



Lights ... action: Comparison of trauma films for use in the trauma film paradigm



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ABSTRACT

Affective films are often used in emotion research and negative films are frequently used as an analogue for trauma (trauma film paradigm). However, different films are used with possibly distinct consequences. We aimed to investigate specific effects of four negative films covering distinct themes (physical, sexual, traffic and food), and tested neutral and positive films with matching content. Self-reported emotional responses and heart rate during the films were examined (immediate responses) as well as intrusions of the films in the subsequent week (delayed responses). Within each theme, negative films were rated as more unpleasant than the positive and neutral counterparts. They also evoked more negative emotions and more intrusive memories. Across themes, the four negative films did not differ in terms of valence and arousal, but clearly differed on immediate (e.g., disgust, embarrassment, heart rate) and delayed (intrusions) effects. Thus, we urge researchers to carefully select negative films for their studies, as different films seem to evoke distinct emotional responses. In addition, using positive films within the same themes is recommended in order to control for effects of arousal. In general, the specific film material should be considered when comparing effects across studies.

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Using validated stimulus material can expedite the process of comparing results across studies in order to determine the reproducibility of effects, an extremely important task in science (Open Science Collaboration, 2015). While many picture sets exist for use in emotion research (e.g., International Affective Picture System, IAPS; Lang, Bradley, & Cuthbert, 1999; Karolinska Directed Emotional Faces, KDEF; Lundqvist, Flykt, & Öhman, 1998), film sets are scarce (Gross & Levenson, 1995), despite the fact that films are potent, have high ecological validity, capture attention well and are thus well suited for research on affective states (Rottenberg, Ray, & Gross, 2007). In the past decades, aversive films have been frequently used in experimental research on the development of posttraumatic stress disorder (PTSD; American Psychiatric Association, 2013). This experimental setup is usually referred to as the “trauma film paradigm” (Holmes & Bourne, 2008; James et al., 2016). However, different films are used across laboratories and across studies, and it is not yet known whether these different

trauma films have distinct effects. In addition, control groups with neutral and positive matching films are seldom used. Here, we present a comparison of a set of neutral, positive and negative films, which can be used in the trauma film paradigm.

The trauma film paradigm has proven to be a good laboratory analogue for the examination of factors, that might be relevant in the etiology of PTSD, in a prospective and controlled design (Holmes & Bourne, 2008; James et al., 2016). In the trauma film paradigm, films with unpleasant or aversive content are shown to non-clinical participants, resulting in short-lived psychological and physiological stress reactions (Holmes & Bourne, 2008). Despite the fact that emotional responses to seeing a trauma film do not reach the magnitude of emotions after a real trauma and participants' PTSD-like reactions rapidly decline in the following days (Butler, Wells, & Dewick, 2009; James et al., 2015), films match the ethically allowed levels of emotion elicitation (Rottenberg et al., 2007). Importantly, with the trauma film paradigm, it is possible to assess responses to the analogue trauma directly and thus reports of peri- and post-trauma symptoms do not suffer from memory biases as in retrospective studies (Merckelbach, Langeland, de Vries, & Draijer, 2014). Other advantages of this analogue paradigm for studies on PTSD development are that the traumatic situation can be easily

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controlled in a laboratory setting, factors under investigation can be manipulated and thus causal inferences can be made (Holmes & Bourne, 2008; James et al., 2016).

In general, film viewing has been shown to be effective in eliciting various basic discrete emotions (Gross & Levenson, 1995) and mixed emotions (Samson, Kreibig, Soderstrom, Wade, & Gross, 2015). Thus, affective films have been used in research in several psychology domains, such as clinical psychology (James et al., 2016; Kunze, Arntz, & Kindt, 2015), emotion research (Gross & Levenson, 1995), cognitive psychology (Papousek et al., 2014; Richards & Gross, 2000) and neurobiology (Henckens, Hermans, Pu, Joels, & Fernandez, 2009; Streb, Mecklinger, Anderson, Lass-Hennemann, & Michael, 2016). Meta-analyses of mood induction studies have shown that using affective films is one of the best methods for eliciting positive and negative affective states in a laboratory setting (Westermann, Spies, Stahl, & Hesse, 1996). Affective films evoke strong psychophysiological responses, indicated by changes in cortisol levels (Holz, Lass-Hennemann, Streb, Pfaltz, & Michael, 2014; Hubert & de Jong-Meyer, 1991), heart rate and skin conductance (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Schaich, Watkins, & Ehring, 2013). Moreover, an aversive film elicited freezing-like behavior (reduced body sway and fear bradycardia; Hagenaars, Roelofs, & Stins, 2014), which again points to the profound impact of film material on the individual. In addition to immediate responses, trauma films elicit long-term symptoms. For example, Horowitz (1975) first showed that watching a trauma film leads to intrusive memories in the general population and this effect has proven essential for research with the trauma film paradigm (Holmes & Bourne, 2008; James et al., 2016).

