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Does habituation really happen? Investigation of psycho-biological responses to body exposure in bulimia nervosa

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ABSTRACT

Background: Body exposure is a common and effective treatment for body image disturbance in bulimia nervosa (BN). However, little is known about treatment mechanisms. Based on models of emotional processing and neurovisceral integration, we expected to observe a) initial activation and b) habituation of cognitive-affective and autonomic responding within one and between two standardized body exposure sessions.
Methods: A group of 13 women with BN and 13 healthy controls (HC) were repeatedly exposed to their bodies. Prior to and after treatment with three individualized mirror exposure sessions participants received a session of standardized exposure to videographic recordings of their body. Subjective ratings of body-related emotions and thoughts were assessed repeatedly throughout the standardized exposure sessions and autonomic responses were recorded continuously.
Results: Subjective and sympathetic responses were activated initially in both groups. Cognitive-affective responses habituated within the standardized sessions in both groups, whereas between the standardized sessions habituation was only found in women with BN. Increasing sympathetic responses were found within the sessions in both groups.
Conclusions: The results support cognitive-affective habituation during body exposure in BN and to a lesser extent in HC. Autonomic responses however did not show a corresponding pattern and did not distinguish between groups. Implications for body exposure research and practice are discussed.

1. Introduction

Body image disturbance is a diagnostic criterion of bulimia nervosa (BN) (American Psychiatric Association [APA], 2013). When confronted with their body, women with BN have been shown to react with distress (Laberg, Wilson, Eldredge, & Nordby, 1991; Ortega-Roldan, Rodriguez-Ruiz, Perakakis, Fernandez-Santaella, & Vila, 2014; Tuschen-Caffier, Vögele, Bracht, & Hilbert, 2003). Following the exposure principle, exposure-based interventions by mirror (e.g., Delinsky & Wilson, 2006; Hilbert & Tuschen-Caffier, 2004; Hildebrandt, Loeb, Troupe, & Delinsky, 2012; Morgan, Lazarova, Schelhase, & Saeidi, 2014; Trentowska, Bender, & Tuschen-Caffier, 2013; Trentowska, Svaldi, & Tuschen-Caffier, 2014; Trottier, Carter, MacDonald, McFarlane, & Olmsted, 2014) or video (Fernandez & Vandereycken, 1995; Rushford & Ostermeyer, 1997) have been shown to be effective with regard to the improvement of body dissatisfaction, body checking and avoidance in women with various eating disorders.

While exposure-based techniques have been shown to be effective with regard to body image treatment, the underlying mechanisms are largely unclear. Knowledge about the underlying mechanisms could help to enhance the efficacy of body exposure, e.g. especially for patients who do not show a strong reduction in their symptoms.

The emotional processing model (EPM; Foa & Kozak, 1986) postulates that changes in cognitive-affective schemas require the integration of information that is incompatible with a dysfunctional schema. Exposure-based therapy is thought to facilitate this process by (a) initial schema activation indicated by an increase in cognitive-affective responses; (b) decrease in cognitive-affective responses within one session (within-habituation); and (c)

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decrease in cognitive-affective responses from one session to the next (between-habituation). It is notable that with regard to exposure-based body-image treatment these principles have rarely been investigated.

Furthermore, neurovisceral models of emotion (dys)regulation elucidate the interplay between neurobiological and mental reactions and their impact on psychopathology of mental diseases (Thayer & Brosschot, 2005; Thayer & Lane, 2000). Experiential emotional responses and activation in the sympathetic and parasympathetic branches of the autonomic nervous system (ANS) are closely associated with each other in order to support dynamic physiological adaptations during emotional reactivity and recovery in a changing environment (Hagemann, Waldstein, & Thayer, 2003). This flexibility might be compromised in eating disorders, as sympathetic activity measured by electrodermal activity (non-specific fluctuations of skin conductance) has been shown to be elevated during confrontation with a body-related film clip in patients with binge eating disorder (Svaldi, Caffier, Blechert, & Tuschen-Caffier, 2009).

In anxiety disorders few premises of habituation as described by the EPM have been detected and shown to predict symptom reduction (see Craske et al., 2008). Therefore, Craske et al. (2008) conclude that the EPM is weakly supported for anxiety disorders. However, studies in the domain of eating disorders are still required since preliminary findings on body exposure support some of the assumptions postulated by the EPM. When looking at one's own body, distress, negative feelings and thoughts increase in individuals with eating disorders (Cooper & Fairburn, 1992a; Hilbert & Tuschen-Caffier, 2005; Hilbert, Tuschen-Caffier, & Vogele, 2002; Vocks, Legenbauer, Wachter, Wucherer, & Kosfelder, 2007; Vocks, Wachter, Wucherer, & Kosfelder, 2008) suggesting initial activation. Within one prolonged Mirror Exposure (ME) session (Trentowska et al., 2013; Vocks et al., 2007) and in a treatment with repeated sessions (Delinsky & Wilson, 2010; Hilbert et al., 2002; Trentowska et al., 2013), distress and negative cognitive-affective responses decreased suggesting within and between session habituation processes. Furthermore, there are studies suggesting that body exposure interventions improve symptoms of body image disturbance and eating disorders (Hilbert & Tuschen-Caffier, 2004; Legenbauer, Schütt-Stromel, Hiller, & Vocks, 2011; Trentowska et al., 2014).

Thus far, only one study (Vocks et al., 2007) has assessed both cognitive-affective and autonomic responses during one session of ME in a sample of women with heterogeneous eating disorders and healthy controls (HC). In this study, an initial activation of negative cognitive-affective responses were followed by a decrease in both groups within the session, as well as significantly higher negative thoughts and emotions in the eating disordered group throughout the session. Autonomic responses remained stable throughout the task and did not differ between groups, apart from an increase in sympathetic activation from baseline to initial ME.

Several key questions though remain unanswered. First, Vocks et al. (2007) recruited a heterogeneous eating-disordered sample, but as recently found, body-related attention differs between participants with Anorexia Nervosa und BN (Blechert, Ansorge, Beckmann, & Tuschen-Caffier, 2011). Second, standing upright for an extended time period - as during ME - increases tonic blood pressure and heart rate and might therefore limit the range of additional phasic increases during exposure. To complicate matters, orthostatic cardiac regulation might in itself be compromised in eating disorders (Murialdo et al., 2007). Therefore, it is advisable to test under conditions of minimal orthostatic effort and changes to body posture. As sitting down during ME would severely limit the procedure, a compromise would be a videotaped full-size body image exposure while seated. Third, Vocks et al. (2007) administered ME with two possible visual distractors: a) physiological assessment instruments, attached to the participants' bodies and b) inclusion of the participants' head and face. A videotaped body image shown during exposure would avoid visual distraction by assessment instruments. Furthermore, as the most distressing body areas for eating disordered women include the waist, hips, stomach and upper legs (Hewig et al., 2008; Jansen, Nederkoorn, & Mulkens, 2005; Tuschen-Caffier et al., 2015), body exposure should focus on these body areas and limit distraction by less rejected body parts in order to enhance maximal cognitive-affective reactivity. Fourth, little is known regarding long-term effects of body exposure. The only study to have investigated this (Vocks et al., 2008) demonstrated decreased entrance levels of negative thoughts and emotions in a second standardized body exposure session after group CBT for body image disturbance.

The present study investigated within and between-habituation during standardized body exposure in cognitive-affective as well as autonomic domains in females with BN and HC. In a former study we showed that body dissatisfaction seems to be common among women in general and decreases in cognitive-affective distress during mirror exposure occur not only in subclinical eating disordered women but also in HC (Trentowska et al., 2013). Therefore, it is reasonable to investigate habituation processes in eating disorders such as BN and additionally to investigate whether processes in subclinical groups are comparable to clinical groups. Also, it is important to include HC to investigate whether specific changes pertain to BN only, or whether they occur in general.

