debate on whether BPD is characterized by a BPD-theme specific (i.e., abuse) emotional hyperresponsivity (Arntz, 2005). In addition, the use of prolonged presented abuse-related stimuli more closely resembles real-life encounters and therefore can provide a more realistic insight into emotional reactivity.

The aim of this study was to investigate the effects of abuse-related stimuli in BPD and ASPD-patients, both at a direct and an indirect level. On a direct level, the effect of abuse-related stress was evaluated by means of self-reported affect and schema modes. Schema modes originate from Schema Therapy (Young, Klosko, & Weishaar, 2003) and represent the momentary emotional and

* Corresponding author. Tel.: +31 43 3881611; fax: +31 43 388 4155.
E-mail addresses: Jill.Lobbestael@maastrichtuniversity.nl (J. Lobbestael), Arnoud.Arntz@maastrichtuniversity.nl (A. Arntz).

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cognitive states and coping responses that are active at a given point in time. Modes can be seen as the different aspects of one's personality, and each individual has several modes. Schema modes can be triggered by emotional events and an individual may shift from one schema mode into another. This way, the schema mode concept describes the rapid shifting in emotion and behaviour demonstrated by patients suffering from severe personality disorders. Modes can be maladaptive or adaptive. The more severe the personality pathology, the stronger the presence of the maladaptive modes and the higher the number of modes a person has and the more mode switches occur. The maladaptive modes are divided into four categories; dysfunctional child modes that result out of unmet core childhood needs; dysfunctional coping modes that correspondent to an overuse of the fight, flight or freeze coping styles and dysfunctional parent modes that reflect negative behaviour of the patient's parent(s) towards the patient as a child that the patient has internalized. The adaptive modes reflect healthy thoughts, feelings and behaviours. A self-report study has demonstrated BPD to be characterized by 9 maladaptive modes, while ASPD was linked to the Enraged Child and the Bully and Attack modes (Lobbestael, van Vreeswijk, & Arntz, 2008). But, assessment by therapists suggests that more schema modes are prominent in ASPD-patients than they report themselves (Lobbestael, Arntz, Löbbes, et al., in press).

Since affect assessment by means of self-report is vulnerable to bias due to lack of self-knowledge or avoidance of negative thoughts and feelings (Wilson & Dunn, 2004), and lying and conning are central diagnostic features of ASPD (APA, 2005), the use of indirect measures is advisable. Therefore, the current study incorporated two types of indirect measures to assess the impact of abuse-related stimuli; psychophysiological indices and a reaction time based paradigm to measure the implicit association between the self and abuse. The latter paradigm was operationalized with the Single Category Implicit Association Test (SC-IAT, Karpinski & Steinman, 2006), a variant of the classical Implicit Association Task (IAT, Greenwald, McGhee, & Schwartz, 1998) in which associations with single targets like the self-concept can be measured without the need for an opposite category.

In sum, the central question of this study was: Do BPD and ASPD-patients differ in their reaction to abuse-related stimuli on self-reported affect, self-reported schema modes, psychophysiological reactivity, and on implicit abuse-related self-image? We expected BPD-patients to display a stronger intensity of affective experiences in reaction to the abuse-related stimuli relative to control patients and non-patients. Due to similarities between BPD and ASPD (APA, 2005; Paris, 1997) and the common etiological influence of abuse, it was hypothesized that BPD and ASPD-patients would show a similar response pattern to abuse-related stimuli on levels the person cannot easily control. Since antisocials tend to underreport the impact of negative events, it was expected that the ASPD-group would indicate a lower increase in self-reported indices of negative affect and schema modes than the BPD group. In contrast, we expected a similar abuse-related reactivity in BPD and ASPD-patients at an indirect level (i.e., the physiological indices and the implicit association task). Additionally, this study assessed the severity of childhood trauma in BPD and ASPD-patients and tested the effect of trauma severity on the changes in the direct or indirect abuse-related reactivity. Finally, the level of psychopathy was assessed in the ASPD-group and the predictive value of psychopathy on abuse-related stress was tested. We compared, according to DSM-IV (APA, 2000), a BPD group, a ASPD-group (with varying degrees of psychopathy), and a Cluster C PD (ClC-PD) patient group, next to a non-patient control group (NpC). By using NpCs as a control group, it can be tested whether results indicate a general Axis II response pattern, while inclusion of ClC-PD patients permits drawing PD cluster-specific conclusions.

Method

Participants

Data were analyzed from $N = 147$ participants, divided into four groups: patients with BPD ($n = 45$), patients with ASPD ($n = 21$), patients with cluster C personality disorder (ClC-PD, $n = 46$) and non-patient controls without psychopathology (NpC, $n = 35$). Of the ClC-PD group, 32 patients had an avoidant PD, 6 a dependent PD, and 19 an obsessive-compulsive PD. Nine patients of this group suffered from two ClC-PDs, and one patient had all three ClC-PD diagnoses. Patients were recruited from clinical, ambulant and forensic institutes of mental health care within the Netherlands and Belgium. The patients of the clinics and prisons were contacted to participate in this study by their therapists who were informed about the in- and exclusion criteria of the patients targeted for this study. The therapists provided general verbal information and an information letter of this study to these patients and if the patients indicated that they were willing to participate, they were contacted by the experimenter. NpCs were recruited by means of advertisement in local papers.

