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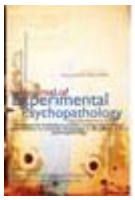

Analogue PTSD Symptoms are Best Predicted by State Rumination

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Abstract

Posttraumatic Stress Disorder (PTSD) is a severe mental disorder characterized by distressing intrusions. Since not all traumatized individuals develop PTSD, it is important to understand its underlying risk factors. So far, several psychological and physiological risk factors have been identified. However, these factors have rarely been examined together. An excellent tool to assess analogue PTSD in a prospective manner is the trauma film paradigm. This study examined relevant psychological and physiological factors in 60 healthy participants before, during and after the presentation of a ”traumatic” film clip, including rumination, dissociation, anxiety, mood, cortisol and psychophysiology measures. Moreover, we assessed intrusions and administered the Impact of Event Scale – Revised (IES-R) for one week following the “trauma”. Surprisingly, the only significant predictor for both intrusion frequency and IES-R was rumination about the film (state rumination). Furthermore, intrusion distress was predicted by both state rumination and an increase in anxiety after the film clip. Our study highlights the relevance of rumination in PTSD. Further well designed clinical studies with PTSD patients should investigate these key variables prospectively to confirm our findings.

Keywords: PTSD, intrusive memories, rumination, dissociation, anxiety, mood, cortisol, psychophysiology, risk factors

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Introduction

Posttraumatic Stress Disorder (PTSD) is a severe mental disorder that may occur after a traumatic event and which is associated with long-term distress and severe impairment in everyday functioning (e.g. Norman, Stein, & Davidson, 2007; Rodriguez, Holowka, & Marx, 2012). Because not all individuals who experience a trauma develop PTSD (Bonanno, 2004; Breslau et al., 1998; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Ozer, Best, Lipsey, & Weiss, 2008), it is important to understand which factors present before, during and after a traumatic event influence the risk for PTSD. Although psychotherapy, especially trauma-focused CBT and EMDR, is effective (e.g. Bradley, Greene, Russ, Dutra, & Westen, 2005; Cusack et al., 2016; Van Etten & Taylor, 1998) a significant number of patients still suffer from PTSD afterwards (e.g. Schottenbauer, Glass, Arnkoff, Tendick, & Hafter Gray, 2008). Examining risk factors might therefore be helpful in extending knowledge of disorder specific mechanisms, developing preventive strategies and improving therapy methods.

It is well established that trauma specific factors play an important role. For example, severity of PTSD is particularly high after interpersonal and longstanding or repeated traumatic events (Maercker, 2013). In addition to type of trauma, reviews and meta-analyses indicate that both psychological and physiological risk factors play an important role in the development of PTSD (Brewin, Andrews, & Valentine, 2000; DiGangi et al., 2013; Ozer et al., 2008; Sareen, 2014; Schmidt, Kaltwasser, & Wotjak, 2013). Clinical and analogue studies find robust relationships between dissociation and PTSD. Peritraumatic dissociation is known to be associated with or to be a strong predictor of PTSD (Kleim, Ehlers, & Glucksman, 2007; Martin, Marchand, Boyer, & Martin, 2009; Ozer et al., 2008) while persistent dissociation sustains PTSD (Ehlers & Clark, 2000; Halligan, Michael, Clark, & Ehlers, 2003; Murray, Ehlers, & Mayou, 2002). Furthermore, there are relationships between both peritraumatic dissociation and trait dissociation and the development of intrusions after an analogue trauma (Laposa & Alden, 2008; Laposa & Rector, 2012). Cognitive theories and research further support the importance of negative emotional responses, such as trait and state anxiety or depressive symptoms, in the development of PTSD and intrusions (Ehlers & Clark, 2000; Frommberger et al., 1998; Kleim et al., 2007; Laposa & Alden, 2008; Laposa & Rector, 2012; Ozer et al., 2008; Regambal & Alden, 2009; Tampke & Irwin, 1999). Moreover, maladaptive cognitive processing styles, in particular rumination, are considered to be connected with PTSD and intrusive symptoms (for a review: Ehlers, Ehring, & Kleim, 2012). Rumination plays an important role in predicting and maintaining PTSD (Ehring & Ehlers, 2014; Ehring, Frank, & Ehlers, 2008; Kleim, Ehlers, & Glucksman, 2012; Michael, Halligan, Clark, & Ehlers, 2007; Spinhoven, Penninx, Krempeniou, van Hemert,

& Elzinga, 2015) and is associated with intrusive memories (Birrer & Michael, 2011; Ehring, Fuchs, & Kläsener, 2009; Laposa & Rector, 2012; Michael et al., 2007; Santa Maria, Reichert, Hummel, & Ehring, 2012; Zetsche, Ehring, & Ehlers, 2009).

Alongside these, physiological variables seem to be associated with posttraumatic symptoms and PTSD. There are associations between measures of peripheral physiology and PTSD, such as electrocardiogram (ECG) (Blanchard, Kolb, Pallmeyer, & Gerardi, 1982; Buckley & Kaloupek, 2001; Paulus, Argo, & Egge, 2013; Pole, 2007; Shalev et al., 1998), electrodermal activity (EDA) (Blechert, Michael, Grossman, Lajtman, & Wilhelm, 2007; Orr et al., 2000; Pole, 2007) and blood pressure (BP) (Blanchard et al., 1982; Buckley & Kaloupek, 2001; Paulus et al., 2013). In addition, the stress hormone cortisol, which modulates memory, has been investigated (e.g. de Quervain, 2006). Although cortisol is secreted in response to stress, PTSD patients seem to have particularly low basal cortisol levels (Meewisse, Reitsma, De Vries, Gersons, & Olff, 2007; Morris, Compas, & Garber, 2012; Wahbeh & Oken, 2013; Yehuda, 2009; but see Klaassens, Giltay, Cuijpers, van Veen, & Zitman, 2012 for contrary findings) and enhanced sensitivity in their cortisol receptors (Yehuda, Golier, Yang, & Tischler, 2004; for general reviews see: Pace & Heim, 2011; Wessa & Rohleder, 2007; Yehuda, 2009). It is not yet clearly established whether these alterations represent a preexisting vulnerability, a response to the traumatic event or a combination of both (Yehuda, 2009).