We predicted based on previous research (a) an increase in cognitive-affective and autonomic responses, especially in sympathetically mediated skin conductance level (SCL; seeSvaldi et al., 2009) and certain parameters of heart rate variability (HRV; see Vocks et al., 2007) at the beginning of body exposure (*initial reactivity*), (b) a decrease within the sessions of repeated exposure (*within session habituation*) and (c) decreased initial responding in a second session (*between-session habituation*). We further explored parameters of the parasympathetic branch and indicators of sympatho-vagal balance based on their known relationship with autonomic responding during stressful exposure (Thayer & Brosschot, 2005; Thayer & Lane, 2000). The correlations between the cognitive-affective and the physiological parameters are of particular interest to test the suggested relationship between subjective and autonomic responding. We also predicted that initial activation, within and between habituation processes would always be stronger in BN than in HC.

2. Methods

2.1. Participants

Participants were recruited by announcements in newspapers and in outpatient clinics. The study was announced as a treatment for body dissatisfaction and disturbance and a 35€ reward was offered to the participants. The inclusion criterion for the BN group ($n = 13$) was the presence of BN according to DSM-IV criteria. Exclusion criteria were the presence of substance abuse or addiction, current or past psychosis, schizophrenia, bipolar disorder, severe symptoms of a post-traumatic stress disorder, current suicidal ideation, risky or life threatening behavior, regular use of medication that may inhibit response to exposure (e.g. benzodiazepines), pregnancy or lactation as well as current receipt of therapy for body image or past therapy using ME. Participants were asked not to undertake any body image interventions during participation in this study. Inclusion criteria for the HC group ($n = 13$) were the absence of a current and lifetime eating disorder, other mental disorders, pregnancy or lactation. HC women were

matched on age and body mass index (BMI) to the BN group. Eating disorder diagnosis was established by the German versions of the Eating Disorder Examination Interview (EDE; Hilbert & Tuschen-Caffier, 2006) and the Eating Disorder Examination Questionnaire (EDE-Q; Hilbert, Tuschen-Caffier, Karwautz, Niederhofer, & Munsch, 2007). The diagnosis of borderline personality disorder (BPD) was not an exclusion criterion in this study, but it was also measured to control for severe emotion regulation problems. All mental disorders were diagnosed by means of the Structured Clinical Interview for DSM-IV Axis I (SCID I) and the section for BPD of the SCID II for Axis II (Spitzer, Williams, Gibbon, & First, 1992; German version:; Wittchen, Zaudig, & Fydrich, 1997). The study was approved by the local ethics committee and all participants provided informed consent.

Groups did not differ in age and BMI, but differed on binging, compensatory behavior and the EDE-Q total score (Table 1). All but one woman in the BN group were in outpatient psychotherapy while participating in the study (92,3%); 61% were in individual therapy with one session a week and 30.8% in group therapy with one bi-weekly session. Ten BN participants (77%) had a history of inpatient treatment related to their eating disorder. None had ever received a body exposure therapy. Regarding comorbidities, ten women had an additional lifetime DSM-IV disorder (77%; eight major depression, one obsessive compulsive disorder and one substance abuse disorder). One BN participant (7.7%) had a current comorbid major depression and two (15.4%) were taking stable anti-depressive medication (selective serotonin reuptake inhibitors and serotonin-norepinephrine reuptake inhibitors).

2.2. Equipment and measures

2.2.1. Questionnaires

The following questionnaires were administered prior to each session and repeatedly throughout each session: (1) The *Thoughts Check List* (TCL; Cooper & Fairburn, 1992b) assesses typical negative thoughts eating disordered women have when looking at their bodies during body exposure on a 6-point scale ranging from 1 = “not at all” to 6 = “always”. Two items with bulimia-specific compensatory content were added following expert advice: “I would like to throw up.” and “I would like to go for a run”. The internal consistency of the TCL score in session 1 was very high for the BN group ($\alpha > 0.90$) and low for the HC ($\alpha > 0.39$). (2) A *rating list of emotions* was used based on previous studies (Trentowska et al., 2013; Tuschen-Caffier et al., 2003; Vocks et al., 2008). It assessed 11 either negatively or positively valenced emotions (EMOneg: sad, disgusted, anxious, distressed, insecure, angry, ashamed and frustrated; EMOpos: relaxed, happy and self-confident) on a 6-point scale ranging from 1 = “not at all” to 6 = “very much “. In session 1 the internal consistency of the EMOneg score was very high in both groups (BN: $\alpha > 0.84$; HC: $\alpha > 0.88$) and of the EMOpos score moderate in BN ($\alpha > 0.59$) and high in HC ($\alpha > 0.82$).

2.2.2. Psychophysiological measures

To investigate autonomic responses during body exposure, measures of the ANS were assessed. Electrode placement, data recording and data reduction followed established conventions for psychophysiological research and published guidelines (Cacioppo, Tassinary, & Berntson, 2007). Psychophysiological channels were sampled continuously at 400 Hz using a Varioport system (Becker Meditec, Germany). Offline, data inspection and artifact rejection was performed using MATLAB (for details see Lackner et al., 2010). The following parameters were extracted: (1) *Heart rate (HR),* a measure jointly innervated by parasympathetic and sympathetic responses, was computed based on R-R intervals (RRI). To obtain RRI time series with equidistant time steps and the beat-to-beat values were resampled at 4 Hz, using piecewise cubic spline interpolation after artifact correction. Single artifacts were replaced by interpolation and their appearance recorded. (2) *Skin conductance level (SCL)*, an indicator of sympathetic activity, was measured via 10-mm Beckman Ag/AgCl electrodes filled with isotonic electrode paste (TD-246, Med Associates, St. Albans, VT) attached to the palmar surface of the middle phalanges of the first and second fingers of the nondominant hand. A constant-voltage device maintained 0.5 V between the electrodes. (3) For *Heart rate variability (HRV)*, frequency domain indexes of the HR series for each segment and the autoregressive Burg algorithm (model order 24) after resampling and removing the linear trend was used. *Low frequency (LFrr)* was defined as 0.04–0.15 Hz, *high frequency (HFrr)* was defined as 0.15–0.40 Hz, according to published recommendations (Task Force, 1996). Because of skewed distributions a natural logarithmic transformation was applied to the LF- and HF-components of RRI and the LF/HF ratio of sympatho-vagal balance (LF/HF ratio).

With respect to the small sample size, non-linear geometric indices were computed to quantify low frequency and high frequency parameters of HRV independently from linear fluctuations (Brennan, Palaniswami, & Kamen, 2001). For RRI as non-linear geometrical indices, *SD1*, an index related to the fast beat-to-beat variability in the data, indicating parasympathetic innervation on the HR, and *SD2*, an index related to the longer-term variability indicating sympathetic innervation on the HR, were computed. Furthermore, the *SD2/SD1 ratio* was calculated as a non-linear index for sympathetic-vagal balance (Lackner et al., 2010).

2.3. Design and procedure

Following the diagnostic session, all participants attended a psychoeducative session. After that, participants’ bodies were video recorded in a laboratory session (see below for details). Participants

Table 1
Means (M), standard deviations (SD) and ANOVA of age, body mass index (BMI), binge frequency and frequency of compensatory behavior within the last month prior to the testing.