General exclusion criteria were psychotic or bipolar disorder, age <18 and >60, intoxication by alcohol or drugs during testing, IQ below 80 and not being a native speaker of Dutch. The non-BPD participants were not allowed to have more than two BPD criteria, and the non-ASPD participants were not allowed to have more than two ASPD criteria. The characteristics of the study groups are presented in Table 1.

Testing of between group differences revealed that the ASPD-group contained fewer women and the BPD group fewer men than the other groups and that the ASPD-group was significantly lower educated than the other groups. Further analyses of this study were corrected for gender, but not for education since a lower education level is inherent to ASPD (Robins, Tipp, & Pzybeck, 1991). The ASPD-group had a significantly smaller number of axis I disorders compared to the BPD and ClC-PD groups, but the patient groups did not differ with respect to number of axis II disorders. The ethical committee of the Academic Hospital of Maastricht (the Netherlands) approved this study. Before starting the study, all participants gave written informed consent. The same study group was used for the study 'Effects of induced anger in patients with antisocial personality disorder'(Lobbestael, Arntz, Cima, & Chakhssi, 2009). Data were described in two different manuscripts because of different research questions. Collection of the data for the two studies was performed in different sessions.

Materials

Screening

Axis I and II diagnoses were made using the DSM-IV criteria with the Dutch versions of the Structured Clinical Interview for DSM-IV Axis I disorders (SCID I, First, Spitzer, Gibbon, & Williams, 1997; van Groenestijn, Akkerhuis, Kupka, Schneider, & Nolen, 1999) and the Structured Clinical Interview for DSM-IV Axis II disorders (SCID II, First, Spitzer, Gibbon, Williams, & Benjamin, 1994; Weertman, Arntz, & Kerkhofs, 2000). Diagnoses were made by the first author or graduate students who underwent an intensive training program. Of the current sample, 97 SCID interviews were rated twice, yielding high inter-rater reliability values for SCID I (Kappa values between .98 and 1.00) and SCID II (ICCs between .88 and .99). Psychopathy was assessed using the Psychopathy Checklist-revised (PCL-r, Hare, 2003) supplemented by collateral data

Table 1
Comparison between the groups on the demographic measures.

	BPD ($n = 45$)	ASPD ($n = 21$)	ClC-PD ($n = 46$)	NpC ($n = 35$)	Statistics	*P* value
Gender						
Men	12	16	17	16	$\chi^2 = 15.14$	.002
Women	33	5	29	19		
Age	33.82 (7.83)	30.29 (7.79)	35.80 (9.32)	36.91 (11.84)	Kruskall–Wallis: $\chi^2 = 6.52$	.09
Education					Kruskall–Wallis: $\chi^2 = 42.96$	<.001
No education	–	2	–	–		
Primary school	5	10	2	–		
High school	17	6	10	6		
Secondary education	19	3	21	16		
Higher education	4	–	13	13		
Number axis I disorders	3.18 (1.44)	1.67 (1.59)	3.09 (1.74)	–	Kruskall–Wallis: $\chi^2 = 15.31$	<.001
Number axis II disorders	2.02 (1.12)	1.57 (.65)	1.50 (.59)	–	Kruskall–Wallis: $\chi^2 = 4.99$	.09

from the patient files. Ratings were made by the first author or staff of the forensic clinics. Previous studies revealed a two-factor, four facet hierarchical model of the PCL-r (Bolt, Hare, Vitale, & Newman, 2004; Hare, 2003). The four facets are: interpersonal (facet 1), affective (facet 2), lifestyle (facet 3) and antisocial (facet 4). These four facets load onto two higher order factors: interpersonal (factor 1), and lifestyle/antisocial (factor 2). The total level of psychopathy, the scores on the PCL-r factors and facets were expressed continuously.

Traumatic events

The Interview for Traumatic Events in Childhood (ITEC, Lobbestael, Arntz, Kremers, & Sieswerda, 2006) was used to assess five forms of childhood maltreatment prior to the age of 18: sexual, physical and emotional abuse and emotional and physical neglect. This interview specifies the actions, age of onset, perpetrator(s), frequency and duration of childhood trauma. The interview has predetermined answer categories and results in composite scores for each of the abuse and neglect scales separately and a total abuse severity score. The higher the composite score, the higher the severity of trauma. Psychometric properties of the ITEC were adequate (Lobbestael, Arntz, Harkema-Schouten, & Bernstein, 2009).

Abuse-related stress induction

Abuse-related stress was induced by means of confrontation with an abuse scene of 20 min derived from the movie 'No child of mine' by Hibbert and Kosminsky (1997). In this fragment, a 13-year old girl was physically, emotionally and sexually abused and neglected by her parents and other caretakers. Film fragments might be especially suitable as an abuse-related stress induction since media presentations were the most commonly reported trigger of recall of trauma by abuse victims (Elliott, 1997).