According to the influential meta-analyses by Brewin, Andrews, & Valentine (2000) and Ozer et al. (2008), it is widely believed that peri- and posttraumatic factors are more important than pretraumatic factors. DiGangi et al. (2013) have recently argued that this belief is partially due to methodological artifacts. They criticize past PTSD research for relying too heavily on cross-sectional studies and retrospective accounts of trauma, thereby being influenced by problems such as recall bias. Moreover, retrospective studies are not able to control for different preexisting conditions, such as individual risk factors or type of trauma, which means that separation of factors influencing PTSD risk and factors arising as a consequence of trauma or the disease itself is difficult. DiGangi's (2013) review, which includes only prospective, longitudinal studies, indicates that many variables previously considered as outcomes of trauma are actually pretrauma risk factors. They also recognize, however, that there is a great deal of evidence demonstrating the importance of both peri- and posttraumatic factors in PTSD and that future research should seek insights that narrow the gap in our knowledge.

Whereas real life assessment involves multiple issues, experimental analogue studies using methods such as the trauma film paradigm afford the opportunity to circumvent potential difficulties by providing the possibility of controlling for pre-, peri- and posttraumatic factors. The trauma film paradigm represents the gold standard for inducing reliable analogue "traumatic" symptoms in healthy participants, especially intrusive memories (e.g. Bourne, Mackay, & Holmes, 2013; Chou, La Marca, Steptoe, & Brewin, 2014a, 2014b; Clark et al., 2014; Lass-Hennemann, Peyk, Streb, Holz, & Michael, 2014; Morina, Leibold, & Ehring, 2013; Nixon, Cain, Nehmy, & Seymour, 2009). In PTSD, intrusions represent short sensory memories (mostly visual) of past traumatic experiences which occur suddenly, unintentionally and uncontrollably (Ehlers, 2015). Although, intrusions are a core symptom of PTSD, neither their presence nor their frequency immediately after trauma is highly predictive of the disorder (e.g. Shalev, 1992), but the degree of distress that accompanies intrusive memories is a powerful predictor of persistent PTSD (e.g. Michael, Ehlers, Halligan, & Clark, 2005).

In this study we assessed rumination, dissociation, anxiety, mood, and measures of physiological arousal, namely cortisol, electrocardiogram, blood pressure and electrodermal activity before, during and after an analogue traumatic experience in 60 healthy participants. Correlations and regression analyses were performed to compare their relationships with different analogue symptoms of PTSD (number of intrusions, intrusion distress, Impact of Event Scale – Revised (IES-R)) and to estimate the most promising predictors for these.

Method

Participants

60 healthy students (30 women, mean age 23.17 (SD 2.76, range 18-29)) took part in our experiment at Saarland University, Germany. Only psychologically and physically healthy, non-smoking students with a body mass index of 19 - 24.9 kg/m² (women) or 20 - 25.9 kg/m² (men) were allowed to participate. Only women who regularly used

monophasic oral contraceptives were included to control for the influence of menstrual cycle phase on hormonal status. Participants with either psychological or pharmacological treatment, current DSM-IV[1] axis I disorder, traumatic experiences in the past[2], severe acute or chronic physical disease, hyper- or hypotension, and a preference for splatter films were excluded. We also required participants to refrain from exercising and drinking alcohol the day before and the day of the experimental session and to refrain from caffeinated drinks and high fat-rich food 2 hours prior to the experimental session. To control for the diurnal cortisol levels, the experimental session took place between 1 p.m. and 6 p.m.. Written informed consent was given by all participants.

Technical Devices and Programs

The experimental software was programmed with E-Prime 2.0 (Psychology Software Tools Inc., Sharpsburg, USA).

HTC Touch 2 smartphones running Windows Mobile 6.5 Professional were used as electronic diaries. The questionnaires were created and run with the open source data acquisition software MyExperience (MyExperience, 2009).

"Traumatic" Film Clip

The 11 minutes film clip contained two extremely aversive scenes from the feature film *Irréversibel* directed by Noé (2002). This film has been shown to reliably induce symptoms of physical and psychological stress along with intrusive memories (e.g. Nixon et al., 2009; Weidmann, Conradi, Grögera, Fehma, & Fydrich, 2009). During the recruiting process, participants were informed with an information sheet and the informed consent agreement that they would watch an extremely distressing film clip with sexual and physical violence and that they could terminate participation at any time without penalty. Ethical approval was given by the ethics committee of the Psychology Faculty at the Saarland University, Germany.

Measures

Pre film: psychological measurements and cortisol.

Trait rumination. To measure trait rumination, a German translation of the Ruminative Responses Scale (RRS) (Treynor, Gonzalez, & Nolen-Hoeksema, 2003) was used. This questionnaire can reach scores from 22 to 88, with higher scores indicating more trait rumination. Internal consistency for the translated version was good (Cronbach's alpha = .76) in our sample.

Trait dissociation. Trait dissociation was measured with the translated version of the Trait Dissociation Questionnaire (TDQ) (Murray, 1997; Murray et al., 2002). This questionnaire can reach scores from 0 to 190, with higher scores indicating more trait dissociation. Again, internal consistency for the translated version was good (Cronbach's alpha = .79) in our sample.

Trait anxiety. Trait anxiety for all participants was assessed with the German trait version of the State-Trait-Anxiety-Inventory (STAI-T, trait version) (Laux, Glanzmann, Schaffner, & Spielberger, 1981). This questionnaire can reach scores from 20 to 80. 20 indicates a very low trait-anxiety level and 80 indicates a very high trait-anxiety level.

Depressed/negative mood. Depression was measured with the German version of the Beck Depression Inventory (BDI) (Hautzinger, Bailer, Worall, & Keller, 1994). The questionnaire measures depressive symptoms for the previous week. This questionnaire can reach scores from 0 to 63. Higher scores indicate more depressive symptoms. A score above 17 is considered to be clinically relevant.

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[1] At the time the study was planned and conducted, the DSM-IV was still in use, so symptoms were not assessed according to the DSM-5.

[2] "Traumatic experiences in the past" refers to any type of "traumatic" life event participants experienced, whether or not the DSM-IV criterion A (PTSD) was met. Due to ethical reasons, we excluded participants for example if they had a car accident even if they experienced this event not as extremely stressful.

Cortisol awakening response (saliva cortisol). Salivette tubes (Sarstedt) were used to collect cortisol data. Participants were asked to chew on a cotton swab provided in the salivette tube for about one minute and then place it back in the tube. Salivette tubes were stored at -20 °C before the analysis in the cortisol laboratory of the University of Trier, Germany. First saliva samples were thawed for biochemical analysis, then the fraction of free cortisol in the saliva was determined using a time-resolved immunoassay with fluorometric detection (described in detail elsewhere: Dressendorfer, Kirschbaum, Rohde, Stahl, & Strasburger, 1992). Saliva cortisol was collected on two consecutive days at home (prior to film presentation) to assess the cortisol awakening response (CAR). For the CAR each participant provided 5 samples per day: the first sample was provided directly after awakening (awake), followed by 4 more samples at intervals of 15 minutes (+15, +30, +45, +60 minutes after awakening).