		M	*SD*	*p*
age	BN	26.2	6.9	
	HC	26.3	6.6	0.977
BMI	BN	23.0	3.1	
	HC	23.6	2.2	0.556
binge frequency	BN	20.3	17.8	
	HC	0	0	0.001
frequency of compensatory behavior	BN	25.1	17.0	
	HC	0	0	0.001
EDE-Q total score	BN	3,6	1,2	
	HC	0,5	0,5	<0.001

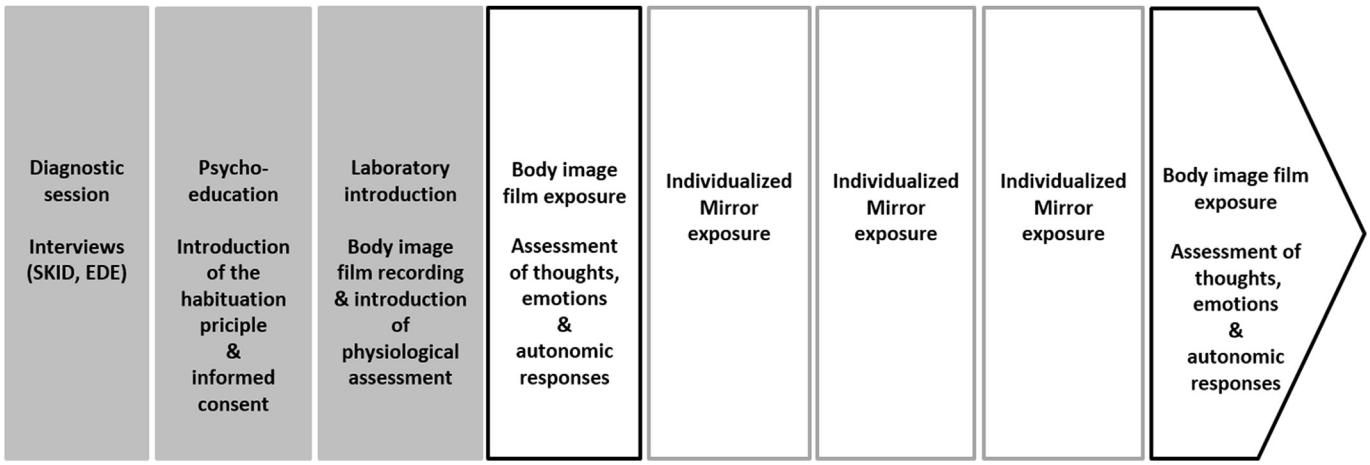

Fig. 1. Design and procedure of the study.

then undertook a standardized video exposure (see below for details) while subjective and objective parameters were assessed, and thereafter received three individual consecutive ME sessions. Finally, participants undertook the standardized video exposure once more and were then debriefed (see Fig. 1). That is, distribution of standardized video exposure and ME sessions was as follows: In week one, a standardized video exposure and a ME session were conduted. In week two, two ME sessions were conduted. Finally, in week three, a standardized video exposure was conducted. Standardized video exposure and ME sessions were conducted in a frequency of 2 respectively 1 session a week.

2.3.1. Psychoeducation

All participants received the same psychoeducation session. Body image disturbance was explained to the participants within cognitive-behavioral models (Cash & Pruzinsky, 2002; Williamson, White, York-Crowe, & Stewart, 2004). To begin, the concept of within and between habituation was introduced by a body image distant example (e.g. specific phobia to heights or animals) and the predictions on changes in cognitive-affective reactivity were explored in a deductive way and depicted in a graph by the participants. The habituation paradigm was then transferred to ME, and prolonged repeated body exposure was introduced as a way to allow habituation to proceed, and as a holistic way to change the vicious cycle of body image disturbance and eating problems. In this context a holistic view of one's own body was the goal of body exposure, i.e. looking at one's body in a fair and self-appreciating way instead of critically focusing on body parts, as is characteristic of body dissatisfaction. Further questions and doubts were then discussed.

2.3.2. Laboratory introduction

Physiological assessment methods were demonstrated and participants' bodies were recorded for four minutes in a standardized beige-colored set consisting of vest and pants against a black background (body image film). The recorded body section showed the torso including arms and upper legs. A body image film was preferred to a static picture to replicate a naturalistic setting. While viewing the body image film, participants were asked to focus on each body area in succession, proceeding from the neck down to the knees, and finally to look at the body as a whole. Body exposure was presented within viewing blocks in an On-Off design as demonstrated in Fig. 2.

2.3.3. Body image film exposure

The body image film was projected in real life size onto a white wall while participants were seated two meters away in a reclining laboratory chair. Before exposure started, electrodes were attached; participants received written instructions on the procedure and were asked to limit movements during exposure. Furthermore, they were asked to rate negative thoughts and emotions in the past few minutes for baseline assessment. During the entire session autonomic responses were recorded.

Each viewing block included three sections of four minutes duration and started with a resting period (baseline) followed by the body image film (film) followed by a recovery period (recovery) (see Fig. 2). During baseline and recovery participants saw a minute counter on a white screen. The viewing block was repeated three times in each session (1st, 2nd and 3rd viewing block). Between the viewing blocks cognitive-affective responses were assessed. One body exposure session lasted approximately 60 min and was conducted in the same controlled room as ME sessions. The experimenter left the room before the 1st viewing block started and reentered between the viewing blocks to collect the rating sheets. After each session participants were debriefed about their experiences.

2.3.4. Mirror exposure

To enhance cognitive-affective changes three individualized ME sessions were administered between the two body image film exposure sessions (see Fig. 1). The aim of the ME sessions was to enhance and allow within and/or between habituation processes to take place while repeatedly watching one's own body and focusing on different body areas. After each body area (head, torso, legs, arms and overall appearance) the therapist asked the participants' stress level on a Subjective Units of Distress Scale (SUD). Furthermore, a holistic view of the body, including liked and disliked body areas, was practiced during ME as described by Tuschen and Bents (1995). During all ME sessions participants wore the same beige-colored outfits as in the body image film exposure sessions. Standing in front of a full length mirror, participants were asked to describe their own body as precisely as possible. They were allowed to express their feelings as they arose and were asked in detail what triggered each particular emotion. The therapist guided the participants' attention to different body parts, starting with the head and ending with their overall appearance. All sessions were administered individually by the first author and followed the same protocol regarding the body part sequence, frequency and duration (60 min per session). According to our earlier findings, 60 min per