Dependent variables

Direct assessment. Self-reported affect was assessed by means of the Profile of Mood States (POMS), short version (McNair, Lorr, & Droppleman, 1992), with five subscales of tension, depression, anger, vigour, and fatigue. The current study reports on the composite scores of the POMS representing all self-reported negative affect (SRNA), with internal consistencies varying between $\alpha = .94$ (pre measurement) and $\alpha = .95$ (post measurement). Schema modes were measured with an abbreviated version of the Schema Mode Inventory (SMI, Young et al., 2007) consisting of 3 items for each of the 14 schema modes; Vulnerable Child, Angry Child, Enraged Child, Impulsive Child, Undisciplined Child, Happy Child, Compliant Surrender, Detached Protector, Detached Self-Soother, Self-Aggrandizer, Bully and Attack, Punitive Parent, Demanding Parent and Healthy Adult modes (see Lobbestael et al., 2008 for descriptions of the modes). Each item had to be scored on a 100 mm VAS scale ranging from 'not at all true' to 'completely true'. An overall score was calculated from the scale sum score divided by three. A psychometric study of the complete version of the SMI (124 items) demonstrated good reliability and validity (Lobbestael, van Vreeswijk, Spinhoven, Schouten, & Arntz, under revision). Internal reliability values of the abbreviated version of the SMI used in the current study varied between $\alpha = .54$ and $\alpha = .88$ with a mean of $\alpha = .72$. Because of the high number of schema modes assessed in this study, baseline and change scores of the schema modes were averaged for the adaptive modes (i.e., the Happy Child and the Healthy Adult modes, Cronbach's alpha between $\alpha = .87$ and $\alpha = .91$) and the maladaptive modes (i.e., the other 12 modes, Cronbach's alpha between $\alpha = .93$ and $\alpha = .94$).

Indirect assessment. To record heart rate, Blue sensor electrodes were attached over the lower rib on the left side of the trunk and to the subject's chest to record a lead II electrocardiogram. Heart rate was expressed as the number of beats per minute. To monitor palm sweat gland activity, Ag/AgCl electrodes (8 mm diameter) filled with isotonic paste were attached to the volar surface of the medial segment of the middle and ring finger of the non-dominant hand. A Galvanic Skin Response coupler supplied a constant .5 Voltage to assess skin conductance response (SCR) and level (SCL). SCR was defined as every response larger than .02 μS and smaller than 30 μS. The number of SCRs was counted during each assessment and divided by the duration of that assessment. Facial EMG was recorded bipolarly over the corrugator supercilli (frowning). The electrodes were placed on the left side of the face with 4 mm standard Ag/AgCl electrodes. Heart rate, SCR, SCL and EMG were recorded using the Vitaport III system, a portable continuously measuring physiological device, and analyzed off-line by means of a specially designed computer program. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured four times at each assessment using Omron M5-I via a standard cuff placed on the subject's right arm above the elbow. The SC-IAT measured the association between self and abuse. Participants were presented with words belonging to a target category or one of the two attribute categories, which they had to classify by pressing the left or right response key (Karpinski & Steinman, 2006). The target category of the SC-IAT consisted of individualized self-related items (first name, second name, date of birth, street[1], city[1], and school[1]), and two attribute categories of 'abuse' (maltreated, abandoned,

[1] Since self-image related to abuse was hypothesized to be associated with negative experiences during childhood, the individualized items of these words referred to the street, city and school the participant lived in or attended for the most part between the age of 5 and 12. This way we attempted to make the self-category childhood related.

powerless, helpless and lonely) and 'love' (loved, safe, wanted, hold, protected and secure). The time between the appearance of the word on the computer screen and the first key press was measured. The SC-IAT consisted of three practice blocks and two test blocks. In the first test block, 'self' and 'abuse' words had to be attributed to the same response button and 'love' to the other button. In the second test block 'self' and 'love' were assigned to the same response button and 'abuse' to the other button. Presentation order of the attribute category was randomized. Participants were presented with identical SC-IATs before and after the abuse-related stress induction. When compatible categories are assigned to the same response button, reaction times should be faster as compared to when both categories are incompatible. By comparing the average reaction time of the compatible block with that of the incompatible, the extent to which targets are associated with one versus the other attribute can be measured (Karpinski & Steinman, 2006).

Procedure

After signed consent was obtained, SCID I, SCID II and (for the ASPD-group) the PCL-r were administered. Next, electrodes and blood pressure cuff were attached. The experiment was divided into three different phases: (i) the neutral phase, in which participants had to watch a movie about monkeys (10 min, used as baseline, music by Oldfield, 2001), (ii) the abuse-related stress induction phase (film fragment, 20 min), and (iii) the positive induction phase, in which participants were shown a fragment of a Mr. Bean movie ('It started with a sneeze', 10 min). This last phase was included to minimize lasting impact of the stress induction on the participants. After each phase, participants filled in the POMS and the abbreviated SMI, while their blood pressure was recorded, and then completed the SC-IAT (except after the positive induction). The experimenter stayed in the test room with the participant during the entire experiment to ensure that participants watched and attended the movie segments. Other physiological variables were measured continuously throughout the experiment. Finally, the experimenter removed the electrodes. The ITEC interview was administered in a second session. At the end of the sessions, subjects were given a small financial compensation and were informed as to the nature of the study.