Intrusive memories or spontaneously occurring recollections of past events are considered to be the hallmark symptom of PTSD (e.g., Berntsen, 2001; Brewin & Holmes, 2003; Brewin, Dalgleish, & Joseph, 1996; Ehlers, Hackmann, & Michael, 2004; Foa, Steketee, & Rothbaum, 1989; Halligan, Clark, & Ehlers, 2002; Holmes, Brewin, & Hennessy, 2004). In the case of PTSD, intrusions are highly distressing (American Psychiatric Association, 2013) and perceived as involuntary (Holmes, 2003). Intrusive trauma memories in PTSD are also highly persistent, continue to be distressing over the years and are more influential physiologically and emotionally than voluntary recall of trauma or involuntary recollections of non-traumatic events (Berntsen, 2001). Therefore, intrusions are a key outcome measure in trauma film experiments.

Although the trauma film paradigm is widely used and many highly relevant findings have been published, comparisons between all findings are hindered by the fact that various films are included (James et al., 2016). Different films depict distinct trauma types and these may evoke diverse immediate and long-term responses, as shown by one study, which compared different trauma films in a between-subject design (Weidmann, Conradi, Groger, Fehm, & Fydrich, 2009). Further, it is not clear whether these effects are due to the traumatic nature of the film (valence) or to the fact that these are arousing. Control stimuli (neutral and/or pleasant pictures) are usually included in experiments involving affective picture viewing, however, hardly any study using the trauma film paradigm includes comparison films (for exceptions, see Hagenaars, Brewin, van Minnen, Holmes, & Hoogduin, 2010; Hagenaars, Roelofs, et al., 2014).

Therefore, we chose to examine films portraying the characteristics described in the trauma criterion of the Diagnostic and Statistical Manual of Mental Health Disorders – 5th edition (DSM-V; American Psychiatric Association, 2013): “... actual or threatened death, serious injury or sexual violation,” as well as matching positive and neutral films. We specifically selected aversive films that covered common trauma themes and have been previously used in trauma film research (physical assault, sexual assault, traffic

accidents, Table 1). Positive and neutral films addressed the same themes (physical contact, sexual contact, traffic and food ingestion), so that they can serve as control films in experimental designs.

Many traumas are associated with disgust and previous research suggests a link between peri-traumatic disgust and PTSD or intrusion development (Bomyea & Amir, 2012; Engelhard, Olatunji, & de Jong, 2011; Weidmann et al., 2009). Like fear, disgust is an emotion aimed at protecting the body from harmful objects (Angyal, 1941; Miller, 2004) and therefore is associated with vivid imagery (Woody & Teachman, 2006). Dalgleish and Power (2004) propose that events eliciting extreme disgust can lead to psychopathological reactions resembling PTSD symptomatology and many individuals, who have experienced a traumatic event, report high levels of disgust (Fairbrother & Rachman, 2004; Hathaway, Boals, & Banks, 2010; Olatunji, Babson, Smith, Feldner, & Connolly, 2009). A highly disgusting film has so far not been compared to other trauma films, even though such a comparison can elucidate more clearly the role of disgust during trauma. Therefore, in this study, we included a negative film that would elicit high levels of disgust (portraying a person vomiting) and which has been previously used in research on disgust responding (see Table 1).

In the present experiment we seek to 1) create an affective film set with neutral, positive and negative films covering four themes (physical contact, sexual contact, traffic and food) with positive and negative films being matched on arousal and 2) compare negative films on several characteristics in order to examine the distinct and possibly unique value of each of these films. To achieve these aims, participants viewed twelve short films depicting the four themes. We measured participants' immediate subjective (self-report emotion ratings) and physiological (heart rate, HR) responses. We also assessed delayed responding with an intrusion diary during the week after film viewing.

Besides the factors already mentioned, our study also differs from the work of Weidmann et al. (2009) in the use of a within-subject design (Weidmann et al., 2009 used a between-subject design), which allowed us to assess variations in responding within an individual. Also, we showed the films without their soundtracks, so that to exclude the possibility that any differences observed resulted from the diverse auditory information provided by each film. Lastly, we assessed a number of different variables from those recorded by Weidmann and colleagues. Namely, we examined valence and arousal, which are important variables in passive picture viewing studies. Participants also rated their immobility, embarrassment, attention and whether they looked away from the film or have seen it before. These factors are relevant for the use of emotional films as analogue trauma, and provide additional information about possible responses to such films.

In order to have an optimal film set, valence ratings should differ between neutral, positive and negative films and arousal ratings for positive and negative films should be both higher than for neutral films. We further hypothesized that the negative films would also elicit higher negative emotional responses than neutral and positive films. With respect to heart rate, we expected freezing – as indicated by heart rate deceleration (bradycardia) – for negative films depicting serious injury (i.e., physical and traffic negative films) (Hagenaars, Stins, & Roelofs, 2012; Holmes et al., 2004). We expected increased heart rate for the sexual negative film (Weidmann et al., 2009), which depicts a sexual assault. Previous heart rate findings on disgust material are mixed, and therefore, we had no precise hypotheses about heart rate during the disgust film. Lastly, within each theme, we hypothesized more intrusions would be reported for the negative films than for the neutral and positive films.