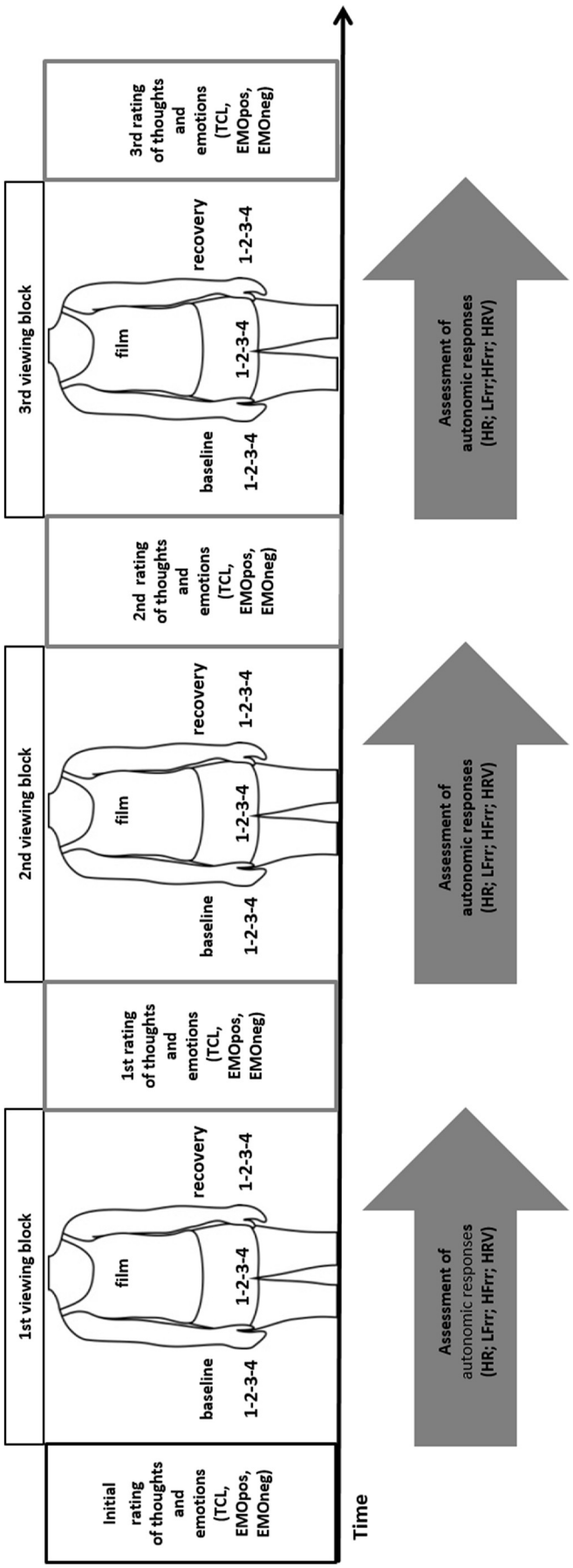

Fig. 2. Graphical description of the video exposure sessions.

session is sufficient for habituation processes to take place (Trentowska et al., 2013). After each session the participants were debriefed about their experiences in the session.

2.4. Data reduction and analysis

For each viewing block and each session a) mean scores for TCL and b) mean values for the two scales of EMOpos and EMOneg were calculated indicating the occurrence of cognitive-affective responses. For cognitive-affective ratings, missing data was estimated by last observation carried forward for individual single missing values and mean substitution for missing rating scores. Initial reactivity and within session habituation hypotheses for cognitive-affective ratings were tested in a 2 (Group: HC, BN) x 4 (Time: baseline, 1, 2, 3rd rating) repeated measures ANOVA, followed by post-hoc *t*-tests. The between-session-habituation hypothesis was tested by means of a 2 (Group: HC; BN) x 2 (Time: 3rd rating/session1, 1st rating/session2) repeated measures ANOVA.[1]

Regarding physiological data, mean HR, LFrr, HFrr, SD1, SD2 and SD2SD1 indices were extracted from minute 2 and 3 of each 4-min section (baseline, film, recovery) within the viewing blocks, based on visual exploration of the data. Similar, mean SCL of minutes 2 and 3 was extracted after correction of movement and electrode artifacts. For HRV means of minutes 1–4 in each section of the viewing blocks were used to obtain more reliable data.

Initial activation was tested by means of a 2 (Group: HC, BN) x 3 (Section of the 1st viewing block: baseline, film, recovery) repeated measures ANOVA; within-session habituation by means of a 2 (Group: HC, BN) x 3 (Time: 1st, 2nd, 3rd film section) repeated measures ANOVA. Between-session habituation hypothesis was tested by means of a 2 (Group: HC; BN) x 2 (Time: 3rd film section/session1, 1st film section/session2) repeated measures ANOVA.[1] For significant main effects of time/section or interaction effects post-hoc analyses (two-tailed *t*-test or ANOVA) were calculated.

Pearson product-moment correlation coefficients were computed to assess the relationship between the cognitive-affective variables (TCL, EMOpos & EMOneg) and the autonomic responding (HR, LFrr, HFrr, SD1, SD2, HRV and SD2SD1).

Power analysis on initial reactivity and within session habituation hypotheses for cognitive-affective ratings was based on a medium effect of $f = 0.30$, with an $\alpha = 0.05$, a power of 0.80 and a correlation among repeated measures of $r = 0.5$. This required a total of 18 participants (i.e., 9 per group). Regarding physiological data, a medium effect of $f = 0.30$, with an $\alpha = 0.05$ and a power of 0.80 yielded a total sample size of $N = 20$ (i.e., 10 per group). Thus, with a sample size of $N = 26$ (i.e., 13 per group) we were able to detect the hypothesized effects at a power in excess of 80%.

3. Results

3.1. Initial activation and within-session habituation in cognitive-affective ratings

3.1.1. TCL

In session 1 main effects of *Group* ($F(1,24) = 26.92$; $p < 0.001$), *Time* ($F(3,72) = 11.44$; $p < 0.001$) and *Group x Time* interaction ($F(3,72) = 4.91$; $p = 0.018$) were found (see Fig. 3a and b for *M* and *SD*). The post-hoc *t*-test shows that for *initial activation*, a significant increase in negative thoughts occurred in both groups from baseline to 1st rating (BN: $t(12) = -3.73$; $p = 0.003$; $d = -1.354$; HC: $t(12) = -2.57$; $p = 0.024$; $d = -1.094$). For *within session habituation*, no change in negative thoughts occurred in either group ($ts(12) < 2.11$; $ps > 0.057$).

In session 2 only main effects of *Group* ($F(1,24) = 13.09$; $p = 0.001$) and *Time* ($F(3,72) = 4.59$; $p = 0.017$) were found. Regarding *initial reactivity*, TCL scores increased from baseline to 1st rating in both groups ($t(25) = -3.25$; $p = 0.003$; $d = -0.333$). Regarding *within session habituation* negative thoughts decreased in both groups from 1st to 2nd rating ($t(25) = 2.33$; $p = 0.028$; $d = 0.154$). Throughout the sessions, BN had higher TCL scores than HC.

3.1.2. EMOneg

There was a main effect of *Group* ($Fs(1,24) < 57.17$; $ps < 0.001$), *Time* ($Fs(3,72) < 13.30$; $ps < 0.009$) and a *Group x Time* interaction ($Fs(3,72) < 9.59$; $ps < 0.012$) in both sessions (see Fig. 3c and d for *M* and *SD*). Regarding *initial reactivity* in session 1, negative thoughts increased significantly between baseline and 1st rating only in BN ($t(12) = -4.50$; $p = 0.001$; $d = -1.855$). Regarding *within session habituation*, there was a decrease between 2nd and 3rd rating in BN ($t(12) = 5.57$; $p = 0.025$; $d = 0.773$) and a decrease between 1st and 2nd rating in HC ($t(12) = 2.56$; $p = 0.025$; $d = 0.474$).

In session 2, post-hoc *t*-tests on *initial reactivity* in BN revealed a significant initial increase ($t(12) = -3.40$; $p = 0.005$; $d = -0.920$), but no indication of changes in *within session habituation* ($ts(12) < 1.68$; $ps > 0.119$). In the HC group no significant changes occurred at any time point ($ts(12) < 1.48$; $ps > 0.165$). Throughout the sessions, BN had higher EMOneg scores than HC.

3.1.3. EMOpos

In both sessions main effects of *Group* ($Fs(1,24) < 57.17$; $ps < 0.001$), *Time* ($Fs(3,72) < 7.76$; $ps < 0.003$) and *Group x Time* interaction ($Fs(3,72) < 7.78$; $ps < 0.005$) were found (see Fig. 3e and f for *M* and *SD*).