Statistical analyses

All dependent variables were transformed into change scores (post minus pre stress induction). The SC-IAT effect was defined as the difference in reaction time between self-words when associated with abuse compared to love. A positive SC-IAT score reflects a stronger self-abuse than self-love association, a negative SC-IAT score reflects a stronger self-love than self-abuse association. The dependent variable of the SC-IAT analyses was the change score of SC-IAT effect from baseline to post-stress induction phase. A positive SC-IAT change score reflected an increase in self-abuse association from baseline to stress induction phase, and negative SC-IAT change scores reflected a decrease in self-abuse association.

A robust approach was chosen to analyze the changes in the dependent variables since inspection of the data showed non-normal distributions of these variables. Specifically, ordinal regressions (PLUM in SPSS) were used. The main effect of gender was assessed by putting in gender as an extra factor. Because some of the group × gender cells were too small, a full-factorial gender by group analyses could not be performed. Instead, only the main effect of gender was evaluated. When the gender effect was not significant, it was left out of further analyses. Since age appeared to partly predict some of the dependent variables, the main effect of age was assessed by putting in age as a covariate. When age was not significant, it was left out of further analyses. To test whether the dependent variables changed from baseline to abuse-related stress phase robust effect sizes were calculated with the following non-parametic formula: $\delta_R = .642\ (\mu_{t2} - \mu_{t1}/\sigma_w)$, with $\mu_t = 20\%$ trimmed mean and $\sigma_w =$ winsorized standard deviation (Algina, Keselman, & Penfield, 2005). An effect size of $\delta = .30$ was interpreted as a small effect or increase from pre to post-stress induction phase, an effect size of $\delta = .50$ as a medium effect, and an effect size of $\delta = .80$ as a large effect (Cohen, 1992). Wald values of the PLUM analyses were used to compare group differences. The severity of childhood abuse history between the groups was calculated with ordinal regression analyses and Wald group comparisons. The relationship between the severity of childhood trauma and the dependent variables were tested by means of Spearman's rho correlations. Finally, it was tested whether the ASPD-patients' level of psychopathy predicted the abuse-related responses by means of ordinal regression analyses.

Results

Self-reported negative affect

At baseline, there was no main effect of gender on the SRNA, $p = .40$. The patient groups indicated a higher baseline level of negative affect than the NpC group while that of the ClC-PD and BPD groups were higher than that of the ASPD-group (Tables 2 and 3). Results on the change scores of the SRNA revealed no significant main effect of gender, $p = .10$, or of age, $p = .26$. There was a significant change in all groups of the SRNA indicating that negative affect increased significantly after stress induction (Table 4). The effect sizes were large for BPD and ClC-PD groups and medium for ASPD and NpC groups (Table 4). Group difference analyses revealed that the BPD group displayed a stronger increase in SRNA than the ASPD and the NpC groups (Table 5).

Schema modes

At baseline, there was no main effect of gender on the level of the adaptive or maladaptive modes, p's $> .27$. The patient groups indicated a higher baseline level of maladaptive modes than the NpC group, and BPD and ClC-PD higher than the ASPD-group. The opposite pattern was found for the adaptive modes (Tables 2 and 3). Results on the change scores of the maladaptive and adaptive modes revealed no significant main effect of gender, p's $> .32$, or of age, p's $> .31$. There was a significant increase of the maladaptive modes, and a significant decrease of adaptive modes in the BPD group (Table 4). Group differences showed that the BPD group indicated a stronger increase in maladaptive modes than the other groups. There were no group differences regarding the change in adaptive modes (Table 5).

Physiological measures

At baseline, there was no main effect of gender on DBP, SCR, or SCL p's $> .06$. There was a main effect of gender on HR, SBP and frowning which were higher in men, *Wald*'s > 7.33, p's $< .004$. There were no group differences in baseline HR, DBP and SCL levels. The BPD group displayed a lower baseline level of SBP compared to the NpC group, and a lower SCR baseline level than the ASPD and NpC groups. The ASPD-group had a higher baseline SCR level compared to the ClC-PD group. The baseline frowning level of the ASPD-group was lower compared to those of the other groups (Tables 2 and 3). Results on the change scores of the physiological indices revealed no significant main effect of gender, p's $> .12$. The change scores did

Table 2
Medians, quartiles (25th percentile and 75th percentile) of the baseline levels of all dependent variables.