With respect to the comparison of the negative films, we did not expect differences in terms of valence, arousal, and most emotional

Table 1

Description of the different film clips used and exemplary references to articles which previously used these clips.

Theme	Category	Length	Content	Source	Country, Year	Director	References
Physical	Neutral	1.54	A male basketball game	"Coach Carter"	USA, 2005	T. Carter	Carter, 2005
	Positive	1.17	Three scenes of football teams celebrating scoring a goal in a funny way	Professional football matches			
	Negative	2.30	A man is hit on the face multiple times with a fire extinguisher	"Irreversible"	France, 2002	G. Noe	Noé, 2002; Streb et al., 2016; Verwoerd, Wessel, & de Jong, 2012
Sexual	Neutral	1.18	A couple walks on the beach talking	"Mr. Jones"	USA, 1993	M. Figgis	Figgis, 1993
	Positive	2.00	A young couple makes love on a bed	"Come Early Morning"	Brazil, 2006	J.L. Adams	Adams, 2006
	Negative	2.09	A man threatens a woman with a knife and rapes her in an underway	"Irreversible"	France, 2002	G. Noe	Lass-Hennemann, Peyk, Streb, Holz, & Michael, 2014; Nixon, Cain, Nehmy, & Seymour, 2009; Noé, 2002; Weidmann et al., 2009
Traffic	Neutral	1.07	A woman goes into her car and drives away; finally parks and gets out of the car	"Happy-Go-Lucky"	U.K., 2008	M. Leigh	Leigh, 2008
	Positive	1.27	Two men drive a car fast, eventually flying over a fence	"Taxi 2"	France, 2000	G. Krawczyk	Krawczyk, 2000
	Negative	2.44	Three girls get into a car accident, two of them and others involve die and the driver is saved by paramedics	"Texting while Driving" PSA	U.K., 2009	P. Watkins-Hughes	Strange & Takarangi, 2012; Takarangi, Segovia, Dawson, & Strange, 2014; Takarangi, Strange, & Lindsay, 2014
Food	Neutral	1.15	A middle aged man eats a variety of foods	"Tom Jones"	France, 1963	T. Richardson	Richardson, 1963
	Positive	1.42	A collection of scenes from chocolate, ice-cream and cake commercials	TV advertisements for sweets			
	Negative	1.51	A woman induces vomiting multiple times and then eats parts of her vomit	"Bowl Girl" - internet clip			Borg, Bosman, Engelhard, Olatunji, & de Jong, 2016; de Jong, Peters, & Vanderhallen, 2002

responses, but we did expect disgust to be highest for the negative food film and embarrassment to be highest for the negative sexual film. In terms of heart rate, we hypothesized that more bradycardia would be produced by the clips depicting physical injury (negative physical and traffic films) than sexual assault (negative sexual film) (Weidmann et al., 2009). We had no a-priori hypotheses for the other variables.

1. Methods

1.1. Participants

Participants for this study were undergraduate psychology students in a large public university in the Netherlands, recruited through posters and online advertisements and compensated for participation with university credits. All interested participants were screened over the telephone for the following exclusion criteria: a history of trauma depicted by one of the films in the study (physical assault, sexual assault, road traffic accident), current treatment for anxiety or depression, blood/injection phobia, and substance abuse. Eighty-one participants took part in the experiment and three participants were excluded due to a computer malfunction. The sample size was determined based on previous studies and a-priori power analysis using the G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). Our final sample of 78 participants (5 males¹) had a mean age of 19.62 (95% CI = [18.86, 20.37]).

¹ We analyzed the data also without the male participants and results were similar. Therefore, we retained them in the analyses.

1.2. Material

Mood-stabilizing film. A three-minute neutral film, portraying a family of polar bears moving around in a snow-covered area (*Planet Earth: From Pole to Pole*; Fothergill, 2007), was used for stabilizing participants' mood and heart rate.

Experimental films. Two pilot studies were conducted to select the final films used in this study. Twenty-two films were tested in total (6 in both the traffic and food themes and 5 in both the sexual and physical themes). These included real-life footage and excerpts from fictional films, edited with Adobe Premiere Pro (Adobe Systems, San Jose, CA) software. The clips were matched on complexity, color and number of people present in the scenes. Certain images (e.g., cutaway shots) and all audio tracks were removed from the original sequences in order to achieve higher similarity among the films. Each film started and ended with a one-second fading from/to black.

Criteria for film selection were: high arousal ratings (for positive and negative films), high pleasant or unpleasant (for positive and negative films respectively) and clearly neutral (for neutral films) valence ratings. Following these criteria, four positive, four negative and four neutral films were selected, one in each theme (Table 1). In the pilot studies, positive and negative films differed on valence ratings, but not on arousal, involvement and attention.

1.3. Immediate responses

Mood questionnaire. State mood after the stabilizing film was measured with nine-point Likert scales (1 = "not at all" and 9 = "extremely/totally") assessing anxiety/distress, happiness, horror, helplessness, control, sadness, anger and immobility (an

example item is “How anxious/distressed do you feel at this moment?”).