Peri film: psychological measures, physiological measures and cortisol as reaction to the analogue "traumatic" event.

State anxiety. The German version of the State-Trait-Anxiety-Inventory (STAI-S) (Laux et al., 1981) was used to measure participants' change in level of anxiety as a response to the "traumatic" film. This questionnaire can reach scores from 20 to 80. 20 indicates a low state-anxiety level and 80 indicates a high state-anxiety level.

State affect. Changes in positive and negative affect before and after the "traumatic" film were assessed with the German version of the Positive and Negative Affect Schedule (PANAS) (Krohne, Egloff, Kohlmann, & Tausch, 1996). The PANAS questionnaire consists of two subscales that measure positive (PANAS positive) and negative affect (PANAS negative). Both subscales can reach scores from 10 to 50, with higher scores indicating more positive/negative affect.

Systolic and diastolic blood pressure (BP systolic and BP diastolic). BP systolic and BP diastolic were measured using a DINAMAP V100 device (GE-Healthcare, Munich, Germany) with a cuff placed around the upper arm.

Electrocardiogram (ECG)/Inter-beat-interval (IBI). To measure inter-beat-interval (IBI) as a response to the film clip, a standard lead-II electrocardiogram (ECG) with two Ag/Ag-Cl-electrodes filled with isotonic electrode gel was used to collect a raw ECG signal with an ActiveTwo amplifier (BioSemi, Amsterdam, The Netherlands) at a sampling rate of 2048 Hz. R-waves were identified automatically by ANSLAB (Wilhelm & Peyk, 2012) and edited manually for artefacts, false positives or unrecognized R-waves and transformed into an inter-beat-interval.

Electrodermal activity (EDA)/Skin conductance level (SCL). Two Ag/Ag-Cl-electrodes filled with isotonic electrode gel were attached to the proximal part of the palm of the participants' non-dominant hand (with an alternating current of 1µA synchronized with the sampling frequency passed between the electrodes). The raw signal of electrodermal activity was continuously collected using an ActiveTwo amplifier system (Biosemi, Amsterdam, Netherlands) at a sampling rate of 2048 Hz, and decimated to 25 Hz before further analysis. Then it was manually edited for artefacts and smoothed using a 1 Hz low-pass filter with ANSLAB (Wilhelm & Peyk, 2012). Skin conductance level (SCL) was calculated as the average of all sampling points across the whole phase of the 5 minute pre film baseline, the duration of the film and the 5 minute post film resting phase.

Saliva Cortisol as a response to the "traumatic" film. To measure the cortisol response to the "traumatic" film each participant provided one saliva sample prior to film presentation (pre film), one sample directly after film presentation (post film) and 4 more samples at intervals of 15 minutes after film presentation (post film +15, post film +30, post film +45, and post film +60).

Subjective unpleasantness and arousal ratings as reactions to the film. Subjective unpleasantness and arousal as reactions to the film were rated after the film on two visual analogue scales from 0 to 100 (very pleasant to very unpleasant; no physical reactions to very strong physical reactions) on the computer screen.

Post film: psychological measurements as reactions to the analogue "traumatic" event.

Intrusion frequency, intrusion distress and state rumination as responses to the film (electronic diary). Using an electronic diary (smartphone), we measured intrusion frequency, intrusion distress and rumination (rumination about the film) in response to the film. Participants were asked to carry the smartphone with them at all times during

their daily routine for 6 days after film presentation and to fill out the questionnaires. If an immediate statement was not possible, participants had the option to add data afterwards along with date and time. First, every intrusion of the "traumatic" film had to be noted at any time it occurred. Moreover, participants had to indicate the degree of distress caused by the intrusion on an 11-point analogue rating scale from 0 (not at all) to 10 (very much). Intrusions were defined as recurrent, sudden, spontaneous and non-initiated memories of film scenes that might be very vivid and consist of pictures, sounds, thoughts, words or sentences, feelings or combinations of those (translated). Second, each evening at bedtime, participants had to indicate the degree of state rumination about the film (rumination about the film) for that day on a rating scale from 0 (not at all) to 10 (very much). Rumination was described as an insistent and repetitive circling of thoughts about the film content lasting for a relatively long period of time (translated). Rumination and intrusions were clearly differentiated in advance by the following instruction: Intrusions do not include reflective and conscious thinking or ruminating about the film (translated).

State dissociation as a response to the film. State dissociation as a reaction to the "traumatic" film was measured with the German version of the Dissociation-Tension-Scale-acute for 7 days after film presentation (DSS-acute) (Stiglmayr, Braakmann, Haaf, Stieglitz, & Bohus, 2003)[3]. This questionnaire can reach scores from 0 to 100, with higher scores indicating more state dissociation.

PTSD symptoms as a response to the film. PTSD symptoms as a response to the "traumatic" film were assessed with the German version of the Impact of Event Scale-Revised (IES-R) (Maercker & Schützwohl, 1998). This questionnaire can reach scores from 0 to 110 and assesses different PTSD symptoms (intrusive reexperiencing, hyperarousal, avoidance).The instruction was matched related to the analogue traumatic event (film clip) as follows (translated): "Please think about the film clip that was presented last week and then indicate how you dealt with this event (film clip) the past week by checking each of the following reactions relating to their frequency."

Compliance. At follow-up participants had to indicate whether or not they had recorded all intrusions experienced for the previous 7 days on a 11 point rating scale from 0 (never forgotten) to 10 (always forgotten).

Procedure

Participation included three appointments at our laboratory: an initial screening interview session to determine eligibility, one experimental session (film presentation) and one follow-up session after 7 days. Furthermore, at home participants had to collect cortisol samples and to fill in the electronic diary.

Recruiting procedure and screening interview. Recruiting was done through postings at Saarland University, Germany. In a short telephone interview participants were informed about the study and an appointment for the screening interview was made. During the screening interview, all participants received detailed information on the procedure and aims of the study. After giving written informed consent, inclusion and exclusion criteria were checked. Blood pressure was measured to exclude hyper- or hypotension and participants completed a demographic questionnaire. Participants were instructed how to use the electronic diary (smartphone). After completing the RRS, TDQ, BDI, and STAI-T they received detailed written instructions for taking cortisol measurements at home and were given the necessary Salivette tubes.

Saliva cortisol at home. Participants collected 10 saliva cortisol samples for two consecutive days at home (prior to the experimental day) and kept them in a refrigerator before bringing them back to our laboratory.