Dependent variables	BPD			ASPD			ClC-PD			NpC		
	Median	25per	75per	Median	25per	75per	Median	25per	75per	Median	25per	75per
SRNA[a]	41.00	21.00	54.50	18.00	12.00	27.50	43.50	22.50	64.25	9.00	6.00	14.00
Mal[b]	45.49	39.44	52.01	27.36	17.40	35.03	43.61	34.15	51.97	14.29	8.72	21.07
Adap[c]	49.33	40.38	62.79	65.00	54.92	78.25	47.33	36.17	61.88	83.83	77.83	92.83
HR[d]	78.76	69.89	84.36	73.96	67.20	82.76	76.86	71.21	84.50	74.65	67.30	82.64
SBP[e]	113.75	108.38	119.88	118.88	111.63	129.06	119.50	109.17	134.38	121.25	115.75	131.50
DBP[f]	76.00	73.50	81.75	77.00	62.38	83.50	80.33	73.88	88.00	79.75	73.50	85.50
SCR[g]	1.90	.90	4.77	7.71	3.70	10.42	3.88	.50	6.21	4.71	2.72	7.52
SCL[h]	2.51	1.54	4.55	3.06	1.67	4.37	2.83	1.80	3.86	3.65	2.23	5.30
Frowning	19.42	10.79	554.59	9.75	5.82	33.83	28.79	11.23	80.99	19.27	10.96	131.03
SC-IAT[i]	80.92	1.43	187.13	185.32	−7.66	255.16	30.69	−34.55	72.32	72.05	30.18	161.83

[a] self-reported negative affect.
[b] maladaptive schema modes.
[c] adaptive schema modes.
[d] heart rate.
[e] systolic blood pressure.
[f] diastolic blood pressure.
[g] skin conductance response.
[h] skin conductance level.
[i] Single-category implicit association task.

not reveal a significant effect of age for DBP, SCR, SCL and frowning, *p*'s > *.10*, while age did significantly influence the change scores of HR, $p = .004$, and SBP, $p < .001$. HR significantly decreased in all groups (all large effects). SBP significantly increased in the BPD and ClC-PD groups (small and medium effects, *respectively*), and DBP significantly increased in the BPD and ClC-PD groups (medium effects) and in the NpC group (small effect). SCR significantly increased in the BPD group (medium effect), while frowning significantly decreased in the BPD group (small effect). Finally, SCL significantly increased in the BPD and ClC-PD groups (small effects, Table 4). Both BPD and ClC-PD groups showed a smaller decrease in HR compared to the NpC group. The BPD group showed a stronger increase in SBP compared to the NpC group, while the ClC-PD group showed a higher increase in SBP compared to the ASPD and NpC groups. There were no group differences in the change scores of DBP and SCL. The BPD group showed a stronger increase in SCR compared to the ASPD and the NpC groups. The ASPD and ClC-PD groups displayed an increase in frowning activity and the BPD group a decrease, which significantly differed from each other (Table 5).

Table 3
Group contrasts (Wald values) of all baseline scores of all groups.

Dependent variables	BPD vs ASPD	BPD vs ClC-PD	BPD vs NpC	ASPD vs ClC-PD	ASPD vs NpC	ClC-PD vs NpC
SRNA[a]	10.71**	.70	49.24**	−15.11**	12.75**	57.22**
Mal[b]	23.53**	−.92	66.82**	−18.12**	12.85**	59.24**
Adap[c]	7.69*	−.72	45.74**	−11.63**	13.67**	53.76**
HR[d]	1.14	.00	1.46	−1.22	.00	1.59
SBP[e]	−2.89	−1.56	−6.23*	−.53	−.16	−1.88
DBP[f]	.28	−1.31	−.60	−1.99	−1.24	−.09
SCR[g]	−13.18**	−1.95	−7.95*	6.76*	1.23	−2.62
SCL[h]	.12	.71	−3.84	−1.06	−3.87	−1.54
Frowning	8.12*	.10	.56	−7.12*	−4.43*	.23
SC-IAT[i]	−1.15	6.09*	−.02	9.02*	.82	−5.91*

*$p < .05$; **$p < .001$.
[a] self-reported negative affect.
[b] maladaptive schema modes.
[c] adaptive schema modes.
[d] heart rate.
[e] systolic blood pressure.
[f] diastolic blood pressure.
[g] skin conductance response.
[h] skin conductance level.
[i] Single-category implicit association task.

SC-IAT

At baseline, there was a main effect of gender on the SC-IAT, $Wald = 11.64$, $p = .001$, indicating that men had a stronger SC-IAT effect (i.e. association between self and abuse) at baseline than women. BPD, ASPD and NpC groups had a higher baseline SC-IAT score than the ClC-PD group (Tables 2 and 3). The effect size indicated a significant change of the SC-IAT effect from the baseline to the stress induction phase in the BPD and ASPD-groups, both small effects (Table 4). Results on the change scores of the SC-IAT revealed no significant main effects of gender, $p = .07$, or age, $p = .71$. The BPD-group displayed a stronger change towards a self-abuse association than the ClC-PD and the NpC groups (Table 5).

Childhood trauma

There was no main effect of gender on the severity of abuse, $Wald = 3.05$, $p = .08$. The patient groups had higher childhood abusive scores than the NpC group, and the BPD group had higher scores than the ClC-PD group (see Table 6).

Influence of trauma history on abuse-related reactivity

The severity of childhood trauma was significantly positively correlated with the changes on SRNA, *Spearman's rho = .29*, $p < .001$, the maladaptive and the adaptive modes, *Spearman's rho = .27 and −.20*, $p = .002$ *and .02 respectively*, SBP, *Spearman's rho = .22*, $p = .009$ and DBP, *Spearman's rho = .19*, $p = .03$.