Subjective responses. Films were rated using the Film Response Questionnaire (FRQ), a nine-point Likert scale (1 = not at all/unpleasant and 9 = very/pleasant) assessing state valence, arousal, immobility (*Indicate to what extent you feel paralyzed or not able to move*), anxiety/distress, disgust, embarrassment, involvement and attention in response to each film. Participants were also asked whether they looked away at any point during each film (yes/no) and if they had seen the film before (yes/no).

Physiological responses. Heart rate (HR) served as an indicator of physiological arousal. It was recorded with a Biopac System Unit MP150 and Acknowledge 3.9.1.4 software (Biopac Systems, Goleta, CA). Three electrodes were attached to the participants: one on each wrist and the third on the back of their neck. HR was measured continuously during the first session and sampled at 500 ms. A high-pass filter was applied to the raw signal. Markers indicated the beginning and end of each film. The mean number of R peaks per film was calculated using MatLab (MathWorks, Natick, MA) and expressed in beats per minute (bpm).

1.4. Delayed responses

Intrusion diary. Each participant recorded intrusive memories of the film during the subsequent week in a diary. Intrusions were defined as any sudden, involuntary memory – image or thought – of any of the films. Intrusions had to “pop up” unexpectedly and spontaneously. Participants had to record whether the intrusion was image-based or thought-based and describe its content. Participants also rated its vividness, spontaneity and how much control they felt over the intrusion, as well as intrusion-related distress. These latter factors were listed in order to confirm that the intrusion was indeed an intrusion (see also Holmes et al., 2004) and were not analyzed further. In addition to the diary, participants indicated the total number of intrusions they experienced in a daily e-mail. We calculated the sum of intrusions from the diaries for each individual film, based on their content.

Diary compliance. Participants also rated their inability to record their intrusions on a scale from 0 (not at all) to 10 (very much) similarly to the way diary compliance was measured by Davies and Clark (1998).

PTSD symptoms. Participants were administered the Impact of Events Scale (IES; M. Horowitz, Wilner, & Alvarez, 1979) with original instructions modified so that they refer to the films rather than to an experienced traumatic event. The scale consists of 15 items regarding intrusive and avoidance symptoms divided into two subscales. The total score of the IES subscales represents the severity of PTSD-like symptoms in each cluster. This scale has been shown to have high split-half reliability ($r = 0.86$), excellent internal consistency for both subscales (Cronbach's alpha for the Intrusion subscale = 0.78; Cronbach's alpha for the Avoidance subscale = 0.82) and validity.

1.5. Baseline and control measures

State and trait anxiety. The State – Trait Anxiety Inventory (STAI; Spielberger, 1983) was used to assess anxiety at both trait and state level. The scale consists of 40 questions divided into two subscales (STAI-T and STAI-S) measuring trait and state anxiety respectively. The STAI has excellent psychometric characteristics (Spielberger, 1983) and excellent convergent validity of both subscales across ethnic groups (Novy, Nelson, Goodwin, & Rowzee, 1993).

Aversive life events. History of traumatic experiences and other aversive life events was evaluated through the Negative Life

Experiences and Trauma Questionnaire (NLETQ; Engelhard, van den Hout, Kindt, Arntz, & Schouten, 2003). This measure consists of 24 items describing various negative life events such as sexual and physical assault, serious accidents or interpersonal conflicts and one open-ended item for other aversive events. Participants provide information about their age at the time the event occurred and the distress it caused (Morgan & Janoff-Bulman, 1994).

Vicarious trauma. Participants reported if someone close to them had ever been physically or sexually abused or in a serious car accident through a yes/no question.

Other questionnaires. The Beck Depression Inventory – II (BDI-II; Beck, Steer, & Brown, 1996), the Disgust Scale – Revised (DS-R; Haidt, McCauley, & Rozin, 1994; modified by Olatunji et al., 2007), the Attentional Control Scale (ACS, Derryberry & Reed, 2002), the Tonic Immobility Questionnaire (TIQ; Abrams, Carleton, Taylor, & Asmundson, 2009), and the Spontaneous Usage of Imagery Scale (SUIS; Reisberg, Pearson, & Kosslyn, 2003) were included for educational purposes only and therefore not analyzed or reported here.

1.6. Procedure

In the first session of this two-part study, participants were seated in front of a computer and signed an informed consent form, after which HR electrodes were attached.

Participants then completed computerized demographic questions (e.g., age and gender), BDI, STAI, TIQ, ACS and SUIS. They watched the three-minute mood-stabilizing film and completed the mood questionnaire. Participants then saw the twelve experimental films in a randomized order while HR was continuously recorded. The FRQ was completed after each clip. After they had seen all 12 films, participants were asked to report vicarious trauma. The electrodes were removed and the experimenter handed out the intrusion diaries and provided instructions about the intrusions' recording procedure.

Participants came back to the laboratory one week later to submit their intrusion diaries. Entries of the diaries were discussed with an experimenter to confirm their intrusive nature. Participants then filled out the diary compliance question and completed IES, NLETQ and DS-R. At the end of this experimental session, participants were given compensation for their participation.