Film presentation. On arrival, the participants were seated in a sound attenuated and electromagnetically shielded cabin where they were prepared for the physiological measurements. Afterwards, participants filled in the PANAS and the STAI-S questionnaires (pre film measurement). After completing the questionnaires, the experimental procedure began. The experimenter was not in the cabin with the participant, but in an adjacent control room and observed from there continually the ongoing in the cabin via a camera placed at the top of the computer screen. Participants put on headphones and were informed on the computer screen that a five minutes baseline measurement of physiological data would be taken during which they should sit relaxed, while keeping their eyes

[3] We analyzed only the dissociation items, omitting those related to tension.

closed and letting their thoughts wander freely. Onset and end of the baseline measurement were indicated by a neutral sound. Blood pressure was measured once in the middle of the baseline phase (after 2.30 minutes). After the baseline measurement, they provided a saliva sample (pre film) and were instructed that the film starts and asked to watch it continually without closing their eyes, not even during the distressing scenes. Moreover, to enhance self-relevance, participants were told to imagine that they were a direct eye witness of the scenes. Next, it was pointed out that they could withdraw from the experiment at any time. When they pressed the “space” button, the video began. Physiological measures were collected throughout the film (blood pressure once in the middle of the film). After the film had ended, participants were asked to provide another saliva sample (post film). Physiological measurement then continued for five more minutes during which the participants were asked to sit relaxed with eyes closed and to let their thoughts wander (post film resting phase measurement). Afterwards, participants rated how unpleasant the film was (subjective valence) and indicated their arousal on visual analogue scales (0-100). They also completed the PANAS and the STAI-S (post film measurement). After that, the electrodes were removed and participants were led to another room, where they received their electronic diary. From now on, they were asked to record all intrusions they experienced. They also provided four more saliva samples (as described above) and received an information sheet with a contact number in case of technical problems (electronic diary) or if they should feel overly distressed as a reaction to the “traumatic” film. Participants left the laboratory after providing the last saliva sample.

Electronic diary measurements over 6 days following film presentation. Intrusion frequency, intrusion distress, and rumination about the film were assessed using a smartphone for the following 6 days.

Follow-up and completion of the study. 7 days after film presentation, participants returned to our laboratory to turn in the smartphones, fill in the DSS-acute and to indicate their compliance with providing the electronic diary entries. They received 40 Euros for their participation and were offered the possibility of asking further questions about the study.

Statistical Methods/Data Analysis

All statistical analyses were performed with SPSS (IBM SPSS Statistics 22) and were carried out two-tailed on a 5 percent level. Alpha level correction was made if indicated (see below).

Electronic diary inputs. Number of intrusions was calculated by summing up all intrusion entries for each participant. Intrusion distress and rumination about the film were averaged over the experimental days for each participant. Mean values for all entries per participant over the experimental days were calculated.

Baseline adjustments. For all peripheral physiology measures (ECG, EDA and BP) as well as for STAI-S, PANAS positive and PANAS negative, we calculated baseline adjustments by subtracting pre film baseline values from the film (for peripheral physiological responses only: IBI film-pre, SCL film-pre, BP systolic film-pre, BP diastolic film-pre) and by subtracting pre film baseline values from the post film data (IBI post-pre, SCL post-pre, BP systolic post-pre, BP diastolic post-pre, STAI-S post-pre, PANAS negative post-pre and PANAS positive post-pre) in order to end up with values that indicated changes caused by the “traumatic” film.

Outliers and extreme scores. Variables were examined with respect to univariate outliers and extreme scores using SPSS (IBM SPSS Statistics 22). Outliers were defined as values between 1.5 and 3 apart, extreme scores as values separated by more than 3 box lengths at the upper or lower end from the 25 percent or 75 percent percentile. Outliers and extreme scores were changed to new raw scores that were one unit larger or smaller than the next most extreme score in the distribution (Tabachnick & Fidell, 2014a). One “unit” was defined as the mean distance of the values in the corresponding variable without considering the outliers and extreme scores (information on the number of changed scores for all variables can be found in the Appendix A).

Cortisol awakening response (CAR). For each participant we calculated the area under the curve with respect to the ground (AUCg) for the cortisol awakening response (CAR AUCg) as described in detail by (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). To calculate CAR, the samples taken at the same time on two consecutive days were averaged per participant. AUCg “takes into account the difference between the single

measurements from each other (i.e., the change over time) and the distance of these measures from the ground, or zero (i.e., the level at which the changes over time occur)" (Pruessner et al., 2003, p. 918-919).

Cortisol response to the film. For each participant we calculated the area under the curve with respect to increase (Cortisol film AUCi) in the cortisol response to the film according to (Pruessner et al., 2003). In contrast to AUCg, AUCi "ignores the distance from zero for all measurements, thereby emphasizing the changes over time" (Pruessner et al., 2003, p. 918-919).

In addition, the cortisol response to the film (Cortisol film AUCi) was analyzed by using a repeated measures analysis of variance with time of measurement as within-subject factor (Cortisol pre film, Cortisol post film, Cortisol post film +15, Cortisol post film +30, Cortisol post film +45 and Cortisol post film +60). Bonferroni pair-wise comparisons were computed to identify differences between single time measurements.

Psychophysiological responses to the film. IBI, SCL, BP systolic and BP diastolic were analyzed using repeated measures analyses of variance with time of measurement (pre film, film and post film) as within-subject factor. Bonferroni pair-wise comparisons were computed to identify differences between single time measurements.

Psychological responses to the film. STAI-S pre versus post film, PANAS positive pre versus post film and PANAS negative pre versus post film were analyzed separately with dependent t-tests for paired samples. Moreover, we examined diversity from zero for both variables (unpleasantness rating and arousal rating) with one-sample t-tests.

Effect sizes. Effect sizes were reported as Cohen's d (for t-tets) and partial η^2 (for ANOVAs).

Main analyses. Pearson correlations were performed to assess relationships between intrusion frequency, intrusion distress, and IES-R as dependent variables and all psychological and physiological independent variables. Because of the multiple correlations, we conducted an alpha level correction (Curtin & Schulz, 1998) resulting in a new alpha level of 0.3 percent (adjusted alpha level = .003)[4] for each of the correlation coefficients. Two stepwise multiple regression analyses were carried out to detect the best predictors for intrusion distress and IES-R. Only variables significantly correlated (0.3 percent level) were included in the regression analyses and entered together in one step. Stepwise regression was used to determine those independent variables that contributed to predicting the corresponding dependent variable and to eliminate those that did not provide any additional prediction over the independent variables already in the equation (Tabachnick & Fidell, 2014b).