Influence of psychopathy

Attempts to predict abuse-related reactivity from the PCL-r total, factor 1 or 2 or facet 1–4 did not reveal any significant results.

Discussion

To our knowledge, this is the first study to assess the impact of traumatic stimuli on patients with BPD and ASPD on a broad range of outcome measures i.e., self-reported affect, schema modes, psychophysiology and implicit self-abuse association. Our hypothesis of a stronger reaction to abuse-related stimuli in BPD-patients was supported on a direct level (i.e., self-reported negative affect and schema modes), and partly supported on an indirect level

Table 4
Medians, quartiles (25th percentile, and 75th percentile), and effect sizes of the change scores of all dependent variables for all groups.

Dependent variables	BPD				ASPD				ClC-PD				NpC			
	Change score				Change score				Change score				Change score			
	Median[j]	25per	75per	ES[k]	Median[j]	25per	75per	ES[k]	Median[j]	25per	75per	ES[k]	Median[j]	25per	75per	ES[k]
SRNA[a]	17.50	8.00	35.00	.88*	5.00	−.50	27.50	.51*	14.00	2.50	25.00	.80**	5.00	1.00	18.00	.68**
Mal[b]	3.38	−.41	9.46	.47*	−.17	−4.98	5.62	.00	.45	−1.99	2.73	.08	−.33	−1.64	2.46	.00
Adap[c]	−4.08	−13.88	4.33	.34*	−2.50	−16.17	6.08	.20	−1.50	−7.42	3.25	.27	−.67	−7.83	3.33	.20
HR[d]	−1.99	−4.42	−.70	.95*	−3.72	−6.10	−1.60	1.21*	−2.28	−4.00	−2.28	.89*	−3.34	−6.67	−1.89	1.13**
SBP[e]	1.25	−1.62	6.63	.34*	−1.88	−5.63	4.69	.09	2.25	−.75	6.88	.54**	−.75	−4.00	4.00	.03
DBP[f]	2.50	−.13	4.46	.62*	.87	−2.13	2.75	.22	2.00	.13	5.00	.61**	1.50	−.50	4.75	.44*
SCR[g]	.63	−.20	1.83	.56*	−.77	−2.12	1.10	.40	2.25	−.75	6.88	.12	−.19	−1.77	1.08	.18
SCL[h]	.21	−.07	.69	.28*	.01	−.19	.44	.14	.12	−.12	.36	.32*	.04	−.49	.32	.03
Frowning	−8.31	−37.14	8.71	.39*	10.34	−10.42	51.91	.36	−3.31	−29.43	31.17	.06	9.26	−24.31	94.70	.22
SC-IAT[i]	−106.19	−262.55	60.67	.42*	−35.34	−142.04	28.91	.39*	13.51	−88.52	81.77	.05	−11.61	−91.72	76.70	.08

*$p < .05$; **$p < .001$. The p-levels are associated with the robust pre-post changes of the within-sample tests.
[a] self-reported negative affect.
[b] maladaptive schema modes.
[c] adaptive schema modes.
[d] heart rate.
[e] systolic blood pressure.
[f] diastolic blood pressure.
[g] skin conductance response.
[h] skin conductance level.
[i] Single-category implicit association task.
[j] positive scores indicate increases in dependent variables, and negative scores indicate decreases in dependent variables.
[k] robust standard deviation ($\sqrt{s^2_w}$)/.642 (;s^2_w = winsorized variance).

(HR, SCR and SBP, and implicit cognitive abuse-related cognitions). To our best knowledge, only one previous study (Arntz, Klokman, & Sieswerda, 2005) tested the impact of traumatic stimuli on self-reported affect and also found self-reported emotional hyperresponsivity in BPD-patients. Schmahl, Elzinga, et al. (2004); Schmahl, Vermetten, et al. (2004) were the only ones to assess the impact of abusive stimuli on physiological reactivity in BPD and also found BPD-patients to respond with greater SCR to abandonment scripts. As far as we know, this is the first study that extended the evidence of trauma-related emotional hyperresponsivity in BPD to an indirect cognitive level. Other studies on emotional reactivity in BPD-patients mainly focused on *general* emotional reactivity (Herpertz et al., 2001; Herpertz, Gretzer, Muhlbauer, Steinmeyer, & Stass, 1998; Herpertz, Kunert, Schwenger, & Sass, 1999; Herpertz et al., 2000; Koenigsberg et al., 2002; Levine, Marziali, & Hood, 1997; Renneberg, Heyn, Gebhard, & Bachmann, 2005) and yielded conflicting results. This might suggest that BPD-patients are not characterized by a general emotional hyperresponsivity as Linehan (1993) suggested, but that the emotional reactivity pattern of BPD-patients depends on the emotion that is targeted. Because of its unique focus on emotional reactivity in response to trauma-related stimuli however, the current study does not allow to draw any general conclusions with respect to Linehan's hypothesis. Future studies should aim to do so by systematically comparing emotional reactivity in BPD-patients to a range of specific stressors.