1.7. Data analysis

The comparison of the films within each theme was done using repeated-measures analyses of variance (rmANOVAs) with Film Category (Neutral, Positive, Negative) as a within-subject independent variable and film responses (immediate subjective, immediate physiological and delayed) as dependent measures. For the comparisons of the negative films, we also conducted a rmANOVA with Theme (physical, sexual, traffic and food) as a within-subject independent variable and film responses (immediate subjective, physiological and delayed) as dependent variables. Pairwise comparisons were done in order to examine the exact effects. For clarity reasons, rmANOVA statistics are listed in Table 2, and post-hoc comparisons are described in the main text.

One participant was identified as an outlier with scores higher than three standard deviations above the mean on total intrusion, total negative film and total neutral film intrusion frequencies. These scores were modified into a score one unit larger than the next most extreme value in the distribution (Tabachnick & Fidell, 1996). The distribution of intrusions was skewed, but we used ANOVAs in order to increase comparability with other film paradigm studies, which mostly use similar statistical analyses (e.g., Hagenaars, van Minnen, Holmes, Brewin, & Hoogduin, 2008;

Table 2
Means (*M*), confidence intervals (*CI*s) and main effects rmANOVAs results (*F*) per theme and category for all film clips (unless otherwise indicated).

Theme	Category	Statistic	Valence	Arousal	Immob.	Distress	Disgust	Emb.	Inv.	Att.	Away (<i>n</i>)	Seen (<i>n</i>)	HR	Intrusion	≥1 intr. (<i>n</i>)
Physical	Neu	(<i>M</i>)	5.50	2.65	1.24	1.41	1.14	1.13	2.73	6.10	5	11	78.62	0.04	3
		(<i>CI</i> s)	5.13, 5.87	2.29, 3.02	1.06, 1.43	1.22, 1.60	0.98, 1.30	1.01, 1.25	2.27, 3.19	5.57, 6.63			76.30, 80.94	−0.01, 0.08	
	Pos	(<i>M</i>)	7.59	4.68	1.27	1.26	1.28	1.40	3.96	8.28	3	6	76.18	0.17	7
		(<i>CI</i> s)	7.18, 8.00	4.12, 5.24	1.03, 1.51	1.07, 1.44	1.04, 1.52	1.14, 1.65	3.37, 4.55	7.98, 8.59			73.92, 78.45	0.02, 0.32	
	Neg	(<i>M</i>)	2.04	6.78	3.91	5.03	7.73	3.14	4.17	6.76	35	2	75.83	1.25	27
(<i>CI</i> s)	1.55, 2.52	6.25, 7.32	3.31, 4.51	4.47, 5.58	7.27, 8.19	2.59, 3.69	3.56, 4.78	6.20, 7.32			73.63, 78.03	0.64, 1.85			
rmANOVA	(<i>F</i>)	187.97*	93.41*	71.02*	162.60*	571.49*	43.50*	12.55*	24.87*			18.86 ^a	15.24*		
Sexual	Neu	(<i>M</i>)	5.51	2.42	1.09	1.18	1.09	1.28	2.92	6.09	6	3	77.20	0.04	2
		(<i>CI</i> s)	5.09, 5.94	2.06, 2.79	0.97, 1.21	1.07, 1.29	0.96, 1.22	1.08, 1.49	2.47, 3.38	5.56, 6.62			74.88, 79.52	−0.02, 0.10	
	Pos	(<i>M</i>)	5.73	5.32	1.59	1.83	1.88	2.79	3.59	7.36	6	1	75.08	0.12	5
		(<i>CI</i> s)	5.36, 6.10	4.85, 5.79	1.35, 1.83	1.54, 2.13	1.52, 2.24	2.37, 3.22	3.07, 4.11	6.96, 7.76			72.82, 77.34	0.01, 0.23	
	Neg	(<i>M</i>)	2.36	6.13	3.12	4.42	7.32	3.94	4.90	7.55	7	3	76.60	0.79	25
(<i>CI</i> s)	1.86, 2.85	5.57, 6.68	2.62, 3.61	3.87, 4.98	6.82, 7.82	3.40, 4.48	4.30, 5.50	7.18, 7.92			74.28, 78.91	0.43, 1.16			
rmANOVA	(<i>F</i>)	89.87*	113.85*	49.85*	94.60*	364.26*	44.96*	27.05*	18.26*			6.67 ^a	14.60*		
Traffic	Neu	(<i>M</i>)	4.77	1.68	1.24	1.51	1.13	1.10	2.00	6.24	5	1	78.75	0.03	2
		(<i>CI</i> s)	4.47, 5.06	1.39, 1.97	1.05, 1.44	1.29, 1.73	0.96, 1.29	0.97, 1.23	1.65, 2.35	5.63, 6.86			76.43, 81.06	−0.01, 0.06	
	Pos	(<i>M</i>)	6.08	3.53	1.28	1.73	1.21	1.23	3.05	7.27	6	23	76.76	0	0
		(<i>CI</i> s)	5.71, 6.44	3.08, 3.98	1.13, 1.44	1.50, 1.96	1.04, 1.37	1.04, 1.42	2.56, 3.54	6.80, 7.74			74.55, 78.96		
	Neg	(<i>M</i>)	2.83	6.32	3.22	4.38	3.59	1.76	5.01	7.86	0	7	74.76	0.47	20
(<i>CI</i> s)	2.43, 3.24	5.86, 6.78	2.72, 3.72	3.90, 4.86	3.09, 4.09	1.42, 2.09	4.49, 5.53	7.53, 8.19			72.60, 76.92	0.23, 0.71			
rmANOVA	(<i>F</i>)	107.39*	153.85*	66.81*	110.23*	88.74*	11.39*	61.97*	15.13*			44.93 ^a	14.42*		
Food	Neu	(<i>M</i>)	4.21	2.87	1.49	1.71	4.29	2.27	2.46	6.53	5	0	76.52	0.05	1
		(<i>CI</i> s)	3.84, 4.57	2.48, 3.26	1.24, 1.74	1.44, 1.97	3.77, 4.82	1.85, 2.69	2.00, 2.92	6.00, 7.05			74.11, 78.93	−0.05, 0.16	
	Pos	(<i>M</i>)	7.62	5.62	1.55	1.28	1.26	1.38	4.49	7.88	2	1	76.63	0.14	8
		(<i>CI</i> s)	7.26, 7.98	5.11, 6.12	1.20, 1.90	1.05, 1.51	1.01, 1.50	1.11, 1.66	3.88, 5.10	7.52, 8.24			74.27, 78.99	0.03, 0.25	
	Neg	(<i>M</i>)	2.27	6.45	3.31	4.03	8.51	3.65	2.86	5.94	43	1	76.78	2.13	54
(<i>CI</i> s)	1.68, 2.86	5.83, 7.07	2.74, 3.87	3.50, 4.55	8.24, 8.79	3.08, 4.22	2.33, 3.39	5.33, 6.54			74.39, 79.17	1.28, 2.98			
rmANOVA	(<i>F</i>)	160.09*	74.57*	29.66*	74.68*	394.50*	34.07*	21.02*	19.02*			0.13 ^a	23.68*		