Because there was only one significant correlation with intrusion frequency, we carried out a linear regression for intrusion frequency with this independent variable.

Results

Descriptive Statistics

Participants experienced on average 3.33 intrusions (SD = 3.37, range = 0 to 12).

78 percent of the participants (n = 47) indicated at least one intrusion (M = 4.25, SD = 3.25)[5]. Intrusion distress had a mean value of 4.19 (SD = 2.34, range = 0 to 8.89). Analogue PTSD symptoms measured with the IES-R showed an average of 17.53 (SD = 12.64)[6]. Ratings immediately after the film indicated high subjective unpleasantness and arousal as reactions to the analogue "traumatic" event (unpleasantness: M = 89.85, SD = 15.03; arousal: M = 65.86, SD = 18.85). Participants' compliance ratings were very high (M = 0.67, SD = 1.46).

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[4] For each of the three dependent variables we calculated the adjusted alpha level according to Curtin & Schulz (1998) with the following formula: adjusted alpha level = $1 - (1 - \text{overall alpha})^{1/k} = 1 - (1 - .05)^{1/19}$. *k* represents the number of correlation coefficients that were calculated for each dependent variable (psychological and physiological variables were taken together resulting in 19 coefficients, k = 19).

[5] For each intrusion participants had to indicate the type of intrusion (multiple answers were possible). We assessed the following types; percentages are stated in brackets: Pictures (93 %), thoughts (30 %), emotions (29%), sounds (25 %), words/sentences (21 %), others (0 %).

A total of five participants, which were initially included in the study, dropped out. Two of them did not appear for the film presentation, whereas three participants dropped out during film presentation, because they showed a decrease in blood pressure and indicated that they felt lightheaded. New participants were tested to replace these dropouts.

Descriptive data for all other variables can be found in the supplementary material (Appendix B).

Cortisol, Physiological and Psychological Reactions to the Analogue Traumatic Event

Cortisol response to the film. We found a significant effect of time for the cortisol measurement, indicating a strong cortisol increase in response to the “traumatic” film clip ($F (1.76, 104.09) = 12.03$, $p < .001$, partial $\eta^2 = .17$). Pairwise comparisons showed a significant increase of cortisol 15 minutes after film presentation (cortisol post film +15) in comparison with the sample directly after the film (post film) ($p = .005$) and significant decreases in cortisol between cortisol post film + 30 and cortisol post film +45 ($p < .001$) as well as between cortisol post film +45 and cortisol post film +60 ($p < .001$).

Psychophysiological responses to the film (IBI, SCL and BP). Significant effects of time were also found for IBI ($F (1.53, 88.92) = 43.50$, $p < .001$, partial $\eta^2 = .43$), SCL ($F (1.48, 85.88) = 137.98$, $p < .001$, partial $\eta^2 = 3.08$), BP systolic ($F (1.67, 98.56) = 55.51$, $p < .001$, partial $\eta^2 = .49$) and BP diastolic ($F (2, 118) = 70.90$, $p < .001$, partial $\eta^2 = .55$). Bonferroni pair wise comparisons showed strong increases in physiological arousal as a response to the film as compared with pre film and post film in IBI (pre film vs. film: $p < .001$, film vs. post film: $p < .001$), in BP systolic (pre film vs. film: $p < .001$, film vs. post film: $p < .001$) and BP diastolic (pre film vs. film: $p < .001$, film vs. post film: $p < .001$) and as compared with pre film in SCL (pre film vs. film: $p < .001$). Moreover, there was a significant increase in SCL post film as compared with SCL film ($p = .02$).

Psychological responses to the film. There was a significant increase in STAI-S and PANAS negative from pre to post film measurement (STAI-S: $t (59) = -11.80$, $p < .001$, $d = -1.41$; PANAS negative: $t (59) = -11.20$, $p < .001$, $d = -1.68$), whereas PANAS positive showed a significant decline ($t (59) = 10.44$, $p < .001$, $d = 1.01$). Both unpleasantness and arousal ratings were significantly different from zero (unpleasantness: $t (59) = 68.69$, $p < .001$, $d = 8.87$; arousal: $t (59) = 29.09$, $p < .001$, $d = 3.76$).

Main Analyses: Correlations and Regression Analyses

Correlations with intrusion frequency, intrusion distress and IES-R as dependent variables. Table 1 presents correlation data for intrusion frequency, intrusion distress and IES-R with the psychological variables. Only state rumination about the film shows a significant positive correlation with all three dependent variables, while STAI-T, BDI, TDQ, RRS, PANAS positive post-pre and DSS-acute show no correlation with any of them. The PANAS negative post-pre shows a significant positive correlation with both intrusion distress and IES-R, while STAI-S post-pre shows a positive correlation only to intrusion distress.

Table 1: Pearson correlations: Intrusion frequency, intrusion distress and IES-R with independent psychological variables.

Independent Variables	Intrusion Frequency n = 60, r	Intrusion Distress n = 46, r	IES-R n = 60, r
STAI-T	.24	.30	.34
BDI	.13	.13	.19
TDQ	.19	.17	.34
RRS	.36	.29	.33
STAI-S post-pre	.27	.54***	.34
PANAS positive post-pre	.01	-.20	-.17
PANAS negative post-pre	.37	.50***	.49***
DSS-acute	.27	.18	.31
Rumination about the film	.54***	.49**	.54***

Note: Data for intrusion distress are only available for participants that had at least one intrusion. For one participant (who experienced one intrusion) information about the degree of distress of the intrusion is missing due to technical problems. Because of alpha level adjustment, p values less than or equal to .003 are significant. ***p < .001 (two-tailed).

Table 2 shows all relationships between the dependent variables intrusion frequency, intrusion distress and IES-R and the physiological variables. There were no significant correlations.

Table 2: Pearson correlations: Intrusion frequency, intrusion distress and IES-R with independent physiological variables.

Independent Variable	Intrusion Frequency n = 60, r	Intrusion Distress n = 46, r	IES-R n = 60, r
CAR AUCg	-.05	-.15	-.08
Cortisol film AUCi	.10	.06	.12
IBI film-pre	-.06	.08	-.13
IBI post-pre	.27	.18	.26
SCL film-pre	-.19	.20	.03
SCL post-pre	-.05	.21	.09
BP systolic film-pre	.19	.06	.19
BP systolic post-pre	.09	.10	.11
BP diastolic film-pre	.15	.15	.20
BP diastolic post-pre	.15	.18	.09

Note: IBI- and SCL- data are missing for one participant due to technical problems. Data for intrusion distress are only available for participants that had at least one intrusion. For one participant (who experienced one intrusion) information about the degree of distress of the intrusion is missing due to technical problems. Because of alpha level adjustment, p values less than or equal to .003 would have been significant.