Although several physiological indices seemed to indicate abuse-related hyperresponsivity in BPD, facial activity was an exception to this since frowning diminished in BPD-patients. Herpertz et al. (2001) also demonstrated little facial frowning activity and Renneberg et al. (2005) little overall facial expression in BPD-patients when viewing pleasant or unpleasant slides. Following Herpertz et al. (2001), we think that this might reflect a restrictive expression and communication of emotions in BPD. Other possible interpretations are that BPD-patients lack facial expressions

Table 5
Group contrasts (Wald scores) on the change scores of all dependent variables.

Dependent variables	BPD vs ASPD		BPD vs ClC-PD		BPD vs NpC		ASPD vs ClC-PD		ASPD vs Nap		ClC-PD vs NpC	
	Wald	p	Wald	p	Wald	p	Wald	p	Wald	p	Wald	p
SRNA[a]	5.03*	.03	2.48	.12	9.27*	.002	−1.02	.31	.14	.71	2.67	.10
Mal[b]	5.18*	.02	4.44*	.04	4.48*	.03	−.38	.54	.21	.65	.03	.87
Adap[c]	.10	.75	−.62	.43	−.57	.45	−.10	.76	−.10	.75	.00	.99
HR[d]	3.13	.08	−.10	.76	6.69*	.01	−2.30	.13	.19	.66	5.46*	.02
SBP[e]	2.78	.10	−.35	.56	3.70*	.05	−4.40*	.04	−.002	.96	6.09*	.01
DBP[f]	1.95	.16	−.006	.94	.43	.51	−2.12	.15	−.67	.41	.53	.47
SCR[g]	7.68*	.006	1.42	.23	5.69*	.02	−3.50	.06	.42	.52	1.82	.18
SCL[h]	.80	.37	−.22	.64	2.90	.09	−.28	.60	.35	.55	1.70	.19
Frowning	−4.39*	.04	−.93	.34	−5.95*	.02	1.83	.18	.00	.99	−2.50	.11
SC-IAT[i]	.65	.42	7.21*	.007	4.72*	.03	1.88	.17	1.06	.30	−.12	.73

*$p < .05$; **$p < .001$.
[a] self-reported negative affect.
[b] maladaptive schema modes.
[c] adaptive schema modes.
[d] heart rate.
[e] systolic blood pressure.
[f] diastolic blood pressure.
[g] skin conductance response.
[h] skin conductance level.
[i] Single-category implicit association task.

Table 6
Medians, quartiles (25th percentile, 'and 75th percentile), and contrasts between the groups of childhood trauma.

Total trauma	BPD	ASPD	ClC-PD	NpC
Median	44.42	24.15	29.69	4.25
25th percentile	27.28	12.26	15.43	1.28
75th percentile	69.04	54.34	53.42	13.42

	BPD vs ASPD	BPD vs ClC	BPD vs NpC	ASPD vs ClC	ASPD vsNpC	ClC vs NpC
Wald	3.06	4.42*	44.55**	−.01	17.75**	26.78**
p	.08	.04	<.001	.92	<.001	<.001

Note: $^{*}p < .05$; $^{**}p < .001$.

because they were often punished for expression of emotions in childhood (Linehan, 1993), or that this dissociation between facial expression and autonomic nervous system responses has the function of emotionally detaching them from the pain they feel (Arntz et al., 2005; Young et al., 2003).

As expected, ASPD-patients reported a lower increase in negative affect than the BPD-patients which could point to a denial of ASPD-patients of the negative impact of the abuse-related stimuli on their affect. On the other hand, such a conclusion might be premature given the ASPD-group's self-reported increase in negative affect was comparable to that of the other control groups.

The premise of comparable impact of traumatic stimuli on an indirect level in BPD and ASPD-patients only received partial support; ASPD-patients were comparable to BPD-patients regarding indirect cognitive reactivity, while their comparability in psychophysiological reactions varied between the specific indices. The hyperresponsive implicit self-abuse association of BPD and ASPD-patients might suggest a strong developed abuse-related cognitive schema or a cognitive preoccupation with malignant others. Although studies on emotional reactivity in ASPD-patients mostly find these patients to be characterized by physiological underarousal (Hare, 1982; Herpertz et al., 2001; Ishikawa, Raine, Lencz, Bihrle, & LaCasse, 2001; Patrick, Zempolich, & Levenston, 1997; Raine, 1993) the physiological reactivity of the ASPD-patients in the current study did not differ from the non-patients. Consequently, the current data suggest that the ASPD-patients showed a non-deviant physiological pattern in reaction to abuse-related stimuli. This is particularly remarkable given both BPD and ASPD had a more severe childhood trauma history and suggests a rather cool and controlled abuse-related reactivity of ASPD-patients. Findings from a study assessing anger-related reactivity in the current sample (Lobbestael, Arntz, Cima, & Chakhssi, 2009) also showed ASPD-patients to display implicit cognitive anger-related hyperreactvity compared to the other groups, but psychophysiological hypo-reactivity, partly mimicking the findings from the current study.

Both ASPD and non-patients responded with a lack or even a reduction of autonomic responses, but increased frowning. This might suggest that the perpetrators in the movie-fragment elicited aversion and moral disgust in the ASPD-group and non-patients. There are indications that moral disgust is associated with diminished autonomic physiological activity (Sherman, Haidt, & Coan, submitted for publication). Additionally, pedophilia is highly negatively stigmatized in forensic environments, which could explain why this moral aspect might have overruled the emotional pain caused by confrontation with the abusive stimuli in ASPD-patients.