In session 1, a significant decrease between baseline and 1st rating indicated *initial reactivity* only in BN ($t(12) = 3.87$; $p = 0.002$; $d = 1.839$). In session 2 a decrease in positive thoughts between baseline and 1st rating again indicated *initial reactivity* in BN ($t(12) = 3.78$; $p = 0.003$; $d = 1.262$). No changes indicated *within session habituation* in either session. Throughout the sessions, BN showed lower positive affect than HC.

3.2. Between-session-habituation in cognitive-affective ratings

3.2.1. TCL

In analyses of changes from session 1 to session 2 main effects for *Group* ($F(1,24) = 19.29$; $p < 0.001$), *Time* ($F(1,24) = 32.51$; $p < 0.001$) and a *Group x Time* interaction ($F(1,24) = 17.87$; $p < 0.001$) were found (see Fig. 3a and b for *M* and *SD*). Post-hoc *t*-test revealed significant decreases in negative thoughts between 3rd rating in session 1 and 1st in session 2 for both groups (BN: $t(12) = 5.23$; $p > 0.001$; $d = 1.272$; HC: $t(12) = 2.35$; $p = 0.037$; $d = 0.684$).

3.2.2. EMOneg

There were also main effects for *Group* ($F(1,24) = 31.82$; $p < 0.001$), *Time* ($F(1,24) = 14.39$; $p = 0.001$) and a *Group x Time* interaction ($F(1,24) = 8.73$; $p = 0.007$; see Fig. 3c and d for *M* and *SD*). Post-hoc *t*-tests revealed a significant decrease in negative emotions between 3rd rating in session 1 and 1st in session 2 only for BN ($t(12) = 3.57$; $p = 0.004$; $d = 1.218$).

[1] In this study we use a standardized stimulus on-off design in order to test habituation in guided trials of body image exposure. This design differs from exposure trials in anxiety disorders, since all parts of the body are considered and habituation to disliked parts is one but not the only condition of the exposure. Others are withstanding watching and accepting disliked body parts, and learning a holistic view of the body.

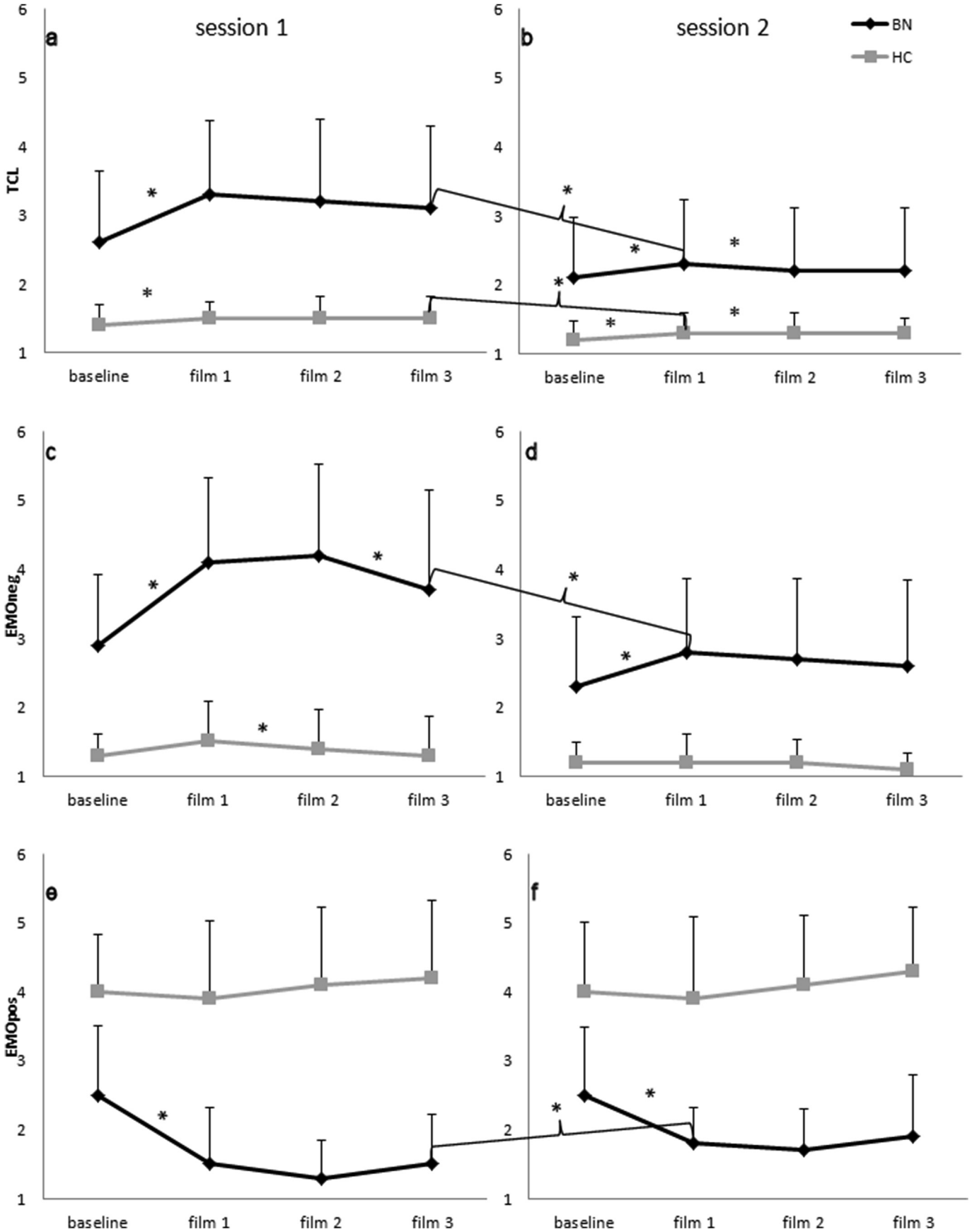

Fig. 3. Means (M) and standard deviations (SD) in baseline and body image film sections for Thoughts Checklist (TCL; Fig. 3a and b), negative emotions (EMOneg; Fig. 3c and d) and positive emotions (EMOpos; Fig. 3e and f) in bulimia nervosa (BN) and healthy control (HC) participants in session 1 and 2.

Table 2
Means (M), standard deviation (SD) and ANOVA of baseline, film and recovery section in the 1st viewing block during session 1 and session 2.