***p* < 0.01 **p* ≤ 0.001.

Note: Pairwise exclusion of missing values was applied for the 95% confidence intervals (*CI*s) and for the mean. *F*-values reflect main effects of the repeated-measures ANOVA within each theme with category as within-subject variable.

Row key: Neu = Neutral, Pos = Positive, Neg = Negative.

Column key: Immob. = Immobility, Emb. = Embarrassment, Inv. = Involvement, Att. = Attention, Away (*n*) = Number of participants who looked away; Seen (*n*) = Number of participants who have seen the clip before; HR = Heart rate (beats per minute), Max intr. = Maximum of intrusions reported to the given film clip by an individual participant, ≥1 intr. (*n*) = Number of participants, reporting at least one intrusion to the given film clip.

^a Missing values present.

Holmes, James, Coope-Bate, & Deeprose, 2009; Holmes et al., 2004; Krans, Näring, & Becker, 2009; Laposa & Alden, 2006). Given the aim of our study, we considered comparability across studies of major importance. Also, ANOVA tests have been shown to be somewhat insensitive to violations of normality (Glass, Peckham, & Sanders, 1972; Harwell, Rubinstein, Hayes, & Olds, 1992; Lix, Keselman, & Keselman, 1996).

For the analysis of HR differences between the negative films across themes, we calculated individual contrast scores by subtracting the mean HR during the negative film from the mean HR during the neutral film in each theme (index 1) and also from the mean HR during the positive film in each theme (index 2). Because higher numbers of these indexes indicate more HR reduction for the negative films relative to neutral and positive films respectively, we refer to these indexes as “bradycardia index”.

For all rmANOVAs, when Mauchly's test for sphericity was significant, a Greenhouse-Geisser correction was used. Bonferroni corrections were applied for post-hoc pairwise comparisons. One participant did not return for the second part of the experiment.

2. Results

2.1. Sample descriptive statistics

At the beginning of the experiment, participants reported low state ($M = 35.62$, 95% $CI = [33.99, 37.25]$) and trait anxiety ($M = 34.19$, 95% $CI = [32.65, 35.73]$).

Thirty-two participants (41%) reported no aversive events in their lifetime, 15 (19.2%) had experienced one aversive event and the rest ($n = 31$, 39.7%) reported two or more aversive events. Twenty-three participants (29.5%) reported having a close person who had been physically/sexually assaulted or in a serious traffic accident.

2.2. Responses after mood-stabilizing film

Participants reported low levels of anxiety ($M = 1.29$, 95% $CI = [1.14, 1.45]$), horror ($M = 1.21$, 95% $CI = [1.06, 1.35]$), helplessness ($M = 1.54$, 95% $CI = [1.28, 1.79]$), sadness ($M = 1.90$, 95% $CI = [1.57, 2.23]$), anger ($M = 1.28$, 95% $CI = [1.09, 1.48]$), and subjective immobility ($M = 1.55$, 95% $CI = [1.27, 1.84]$) after the mood-stabilizing film, as well as high levels of happiness ($M = 5.96$, 95% $CI = [5.62, 6.30]$) and subjective control ($M = 6.06$, 95% $CI = [5.17, 6.56]$). Mean HR during this film was 78.28 (95% $CI = [75.71, 80.85]$). These results suggests that following the baseline film, participants were not experiencing high negative emotions.