It was an interesting finding that BPD-patients were the only group that indicated a significant increase in maladaptive schema modes. This finding is in line with that of Arntz et al. (2005) who found that confrontation with a comparable abuse-related movie-fragment uniquely caused the Detached Protector mode to increase in the BPD group. Another study by (Lobbestael, Arntz, Cima, & Chakhssi, 2009) evaluated the effect of anger induction on mode change and discovered that the anger-related schema modes significantly increased in BPD-patients, and in ClC-PD patients, but significantly less in ASPD-patients. Thus, at least with respect to abuse-related reactivity, the current study seems to support Young's premises that mode switches are especially prominent in BPD (Young et al., 2003).

The ClC-PD patients of this study showed an abuse-related response pattern of self-reported affect that was comparable to that of the two other PD patients groups. The mode change and the change in SC-IAT scores of the ClC-PD group were highly similar to that of the non-patients and the ASPD-group, indicating that both the self-reported and implicit cognitive reactivity of the ClC-PD group to the abusive-related stimuli can be labeled as non-deviant. The physiological response pattern of the ClC-PD group was comparable to that of the BPD group, suggesting that, just as the BPD-patients, ClC-PD patients were more reactive on a psychophysiological level to the abuse-related stimuli.

The comparable baseline SC-IAT level of self-abuse association of the BPD, ASPD and NpC groups was unforeseen given the higher prevalence of childhood abuse in BPD and ASPD-patients. This could indicate that the baseline self-abuse association level of the SC-IAT is not that much influenced by past abusive experiences, but that the associations first have to be primed, as we did with the movie-fragment. This is in line with schema mode theory that states that patients switch to modes in reaction to emotional primes.

Several limitations have to be considered in interpreting our results. First, not enough female antisocial and male borderline patients were included in the current study to assess all group and gender interactions. This made it impossible to fully evaluate the impact of gender on the current findings. Unfortunately, women that are antisocial but not borderline and borderline men that are not antisocial are quite rare in practice and therefore very difficult to recruit. Gender might also have influenced the reactivity on the film fragment since it depicted abuse of a young girl. The possibility that being female rather than having a BPD might have caused hyper-reactivity following abuse-related stress is unlikely however as we controlled for main effects of gender. But, gender by group reactions might play a role here that could not be analyzed due to too small numbers of male BPD and female ASPD-patients. However, we think that such an alternative gender based explanation is unlikely because the girl depicted in the film fragment was not abused *because of* her gender. Second, next to personality disorder pathology, differences in abuse history might play a crucial role in reactivity to abuse-related stimuli. Analyses showed that group and severity of abuse were highly correlated. In addition, there were not enough NpC's with elevated abuse scores and not enough patients with low abuse scores to use trauma level as a covariate in the analyses. Furthermore, there were many participants with zero-scores on abusive history. These factors prevented testing whether the personality disorder diagnoses or abuse severity were more important in predicting abuse-related stress reactivity. Nonetheless, correlational results indicated that the severity of childhood abuse was strongly related to several abuse-

related reactions. Therefore, although we found clear diagnostic patterns of abuse-related reactivity, it cannot be ruled out that the emotional reactivity pattern to the abusive reminders merely depends on the severity of abusive events in one's past. Third, the lack of findings of the level of psychopathy on abuse-related reactivity might be due to the low number of psychopathy scores we had available. Therefore, replication studies with a larger number of psychopathy scores are needed. Additionally, by not correcting the significance level of our analyses for the number of analyses we did, we risked an increase in type I errors. This choice however was based on minimizing type II errors in this rather small sample. Finally, the use of personalized scripts as trauma stimuli could have increased the emotional impact on the participants and might have excluded the possibility of eliciting moral disgust. On the other hand, non-standardized stimuli diminish the comparability of impact between participants. Also, it might be difficult to construct personalized abusive scripts in non-abuse participants.

In sum, this study demonstrated that BPD-patients react with stronger intensity to abuse-related stimuli as compared to patient- and non-patient control groups. More specifically, they reported a stronger increase in self-reported negative affect than the ASPD and NpC groups, and a stronger increase in maladaptive schema modes than all other groups after viewing a trauma-related film fragment. Furthermore, BPD-patients displayed a lower decrease in HR and a higher increase in SBP than the NpCs, and a higher increase in SCR compared to the ASPD and NpC groups. While childhood trauma plays a central role in the aetiology of both BPD and ASPD-patients, BPD-patients showed higher self-reported and physiological reactivity. Only on implicit self-abuse associations, ASPD-patients showed a similar hyperresponsivity as BPD-patients. These findings contribute to knowledge on emotional responsivity and on disentangling BPD from ASPD. In the long term, they can help to increase insight into the reactivity of these patients to abuse-related stimuli, which are often encountered in daily life situations. When presented in therapy, confrontation with abuse-related stress could be effective in making people more resilient to confrontation with stimuli of past traumatic events.

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