		1st viewing block session 1 section			ANOVA			1st viewing block session 2 section			ANOVA		
		baseline	*M* (*SD*) film	recovery	Group *F* (1,24)	Section *F* (2,48)	Group X Section *F* (2,48)	baseline	*M* (*SD*) film	recovery	Group F (1,24)	Section F (2,48)	Group X Section F (2,48)
HR	BN	67.5 (10.9)	66.2 (11.5)	66.1 (7.2)				66.1 (8.6)	63.7 (7.4)	64.0 (7.4)		**16.90***	
	HC	73.4 (8.5)	71.6 (7.5)	71.9 (6.8)				72.0 (9.2)	69.6 (8.5)	69.5 (8.3)			
SCL	BN	2.4 (1.8)	2.4 (1.6)	2.1 (1.4)				1.5 (1.1)	1.4 (1.3)	1.2 (0.8)		**7.13***	
	HC	1.5 (0.7)	1.4 (0.7)	1.5 (0.7)				1.4 (0.9)	1.3 (0.9)	1.3 (1.0)			
LFrr	BN	6.8 (1.2)	6.7 (1.0)	6.9 (0.7)				6.5 (0.7)	6.5 (0.7)	7.1 (0.7)		**30.03***	
	HC	6.6 (1.1)	6.6 (1.0)	6.7 (1.0)				6.5 (1.2)	6.7 (1.1)	6.9 (1.0)			
HFrr	BN	6.4 (1.0)	6.3 (1.0)	6.6 (1.1)				6.3 (1.4)	6.2 (1.1)	6.4 (1.1)			
	HC	6.5 (1.4)	6.4 (1.4)	6.5 (1.5)				6.3 (1.5)	6.3 (1.4)	6.5 (1.3)			
SD 1	BN	39.3 (27.0)	34.5 (22.1)	38.2 (21.6)				36.3 (23.1)	37.3 (22.9)	38.6 (22.2)			
	HC	37.5 (23.7)	36.6 (22.0)	38.2 (25.9)				35.6 (19.2)	36.6 (18.5)	39.4 (19.6)			
SD 2	BN	76.3 (46.4)	60.8 (32.2)	67.9 (31.1)		**4.01** *		62.5 (23.8)	55.5 (23.5)	63.9 (27.7)		**4.02***	
	HC	71.6 (37.3)	62.4 (27.6)	72.0 (37.3)				65.8 (38.6)	59.5 (30.8)	72.6 (38.4)			
HRV	BN	0.29 (0.9)	0.12 (0.9)	0.22 (0.6)		**3.39***		0.08 (0.9)	0.13 (0.9)	0.57 (0.7)		**22.31***	
	HC	0.03 (0.8)	0.05 (0.8)	0.29 (0.7)				0.04 (0.8)	0.13 (0.7)	0.41 (0.6)			
SD2/SD1	BN	2.2 (0.8)	2.0 (0.8)	2.0 (0.7)				2.1 (1.3)	1.8 (0.9)	1.9 (0.7)			
	HC	2.1 (0.6)	2.0 (0.5)	2.1 (0.6)				2.0 (0.5)	1.8 (0.7)	1.9 (0.4)			

Note. Significant differences in bold; Heart rate (HR); skin conductance level (SCL); low frequency (LFrr); high frequency (HFrr); heart rate variability (HRV); non-linear geometrical indices: index related to the fast beat-to-beat variability (SD1); index related to the longer-term variability (SD2); index for sympathetic-vagal balance (SD2/SD1).

3.2.3. EMOpos

Main effects for *Group* ($F(1,24) < 49.48$; $p < 0.001$) and a *Group x Time* interaction ($F(1,24) = 5.62$; $p = 0.026$) appeared for positive emotions (see Fig. 3e and f for *M* and *SD*). Post-hoc *t*-tests indicated a significant increase in positive emotions between 3rd rating in session 1 and 1st in session 2 only in BN ($t(12) = -3.63$; $p = 0.003$; $d = -1.699$).

3.3. Initial activation and within-habituation in autonomic responses

Table 2 lists *M* and *SD* for HR, SCL, LFrr, HFrr, HRV, SD1, SD2 and SD2SD1 in the 1st viewing block divided by baseline, film and recovery sections along with ANOVA results. For clarity, only significant ANOVA results are shown.

Analyses of *initial activation* within the 1st viewing block showed a Section main effect for SD2 and HRV in session 1, indicating a significant decline in sympathetic activity in both groups from baseline to film ($t(25) = 2.76$; $p = 0.011$; $d = 0.557$).

In session 2 Section main effects were found for HR, SCL, LFrr, SD2 and HRV, indicating significant changes in sympathetic reactivity in both groups. HR, SCL and SD2 declined from baseline to film (HR: $t(25) = 4.76$; $p < 0.001$; $d = 0.494$; SCL: $t(25) = 2.12$; $p = 0.044$; $d = 0.187$; SD2: $t(25) = 2.06$; $p = 0.050$; $d = 0.412$) indicating of a kind of 'negative reactivity'. LFrr values and SD2 increased from film to recovery section (LFrr: ($t(25) = -5.36$; $p < 0.001$; $d = -0.828$; SD2: $t(25) = -3.07$; $p = 0.005$; $d = -0.626$) indicating increasing sympathetic reactivity after the 1st film. HRV values also increased from film to recovery section ($t(25) = -4.95$; $p < 0.001$; $d = -0.841$) indicating sympathetic innervated activity.

Table 3 lists *M* and *SD* for body image film sections in each viewing block in session 1 and 2. Additionally, the significant

Table 3
Means (M), standard deviation (SD) and ANOVA during film sections of the 1st, 2nd and 3rd viewing blocks in session 1 and session 2.

Assessment		Film sections session 1 viewing block			ANOVA			Film sections session 2 viewing block			ANOVA		
		1st	2nd *M* (*SD*)	3rd	Group *F* (1,24)	Time *F* (2,48)	Group X Time *F* (2,48)	1st	2nd *M* (*SD*)	3rd	Group *F* (1,24)	Time *F* (2,48)	Group X Time *F* (2,48)
HR	BN	66.2 (11.5)	64.2 (8.4)	62.9 (6.8)		**8.64***		63.7 (7.4)	64.5 (6.9)	64.8 (7.0)			
	HC	71.6 (7.5)	69.1 (5.4)	68.3 (4.3)				69.6 (8.5)	67.5 (7.5)	68.1 (6.0)			
SCL	BN	2.4 (1.6)	2.0 (1.4)	1.9 (1.3)			**4.43***	1.4 (1.3)	1.7 (1.5)	1.6 (1.7)		**4.64***	
	HC	1.4 (0.7)	1.6 (0.6)	1.5 (0.6)				1.3 (0.9)	1.4 (1.0)	1.4 (1.0)			
LFrr	BN	6.7 (1.0)	6.6 (1.0)	6.9 (0.8)	.	**3.78***		6.5 (0.7)	6.9 (0.9)	7.0 (0.9)		**8.66***	
	HC	6.6 (1.0)	6.7 (0.9)	6.8 (0.9)				6.7 (1.1)	6.9 (1.0)	7.0 (1.1)			
HFrr	BN	6.3 (1.0)	6.2 (0.9)	6.2 (1.0)				6.2 (1.1)	6.3 (1.2)	6.2 (1.0)			
	HC	6.4 (1.4)	6.3 (1.4)	6.5 (1.3)				6.3 (1.4)	6.6 (1.2)	6.6 (1.2)			
SD 1	BN	34.5 (22.1)	33.5 (14.0)	33.6 (13.1)				37.3 (22.9)	36.6 (21.5)	35.6 (17.1)			
	HC	36.6 (22.0)	36.5 (20.7)	38.4 (21.8)				36.6 (18.5)	40.7 (21.5)	39.6 (19.8)			
SD 2	BN	60.8 (32.2)	59.7 (32.7)	54.9 (20.8)				55.5 (23.5)	63.3 (23.7)	69.6 (30.9)		**9.98***	
	HC	62.4 (27.6)	59.8 (29.5)	65.5 (29.3)				59.5 (30.8)	72.2 (34.6)	77.2 (33.0)			
HRV	BN	0.12 (0.9)	0.05 (0.9)	0.25 (1.0)				0.13 (0.9)	0.48 (0.7)	0.47 (0.6)			
	HC	0.05 (0.8)	0.15 (0.7)	0.09 (0.8)				0.13 (0.7)	0.14 (0.7)	0.24 (0.7)			
SD2/SD1	BN	2.0 (0.8)	1.9 (0.9)	1.8 (0.8)				1.8 (0.9)	2.0 (0.7)	2.1 (0.7)		**4.08***	
	HC	2.0 (0.5)	1.8 (0.3)	1.8 (0.3)				1.8 (0.7)	1.9 (0.6)	2.1 (0.6)			

Note. Significant differences in bold; Heart rate (HR); skin conductance level (SCL); low frequency (LFrr); high frequency (HFrr); heart rate variability (HRV); non-linear geometrical indices: index related to the fast beat-to-beat variability (SD1); index related to the longer-term variability (SD2); index for sympathetic-vagal balance (SD2/SD1).