2.3. Comparisons of films

2.3.1. Immediate responses per theme

Physical films. The main effect of Film Category was significant for the films in the physical theme (see Table 2 for descriptives and statistics). The three films differed from each other in terms of valence and arousal (all $ps < 0.001$). The negative and positive films differed on immobility, distress, disgust, embarrassment and attention (all $ps < 0.001$), but not on involvement. The negative and neutral films differed on immobility, distress, disgust, embarrassment and involvement (all $ps < 0.001$), but not on attention ($p = 0.21$). Positive and neutral films differed on involvement and attention (both $ps < 0.001$), but not on immobility, distress, disgust and embarrassment (all $ps > 0.07$).

The main effect for HR was significant in the physical theme. HR during the negative film was decreased relative to the neutral film ($p < 0.001$), but not relative to the positive film ($p = 1.00$). HR during the positive film was lower than during the neutral film

($p < 0.001$).

Sexual films. The main effect of Film Category was also significant in the sexual theme. Pairwise comparisons revealed that the three films differed from each other on arousal, immobility, distress, disgust, embarrassment (all $ps < 0.01$) and involvement (all $ps \leq 0.05$). The positive and neutral films did not differ on valence, while the comparisons between the negative and positive and the negative and neutral films on valence were significant (all $ps < 0.001$). Negative and positive films did not differ on attention, while the comparisons between the negative and neutral and the positive and neutral films on attention were significant (all $ps < 0.001$).

We also observed a highly significant main effect of category on HR in this theme. HR during the negative film was higher than that during the positive film ($p = 0.03$), but not different from HR during the neutral film. HR for the positive film was lower than HR for the neutral film ($p = 0.001$).

Traffic films. The main effect of Film Category was significant in the traffic theme. Pairwise comparisons showed that all films differed from each other on valence, arousal and involvement (all $ps \leq 0.001$). The negative and positive films also differed on immobility, distress, disgust, embarrassment and involvement (all $ps < 0.001$), but not on attention ($p = 0.07$). The negative and neutral film differed on all ratings (all $ps \leq 0.001$). Positive and neutral films differed on attention ($p = 0.004$), but not on immobility, distress, disgust and embarrassment.

The main effect of Film Category was highly significant for HR, as well, for this theme. HR during the negative film was lower than HR during the positive and the neutral film ($ps < 0.001$). HR for the positive film was lower than HR for the neutral film ($p < 0.001$).

Food films. Finally, the main effect of Film Category was significant in the food theme. Pairwise comparisons revealed that all films differed from each other on valence, disgust and embarrassment. The negative and positive films also differed on immobility, distress, involvement and attention (all $ps < 0.001$), but not on arousal ($p = 0.06$). The negative and neutral films differed on arousal, immobility and distress (all $ps \leq 0.001$), but not on involvement ($p = 0.55$) and attention ($p = 0.23$). Positive and neutral films differed on arousal, distress, involvement and attention (all $ps \leq 0.05$), but not on immobility.

The main effect of category was not significant for HR in this theme ($p = 0.88$). Thus, no further analyses were performed on this measure.

2.3.2. Delayed responses per theme

Participants reported on average 4.86 intrusions over the week (95% $CI = [3.65, 6.07]$), with a higher number of negative intrusions ($M = 4.39$, 95% $CI = [3.25, 5.53]$) than positive intrusions ($M = 0.43$, 95% $CI = [0.19, 0.67]$), $F(1, 76) = 50.82$, $p < 0.001$, $\eta_p^2 = 0.40$, and neutral intrusions ($M = 0.12$, 95% $CI = [0.01, 0.22]$), $F(1, 76) = 61.00$, $p < 0.001$, $\eta_p^2 = 0.45$. The total number of intrusions was highly correlated with the IES Intrusion scale, Spearman's $\rho = 0.82$, $p < 0.001$, validating the diary method of recording intrusions in this study. Participants also indicated to have been able to complete the diary ($M = 2.34$, 95% $CI = [1.73, 2.94]$), which is similar to diary completion in other studies (e.g., Hagenaars et al., 2008; Krans et al., 2009).

The number of intrusions for each film, as well as the number of people, who reported at least one intrusion for that film, can be found in Table 2. The main effect of Film Category was highly significant; pairwise comparisons revealed that in all themes, the negative films resulted in the most intrusions (all $ps \leq 0.001$). No difference was observed in the number of intrusions reported for neutral and positive films in any theme.