Regression analyses to predict intrusion frequency, intrusion distress and IES-R. A linear regression analysis for intrusion frequency was conducted with rumination about the film as independent variable. For intrusion distress and IES-R, all variables significantly correlated with them (intrusion distress: STAI-S post-pre, PANAS negative post-

pre, rumination about the film; IES-R: PANAS negative post-pre, rumination about the film) were entered in the stepwise multiple regression analyses (results are shown in Table 3).

Table 3: Regression analyses to predict intrusion frequency, intrusion distress and IES-R.

Dependent Variable	Overall Effect		Independent Variables	t	p	Beta
	F	Adjusted R^2				
Intrusion frequency	23.72***	.28	Rumination about the film	4.87	.000	.54
Intrusion distress	14.24***	.37	STAI-S post-pre	3.40	.001	.42
			Rumination about the film	2.80	.008	.35
IES-R	24.31***	.28	Rumination about the film	4.93	.000	.54

***p < .001 (two-tailed).

Rumination about the film is a significant predictor for intrusion frequency and accounts for 28 percent (using adjusted R^2) of the total variance.

Regarding intrusion distress, the best model predicts 37 percent (using adjusted R^2) of the variance with STAI-S post-pre being the strongest predictor followed by rumination about the film. There were no indications of problems with multicollinearity (all tolerances > .90, all variance inflation factors < 1.12) and autocorrelation of the residuals (Durbin-Watson = 2.32).

With respect to IES-R, the best model accounts for 28 percent (using adjusted R^2) of the variance with rumination about the film as the only predictor. Again, there were no indications of problems with multicollinearity (tolerance = 1.0, variance inflation factor = 1.0) and autocorrelation of the residuals (Durbin-Watson = 1.78).

Discussion

This prospective study was designed to find the most promising predictors for analogue PTSD symptoms after exposure to a highly aversive film. Different psychological and physiological trait and state variables known to influence the development and maintenance of PTSD were assessed before, during and after the “traumatic” film clip. We measured intrusion frequency, intrusion distress and IES-R as analogue PTSD symptoms (dependent variables) for one week after film presentation and assessed anxiety, mood, dissociation and rumination together with cortisol, electrocardiogram, electrodermal activity and blood pressure (independent variables) to estimate their associative strengths with analogue PTSD symptoms.

Surprisingly, the only significant predictor for both intrusion frequency and IES-R was rumination about the film (state rumination). For intrusion distress, a similar pattern emerged; intrusion distress was predicted by state rumination and an increase in anxiety as a reaction to the “traumatic” film. At first sight, the result that only state rumination but not trait rumination predicted analogue PTSD symptoms is somewhat surprising, as one might assume that a state variable (e.g. state rumination) is influenced by its corresponding trait personality variable (e.g. trait rumination). Indeed, these two variables were significantly - but not perfectly - correlated with each other[7]. Furthermore, although trait rumination was not a significant predictor of intrusion frequency, intrusion distress or IES-R, it showed weak to medium size positive correlations with all three dependent variables (see Table 1). In this study, state rumination referred explicitly to rumination about the “traumatic” event (film content), whereas trait rumination, measured with the RRS, includes different aspects of ruminative thinking (Treynor et al., 2003) that do not necessarily refer to traumatic events. Given that this analogue study had small effect sizes in general, it seems plausible that state rumination in response to the “traumatic” event was more powerful than trait rumination in predicting analogue PTSD symptoms. These findings are further in line with another trauma film study by Laposa & Rector (2012) that compared trait and state rumination and that found a relationship between state rumination, but not trait rumination, and intrusion development (but see Kubota, Nixon, & Chen, 2015). However, a recent clinical prospective study by Spinhoven et

[7] A post-hoc correlation analysis showed a significant relationship between trait and state rumination (r (58) = .367, p = .004).

al. (2015) showed that trait rumination predicted PTSD. State rumination was not assessed in this study, thereby allowing no comparison between these two aspects of ruminative behavior. In sum, one may suppose that both rumination about the traumatic event and a general tendency for rumination predict PTSD.

Our results raise the question which mechanisms could be responsible for the observed relationship between state rumination and our outcome measures. There is a wide range of literature suggesting that rumination is a transdiagnostic process that is associated with a wide range of disorders including PTSD (Ehlers & Clark, 2000; Roley et al., 2015; White & Wild , 2016). With respect to PTSD it is assumed that rumination represents a cognitive avoidance strategy[8] in which the person focuses on the reasons and consequences of the trauma that prevents processing of the traumatic memories (Michael et al., 2007) and increases faulty processing of information (Ehring, Frank & Ehlers, 2008). Another mechanism which might explain the relationship between state rumination and intrusive experiencing refers to the growing body of research looking into the relationship between executive/attentional control, rumination and psychopathology. There is accumulating evidence that rumination is associated with reduced executive control (e.g. De Lissnyder, Derakshan, De Raedt, & Koster, 2011). In light of these findings it has been argued that rumination results from an impairment in the ability to disengage attention from self-reflective negative thoughts (Koster, De Lissnyder, Derakshan, & De Raedt, 2011). Given the well-established connection between rumination and deficits in executive functioning, it has recently been proposed that rumination is associated with diminished inhibitory control over memory (Fawcett et al., 2015). In fact, the authors find a clear linkage between rumination and memory suppression ability in healthy adults and suggest that inhibitory deficits complicate the termination of ruminative thoughts. Interestingly, it has recently been shown that retrieval suppression is compromised in PTSD patients (Catarino, Kupper, Werner-Seidler, Dalgleish, & Anderson, 2015) and that reduced retrieval suppression ability is a potential risk factor for distressing intrusions after an analogue trauma (Streb, Mecklinger, Anderson, Lass-Hennemann, & Michael, 2016). Thus, rumination and intrusions may - at least partially - have the same underlying mechanism, namely reduced inhibitory control.

It is important to note that in the current study intrusive memories and state rumination were assessed concurrently with an electronic diary for 6 days after film presentation. Therefore, a reverse relationship between intrusions and state rumination, that is higher levels of intrusive memories leading to more rumination after the traumatic film clip, cannot be ruled out. To analyze the temporal precedence we conducted two post-hoc regression analyses investigating whether state rumination on day 1 predicted intrusions on days 2-7, and whether intrusions on day 1 predicted state rumination on days 2-7. Both regression analyses were highly significant, showing that initial state rumination was predictive of intrusions and initial intrusions were predictive of state rumination[9]. The finding that both state rumination and intrusion frequency predict each other is not surprising given that previous research has already shown double-sided relationships and interactions between these two variables (Speckens, Ehlers, Hackmann, Ruths, & Clark, 2007) and given the assumption that reduced inhibitory control contributes to both mechanisms. Moreover, in this study state rumination was also a strong predictor for IES-R, which was assessed with a questionnaire at follow-up independent from state rumination. Thus, our data point to a predictive role of state rumination for intrusions, but also to an interaction between both variables. Further research is needed to have a closer look at the relationship between state rumination and PTSD symptoms.