Table 4
Means (M), standard deviation (SD) and ANOVA during film sections of the 3rd viewing block in session 1 and the 1st viewing block in session 2.

Assessment		session 1 3rd viewing block *M* (*SD*)	session 2 1st viewing block *M* (*SD*)	Group *F*(1,24)	Time *F*(2,48)	Group X Time *F*(2,48)
HR	BN	62.9 (6.8)	63.7 (7.4)	**6.18***		
	HC	68.3 (4.3)	69.6 (8.5)			
SCL	BN	1.9 (1.3)	1.4 (1.3)			
	HC	1.5 (0.6)	1.3 (0.9)			
LFrr	BN	6.9 (0.8)	6.5 (0.7)			
	HC	6.8 (0.9)	6.7 (1.1)			
HFrr	BN	6.2 (1.0)	6.2 (1.1)			
	HC	6.5 (1.3)	6.3 (1.4)			
SD 1	BN	33.6 (13.1)	37.3 (22.9)			
	HC	38.4 (21.8)	36.6 (18.5)			
SD 2	BN	54.9 (20.8)	55.5 (23.5)			
	HC	65.5 (29.3)	59.5 (30.8)			
HRV	BN	0.25 (1.0)	0.13 (0.9)			
	HC	0.09 (0.8)	0.13 (0.7)			
SD2/SD1	BN	1.8 (0.8)	1.8 (0.9)			
	HC	1.8 (0.3)	1.8 (0.7)			

Note. Significant differences in bold; Heart rate (HR); skin conductance level (SCL); low frequency (LFrr); high frequency (HFrr); heart rate variability (HRV); non-linear geometrical indices: index related to the fast beat-to-beat variability (SD1); index related to the longer-term variability (SD2); index for sympathetic-vagal balance (SD2/SD1).

results of repeated measures ANOVA are shown.

Concerning *within session habituation* in session 1, changes from one film section of a viewing block to the other were analyzed. A *Time* main effect was found for HR activity and LFrr. Post-hoc *t*-tests revealed significant decreases in HR activity from one film to the other in both groups ($ts(25) < 2.86$; $ps > 0.003$; $ds > 0.278$). For LFrr responses there was an increase between the films in the 2nd and 3rd viewing blocks ($t(25) = -2.03$; $p = 0.053$; $d = -0.327$).

A *Group x Time* interaction effect was found in session 1 for SCL regarding *within session habituation*, indicating different patterns of SCL reactivity between the groups. In BN, there was no significant change in SCL response between the films of the viewing blocks ($ts(12) < 1.73$; $ps > 0.110$). In HC, SCL increased between the films of the 1st and 2nd viewing blocks ($t(12) = -2.40$; $p = 0.034$; $d = -0.383$).

In session 2, Time main effects were found for SCL, LFrr, SD2 and SD2SD1 values for *within session habituation* between the film sections of the viewing blocks. As post-hoc *t*-tests for both groups revealed that SCL increased between films of the 1st and 2nd viewing blocks ($t(25) = -2.37$; $p = 0.026$; $d = -0.305$) as well as LFrr activity ($t(25) = -2.83$; $p = 0.009$; $d = -0.611$) indicating sympathetic reactivity. The SD2 values also increased in both groups between films of the 1st and 2nd viewing blocks ($t(25) = -3.95$; $p = 0.001$; $d = -0.670$). No further significant changes were found.

3.4. Between-session-habituation in autonomic responses

Table 4 lists *M* and *SD* for the 3rd body image film in session 1 and the 1st body image film in session 2. The significant results of repeated measures ANOVA are also displayed.

There were main effects for *Group* in HR activity, indicating significantly lower HR in BN than in HC at the end of session 1 and at beginning of session 2 ($F(1,24) = 6.18$; $p = 0.020$; $d = -0.21$). No other significant results were found.

Table 5
Correlations between mean subjective ratings and physiological measures for films 1–3 and baseline in the 1st viewing block for sessions 1 and 2.

		session 1				session 2			
		TCL	EMOneg	EMOpos	HR	TCL	EMOneg	EMOpos	HR
		film 1				film 1			
film 1	TCL	-				-			
	EMOneg	0.917**	-			0.872**	-		
	EMOpos	-0.736**	-0.802**	-		-0.572**		-	
	HR	-0.428*	-0.417*		-				-
		film 2				film 2			
film 2	TCL	-				-			
	EMOneg	0.906**	-			0.882**	-		
	EMOpos	-0.736**	-0.841**	-		-0.651**	-0.751**	-	
	HR	-0.478*	-0.438*		-				-
		film 3				film 3			
film 3	TCL	-				-			
	EMOneg	0.932**	-			0.869**	-		
	EMOpos	-0.748**	-0.742**	-		-0.637**	-0.718**	-	
	HR	-0.549**	-0.514**		-				-
baseline 1st viewing block	baseline 1st viewing block					baseline 1st viewing block			
	TCL	-				-			
	EMOneg	0.907**	-			0.859**	-		
	EMOpos	-0.669**	-0.737**	-		-0.567**	-0.677**	-	
	HR	-0.399*	-0.450*		-				-

Note. Significant correlations in bold. *p < 0.05; **p < 0.01; Thoughts Checklist (TCL); negative emotions (EMOneg); positive emotions (EMOpos) and heart rate (HR).

3.5. Correlation between the cognitive-affective and autonomic parameters

Table 5 summarizes the results of the correlation analysis between cognitive-affective and autonomic responding. Only significant results are reported. Concerning the film sections 1–3 there were positive correlations between TCL and EMOneg and negative correlations between TCL and EMOpos in both sessions. TCL and EMOneg only correlated negatively with HR in all film sections in session 1. There was a negative relationship between EMOneg and EMOpos in all film sections and both sessions, except for film 1 in session 2.

4. Discussion

Our study aim was to test mechanisms underlying body image exposure. The cognitive-affective results confirmed the hypothesized *initial reactivity* in both sessions in the BN group. Initial cognitive activation regarding the frequency of negative thoughts was found in both groups.

The expected *within session habituation* was only found for negative emotions in session 1. Although negative emotions decreased in both groups, they did so over a different timeframe; the decrease in BN was delayed relative to HC. This corresponds with our earlier findings showing that participants with bulimic symptoms differed from HC in the time course of cognitive-affective changes during a ME treatment (Trentowska et al., 2013). Within session habituation in session 2 was marked by a decrease in negative thoughts in both groups from the first to the second body image film. This confirms that HC react to body image exposure, but at a much lower level and with different emotional changes. While BN participants showed initial activation and within habituation of negative thoughts accompanied by an initial increase in negative emotions and a decrease in positive emotions in session 2, HC did not show the same pattern of emotional changes. The interplay between cognitive and emotional reactions seems to be different in BN and HC when confronted with their own body as shown in both sessions. This should be a focus of future research.

In summary, differences in within session habituation between the groups could only be found in session 1.

Regarding *between session habituation* patterns, only BN patients reported fewer negative emotions and more positive emotions between the last rating in session 1 and the first in session 2, indicating distinct between session habituation across the groups. This was different for negative thoughts; both groups had fewer negative thoughts after the first body image film in session 2 than after the third body image film in session 1. Nevertheless, in both sessions there were group differences, with BN always showing cognitive-affective responses to a greater extent than HC. However, changes in negative thoughts in HC should be interpreted with caution, since the internal consistency of the questionnaire was low in this group and the measurement might not be suitable to assess negative thoughts in HC.