Apart from rumination about the “traumatic” film, an increase in anxiety after the film (state anxiety) was predictive for intrusion distress in this study. Previous analogue studies have found similar results regarding state anxiety and analogue intrusive memories (Hagenaars, Brewin, van Minnen, Holmes, & Hoogduin, 2010; Laposa & Alden, 2008;

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[8] A post-hoc regression analysis showed that intrusion distress at the day of the film presentation predicts state rumination at the following days of the experiment ($b = .41$, $t(36) = 2.73$, $p = .01$). The reverse regression analysis showed that state rumination at the day of the film presentation also predicted intrusion distress on the following days, however it had a lower predictive value than the reverse relationship ($b = .33$, $t(34) = 2.05$, $p = .05$). These results might indicate that individuals who perceive intrusions as distressing are more likely to try to avoid them than those who do not find them distressing (see also Steil & Ehlers, 2000). Thus, state rumination might be employed as an avoidance strategy.

[9] The first post-hoc regression analysis showed that state rumination at the day of the film presentation predicts intrusion frequency at the following days of the experiment ($b = .46$, $t(53) = 3.78$, $p < .001$). However a second post-hoc regression analysis showed vice verca that intrusion frequency at the day of the film presentation predicts state rumination at the following days of the experiment as well ($b = .44$, $t (58) = 3.77$, $p < .001$).

Laposa & Rector, 2012). Moreover, the results are in line with clinical studies showing that trauma severity (Brewin, Andrews, & Valentine, 2000) along with emotional responses involving intense fear, helplessness or horror at the time of trauma are associated with later PTSD (Breslau & Kessler, 2001; Brewin, Andrews, & Rose, 2000), and that experiencing a trauma together with these intense emotions results in greater symptom severity than trauma alone (Schnurr, Spiro, Vielhauer, Findler, & Hamblen, 2002). However, some people exposed to a traumatic event deny having such intense emotional reactions (Brewin, Andrews, & Rose, 2000; Friedman, 2013) and requiring fear, helplessness or horror as a criterion for diagnosis has no impact on PTSD prevalence (Schnurr et al., 2002). Schnurr et al. (2002) have emphasized the potential ability to help predict which individuals are unlikely to develop PTSD by interpreting the findings of Brewin, Andrews & Rose (2000). They state that it is more likely the absence of such intense emotional reactions is highly predictive of not having PTSD. However, our results point to the importance of the connection between state anxiety and distress experienced during intrusive memories.

Surprisingly, neither state dissociation nor trait dissociation was predictive of intrusion frequency, intrusion distress or IES-R in our study. This is in contrast to previous research showing that peritraumatic dissociation is a strong predictor for PTSD (e.g. Martin et al., 2009; Ozer et al., 2008) and is associated with intrusions after an analogue trauma (Holmes, Brewin, & Hennessy, 2004). Other studies have also found trait dissociation (Galatzer-Levy, Madan, Neylan, Henn-Haase, & Marmar, 2011; Laposa & Alden, 2008; McCaslin et al., 2008; Murray et al., 2002) as well as persistent dissociation (Ehring, Ehlers, & Glucksman, 2008; Murray et al., 2002) to be associated with PTSD and analogue PTSD symptoms.

Importantly, our participants scored relatively low on the trait dissociation measure, which is to be expected in a healthy sample excluding any psychiatric disorders and previous trauma. However, this relatively low score on trait dissociation might explain why we did not find a relationship between dissociation and intrusions and IES-R in our sample. Our findings are in line with a recent study that employed the trauma film paradigm in healthy emergency workers, military personnel, and journalists working in conflict zones, which also did not find a relationship between trait dissociation and intrusive memories of the film (White & Wild, 2016). Exclusion criteria were also quiet strict in this study and participants scored low in trait dissociation.

Contrary to expectations, none of the physiological variables showed a significant relationship with analogue PTSD symptoms. This is in contrast to clinical studies that point to the high relevance of physiological measures in the context of PTSD. Experimental studies with PTSD patients have found changes in physiology, such as enhanced activity in electrocardiogram, electrodermal activity or blood pressure, as reactions to traumatic stimuli or under resting conditions (e.g. Blechert et al., 2007; Buckley & Kaloupek, 2001; Paulus et al., 2013; Pole, 2007). With respect to cortisol, neither basal levels measured before the “traumatic” film clip nor cortisol levels as a reaction to the film were associated with analogue PTSD symptoms. This is in contrast with clinical findings of changes in the hypothalamic-pituitary-adrenal axis, particularly in basal cortisol levels in PTSD (Meewisse et al., 2007; Morris et al., 2012; Pace & Heim, 2011; Wahbeh & Oken, 2013; Wessa & Rohleder, 2007; Yehuda, 2009). There are, however, also studies showing no alterations in basal cortisol even for PTSD patients (Klaassens et al., 2012). A recent analogue study by Chou et al. (2014a), also using the trauma film paradigm, has found lower cortisol concentrations after the film, and that those lower cortisol levels predicted more vivid intrusions about the film. Chou and colleagues did not exclude participants with prior traumatic experiences and the influence of cortisol on intrusive memories was only found in those participants with more recent trauma experiences and more subclinical PTSD symptoms. They also found that decreases in heart rate during a “traumatic” film predicted the development of intrusive images (2014b). This replicates earlier findings by Holmes et al. (2004). Even though Holmes and colleagues accepted only student volunteers who affirmed that they had received no treatment for a mental health problem in the past, this exclusion criterion does not preclude the possibility that those students had experienced traumatic events in their lives or that they may have suffered from a mental disorder. We included only physiologically and mentally healthy participants in this study and excluded any participants with past trauma experience for ethical reasons. The absence of any relationships between cortisol as well as all other physiological measures and analogue PTSD symptoms may have resulted from having a very healthy sample without prior trauma (but see Weidmann et al., 2009). In summary, inconsistent findings indicate more research is needed to further illuminate the role of physiological factors in PTSD.