Overall, the results correspond with the cognitive-affective changes found in other studies within and between sessions (Hilbert & Tuschen-Caffier, 2004, 2005; Vocks et al., 2007, 2008). Furthermore, similar to a recent study (Trentowska et al., 2013), the current results suggest that HC also respond to body exposure, though not to the same extent as BN patients.

At the psychophysiological level *initial reactivity* was also demonstrated by changes in sympathetic activity, but in an unexpected way. There was in both groups a pattern of decreasing sympathetic activity from baseline to body image film within the first viewing block which was more profound in session 2 with small to high effect sizes. Furthermore, in session 2 sympathetic activity again increased after the film ended during recovery. One explanation for this surprising finding may be that sadness and insecurity, rather than fear, are the main emotions targeted by body exposure (Tuschen-Caffier et al., 2003). Previous research (Kreibig, Wilhelm, Roth, & Gross, 2007) has shown that fear increases and sadness decreases HR in healthy adults. An exploratory inspection of single items on the EMOneg instrument showed that average sadness during body image film exposure was higher (>4) than average fear (<4). Thus, fear was not the most intense emotion at initial body exposure. In this context and in terms of hypothesized initial schema activation, autonomic responses correspond with the affective ratings by showing a kind of negative reactivity.

The hypothesized relationships between cognitive-affective and autonomic responding could only be found between the cognitive-affective variables; increases in negative thoughts were positively correlated with increases in negative emotions and negatively correlated with increases in positive emotions at the baseline of the 1st viewing block and in all films in both sessions. Furthermore, there was a negative relationship between heart rate and negative thoughts and negative emotions at baseline and in all films in session 1.

Overall, the results do not support the hypothesized autonomic reactions, apart from the HR decrease in session 1. Analyses of differences in reactivity indicating *between session habituation* showed none of the expected changes in autonomic responses and no correspondance with the cognitive-affective changes. Hence, in this study cognitive-affective and autonomic responses comprise hypothesized *initial reactivity*. Contrary to our expectations *within and between session habituation* appeared only in cognitive-affective ratings. Therefore, the responses during body exposure in this study support a cognitive-affective habituation process.

Nevertheless, it remains unknown whether habituation is the only modification mechanism. Future research should investigate other possible modification mechanisms such as inhibitory learning. Recent anxiety research has focused on inhibitory learning as a modification mechanism (see Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014), and this could also be of interest for body exposure research. Examining this in more detail, during body exposure cognitive-affective changes such as a decrease in negative thoughts and emotions occur. In this context, the suggested expectancy violation strategy could be investigated in body exposure by accessing expected cognitive-affective reactions during exposure before the session and the experienced cognitive-affective changes after the session. A larger mismatch between the experienced cognitive-affective changes and the expectancies should indicate greater inhibitory learning (Craske et al., 2014). Furthermore, the training of a holistic way of looking at one's body is a way of changing attentional biases that are characteristic of body image disturbance (e.g. selective view of disliked body parts). These new experiences could be compared to the disturbed way of looking at one's own body and lead to cognitive-affective changes (Smeets, Jansen, & Roefs, 2011). suggest that attentional retraining impacts on thoughts and emotions during body exposure.

The findings regarding autonomic responses were inconclusive, and did not differ between HC and BN in this study. Overall the evidence on autonomic reactivity in eating disorders is inconclusive. Some studies indicate blunted reactivity in BN (Koo-Loeb, Costello, Light, & Girdler, 2000; Koo-Loeb, Pedersen, & Girdler, 1998; Messerli-Burgy, Engesser, Lemmenmeier, Steptoe, & Laederach-Hofmann, 2010), while others report comparable reactivity between individuals with eating disorders and controls (Hilbert, Vögele, Tuschen-Caffier, & Hartmann, 2011; Tuschen-Caffier & Vögele, 1999; Vocks et al., 2007). Evidence from BN

patients suggests that nutritional status affects cardiac responses (Vogele, Hilbert, & Tuschen-Caffier, 2009). These results fit with the interplay of systems and processes within the central autonomic network postulated by Thayer and Sternberg (2006). They suggest that vagal activity, glucose regulation and hypothalamic-pituitary-adrenal axis function are associated with each other and play important roles in maintaining allostasis. Unfortunately, the present study did not assess biochemical markers of nutrition status, so we cannot rule out that the autonomic responses of women with BN were affected by an uncontrolled starvation status. Future studies should assess the biochemical nutrition status of eating disordered subjects in order to achieve "unconfounded" physiological measures.

Other limitations of the present study include the failure to control for indicators of avoidance or hyper-focus during the standardized video exposure, meaning that variation in autonomic responses due to differences in the way participants watched their video cannot be excluded. Future research should control this by assessing e.g. observer ratings or eye-tracking methods. Furthermore, the small sample size might account for the lack of differences, e.g., in physiological data. However, the power analysis indicates the sample size in this study was large enough to detect medium effects at a power in excess of 80%. Other limitations include the lack of a controlled randomized design and the lack of post-treatment measures of outcome (e.g. symptom reduction). Beyond that, the fact that all tested participants were in treatment limits the conclusions that can be drawn from our results. As such, self-selection biases and concurrent influence of treatment cannot be ruled out. However, no participant received any other body image interventions during the study.

Also of note, the habituation rationale was delivered to the participants in the psychoeducation session. This could have created demand characteristics to the mainly subjective changes in this study. Although the negative relationship between negative thoughts and emotions in session 1 provides evidence against the assumption of demand characteristics, future research should vary the preparatory session and the therapy rationale (e.g. no rationale, fake rationales, physiology or cognitive-affective based rationales). In line with this, a potential criticism is that a 60-minute ME protocol was used contemporarily with a habituation rationale. In the present study, a slightly different protocol than the one usually adopted for anxiety disorders was used. According to this protocol (see Tuschen & Bents, 1995) ME should be conducted repeatedly over all body areas. ME is not stopped when habituation occurs. No habituation and an activation of arousal were also accepted. The aim is to achieve habituation within and/or between in repeated sessions and to teach a holistic view of the body, including liked and disliked body areas. Based on previous studies (e.g., Trentowska et al., 2013), a duration of 60 min is sufficient for habituation processes to occur.

Finally, since the EDE(-Q) was only administered for diagnostic reasons and not for measuring symptom reductions, it must be stressed that we did not directly test whether habituation is indeed causally linked to symptom reduction. Hence, it is possible that some patients might have improved regardless of whether habituation occurred. Indeed, studies on anxiety disorders have shown that habituation can occur in exposure sessions, but that this is not consistently related to better treatment outcome. Even stopping exposure at the highest level of anxiety can still be effective for symptom reduction (see review by Craske et al., 2008). Therefore, future studies should assess reduction in body disturbance and eating disorder symptoms contemporarily with habituation processes during ME. This is especially important, as other possible mechanisms underlying symptom reduction after exposure have been suggested. For example, within the inhibitory learning approach strategies such as expectancy violation, variation of stimuli, spaced exposure, multiple contexts and affect labeling (Craske et al., 2014) seem to optimize long term treatment outcome.

Nevertheless, to our knowledge this is the first study to investigate habituation in cognitive-affective and autonomic responses during repeated standardized body exposure before and after a ME treatment. Overall, cognitive-affective results support the usage of habituation as an exposure rationale in exposure-based body image treatment. Changes in autonomic reactivity did not differentiate between the groups and were conclusive only with regard to the initial reactivity. Therefore, the existence of a constitutive physiological dimension of the body image construct is still open to debate, and it remains unclear whether physiological habituation is at all essential to exposure in body image treatment. Future studies with advanced designs (e.g. larger sample size, better control of physiological confounding factors) should investigate whether there is a relationship between cognitive-affective changes and physiology.

Declaration of interest

None.

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