This study has some limitations that need to be taken into account. We used an analogue paradigm in healthy participants instead of investigating clinical PTSD patients before, during and after a real traumatic event. It must be

emphasized that watching a “traumatic” film clip is not comparable to experiencing an actual traumatic event. Nonetheless, movies and pictures can fulfill the trauma criterion (A.4.) of the DSM-5, if the exposure to the material is work related (American Psychiatric Association, 2013). The exposure to traumatic film contents is, therefore, able to induce significant, PTSD relevant impacts. As mentioned above, real life assessments in patients create various challenges and problems that can be circumvented by analogue designs. The trauma film paradigm represents the gold standard in examining key processes and factors in PTSD (for a review: Holmes & Bourne, 2008), such as intrusions. As in many previous trials, our participants exhibited intrusions accompanied by moderate distress in the week following exposure to the “traumatic” event, which was experienced as very unpleasant and arousing. Moreover, the film clip induced both high psychological stress and physiological arousal. Thus, our paradigm led to the expected analogue symptoms. Nonetheless, generalizability may be restricted since for ethical reasons only healthy participants without any psychopathology and without prior traumatic experiences were included. Participants reported an average of 3.33 intrusions in this study. There are studies using the same film clip and similar exclusion criteria showing similar results (Streb et al., 2016). Other studies, however, report more intrusions in a one week follow-up period (Nixon et al., 2009). Thus, due to our very strict exclusion criteria, we might have captured a very resilient sample. It is possible that the inclusion of resilient participants resulted in relatively few intrusions and a relatively low variability in the independent variables (e.g. trait dissociation). This low variability might be responsible for some non-significant results in variables that have previously been shown to be important for PTSD, such as physiology measures (see above) or trait rumination and dissociation. However, we did not directly assess resilience in our participants. Thus, we can only speculate about this issue.

We also have to consider that due to multiple testing (great number of variables), we performed an alpha level adjustment that resulted in fewer significant results. Even though this is advisable in a study as ours, it has not been performed in all studies investigating risk factors/predictors of PTSD. Thus, our very strict statistical analysis might also limit the comparability to the findings of other studies. On the one hand a larger sample size could have lead in another pattern of results, e.g. more significant predictor variables. On the other hand, non-significant findings could simply reflect that those variables are not as important as the significant ones.

Finally, although we assessed “clinical” PTSD symptoms according to DSM-IV with the IES-R, our main focus with regard to the dependent variables was on intrusions (frequency and distress). Most authors stress intrusions as the core symptom of PTSD (e.g. Ehlers, 2015; Laposa & Rector, 2012; Michael et al., 2005), while others focus on avoidance and numbing (North, Suris, Davis, & Smith, 2009). Further studies should examine the whole symptom cluster of DSM-5, including marked alterations in arousal and reactivity, persistent avoidance and negative alterations in cognitions and mood, along with intrusions. Nevertheless, in addition to IES-R and intrusions, we assessed key variables that play a major role in PTSD, such as rumination and dissociation together with cortisol and other psychophysiological variables.

In this prospective analogue study we found state rumination to be the only predictor for both intrusion frequency and the IES-R. Moreover, together with an increase in anxiety, state rumination predicted intrusion distress. Further well designed clinical studies with PTSD patients should investigate these key variables prospectively to confirm our findings.

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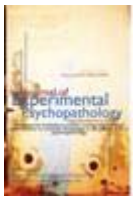

Appendices

Appendix A: Number of changed outliers and extreme scores for all variables.

Number of Changed C Scores	Variables
0	Intrusion distress, IES-R, BDI, TDQ, RRS, STAI-S post, STAI-S post-pre, PANAS positive pre, PANAS positive post, PANAS negative post, PANAS negative post-pre, Rumination about the film, BP diastolic film-pre, BP diastolic post-pre, IBI film, BP systolic post film
1	STAI-T, STAI-S pre, PANAS positive post-pre, Arousal rating, CAR AUCg, SCL film-pre, SCL post-pre, IBI pre film, IBI post film, BP systolic pre film
2	Intrusion frequency, IBI film-pre, BP systolic film-pre, Cortisol pre film, Cortisol post film, BP diastolic film, BP diastolic pre film, BP systolic film, SCL post film
3	PANAS negative pre, IBI post-pre, BP systolic post-pre, Cortisol post film +60
4	Unpleasantness rating, BP diastolic post film
5	Cortisol post film +15, Cortisol post film +30, Cortisol post film +45, SCL film, SCL pre film
6	DSS-acute, Cortisol film AUCi

Appendix B: Descriptive statistics for the variables.

Variable	n	M	SD
STAI-T	60	31.59	7.95
BDI	60	2.48	2.63
TDQ	60	15.02	10.19
RRS	60	33.43	8.83
STAI-S pre	60	33.51	6.07
STAI-S post	60	47.67	11.30
STAI-S post-pre	60	14.08	9.27
PANAS positive pre	60	30.78	6.50
PANAS positive post	60	24.13	6.65
PANAS positive post-pre	60	-6.47	4.38
PANAS negative pre	60	11.84	1.77
PANAS negative post	60	22.87	8.01
PANAS negative post-pre	60	10.98	7.61
Unpleasantness rating	60	91.29	10.29
Arousal rating	60	66.30	17.66
DSS-acute	60	2.18	2.59
Rumination about the film	60	2.58	1.72
CAR AUCg	60	38.87	11.63
Cortisol film AUCi	60	17.80	121.67
IBI film-pre	59	-60.71	62.50
IBI post-pre	59	2.99	38.55
SCL film-pre	59	4.48	2.47

Variable	n	M	SD
SCL post-pre	59	4.84	2.86
BP systolic film-pre	60	9.49	8.51
BP systolic post-pre	60	2.98	5.61
BP diastolic film-pre	60	6.20	4.54
BP diastolic post-pre	60	3.30	4.58
Cortisol pre film	60	3.97	2.13
Cortisol post film	60	3.92	2.05
Cortisol post film +15	60	5.17	3.27
Cortisol post film +30	60	4.72	2.90
Cortisol post film +45	60	3.88	2.24
Cortisol post film +60	60	3.44	1.97
IBI pre film	59	819.36	122.46
IBI film	59	760.21	119.32
IBI post film	59	823.45	114.06
SCL pre film	59	9.68	4.46
SCL film	59	14.12	5.66
SCL post film	59	14.83	6.51
BP systolic pre film	60	117.06	9.06
BP systolic film	60	126.86	11.67
BP systolic post film	60	120.15	10.13
BP diastolic pre film	60	68.35	6.37
BP diastolic film	60	74.69	7.71
BP diastolic post film	60	71.72	6.46

4 Note: IBI- and SCL- data are missing for one participant due to technical problems.