2.3.3. Immediate responses to negative films

Most importantly, the main effect of theme for the negative films did not reach significance for valence and arousal, indicating that all negative films were similarly unpleasant, $F(3,231) = 2.11$, $p = 0.10$, $\eta_p^2 = 0.03$, and arousing, $F(2.73, 210.52) = 1.91$, $p = 0.13$, $\eta_p^2 = 0.02$. There was a significant main effect (all $ps \leq 0.02$) for all other measures, though, suggesting that the different films evoked distinct emotional responses. The negative food film produced the highest levels of disgust (all pairwise comparisons, $p < 0.01$). The physical and sexual films did not differ on disgust, but both elicited more disgust than the traffic film (both $ps < 0.001$). Least embarrassment was reported for the traffic film (all pairwise comparisons, $p < 0.001$). The sexual film produced more embarrassment than the physical film ($p = 0.03$). Other pairwise comparisons on embarrassment were not significant.

The films differed in the extent to which they elicited subjective immobility, although the direction of the effect was not clear (all post-hoc analyses were non-significant, $ps \geq 0.06$). Participants reported more distress after the physical film than the traffic ($p = 0.04$) or food ($p = 0.004$), while the other films did not differ on distress. The lowest level of involvement and attention was reported for the negative food film (all pairwise comparisons, $p < 0.001$). Involvement was also lower for the physical than for the traffic film ($p = 0.04$). None of the other comparisons were significant (all $ps > 0.10$). Significant differences in reported attention were revealed in the pairwise comparison between the physical and traffic films ($p = 0.001$), while other comparisons were not significant.

The main effect of theme was highly significant for the bradycardia index 1, $F(3, 222) = 16.92$, $p < 0.001$, $\eta_p^2 = 0.19$. HR reductions during the negative film relative to the neutral film were larger in the physical and traffic themes than that in the sexual and food themes (all $ps \leq 0.03$). Physical and traffic films did not differ on bradycardia index 1 ($p = 0.21$). No difference was observed on bradycardia index 1 between the sexual and food themes ($p = 1.00$).

The main effect of theme was also highly significant for the bradycardia index 2, $F(3, 222) = 9.65$, $p < 0.001$, $\eta_p^2 = 0.12$. The HR reduction during the negative film relative to the positive film in the physical theme was larger than that in the sexual theme (all $ps = 0.03$), but did not differ from that in the traffic or food themes (all $ps \geq 0.06$). No difference was observed on bradycardia index 2 between the sexual and food themes ($p = 0.30$). This bradycardia index 2 was also higher in the traffic theme than in than in the sexual and food themes (all $ps \leq 0.01$).

2.3.4. Delayed responses to negative films

A main effect of film theme was found for the number of intrusions, $F(2.04, 155.07) = 7.84$, $p = 0.001$, $\eta_p^2 = 0.09$. The negative food film produced more intrusions than the negative sexual ($p = 0.03$) and traffic ($p = 0.001$) films, but not more than the physical film ($p = 0.25$). In addition, the physical negative film did not produce a different number of intrusions from both the traffic and sexual negative films (all $ps \geq 0.09$). The negative sexual and traffic films also did not differ in terms of intrusions ($p = 0.40$).

3. Discussion

In the present experiment, we examined positive, negative and neutral films within four themes (physical contact, sexual contact, traffic and food), which can be used in the trauma film paradigm. We compared the films within each theme, as well as the negative films across themes on immediate subjective and physiological responses and delayed responses.

3.1. Comparison of neutral, positive and negative films

In general, we have succeeded in creating a set of films within four themes with distinct valence levels. More specifically, in all four themes negative films were rated as more unpleasant and elicited more negative emotions than their positive and neutral counterparts. All negative films were more arousing than their neutral counterparts. Notably however, except for the food theme, arousal was higher for the negative than for the positive films. Positive films were rated as more arousing than the neutral films in all themes.

Preferably, arousal levels would have been similar for positive and negative films within each theme, so that the positive films can serve as control stimuli in the trauma film paradigm. Such similarity, however, is difficult to achieve, because our negative films were extremely negative, and finding similar extremely arousing positive films of the same theme is complicated. It has been shown that, even though negative affective states are typically associated with heightened arousal, this is not always the case with positive affective states (Ashby, Valentin, & Turken, 2002). In a frequently used validated picture set, the IAPS, for example, there is only one category of positive pictures with consistently high arousal levels matching those of the extremely negative pictures (mutilation), i.e., erotic pictures (Lang et al., 1999). Erotic stimuli have some limits, though. First, they can elicit mixed emotions, which was confirmed by our findings (e.g., higher levels of embarrassment for the positive sexual than the neutral sexual films). Second, there are gender differences in processing and responding to these pictures (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Wrase et al., 2003), which might make them unsuitable for research with heterogeneous samples. Lastly, there is a high prevalence of sexual trauma in student populations, which might make this type of content not the most adequate stimulus in experiments with healthy student participants. We specifically wanted positive films depicting the same topic as the negative films used in the trauma film paradigm. Importantly, the positive films in the presented set were clearly more arousing than their neutral counterparts, allowing for control of arousal effects to some extent.

The negative films within each theme were also rated higher than the positive and neutral films on all negative emotions assessed in this experiment (distress, disgust and embarrassment), as predicted. Participants also reported higher levels of subjective immobility to the negative films than to the positive and neutral films in all four themes. All negative films used here would be thus adequate to serve as analogue trauma, because they produce strong negative reactions.

Participants reported also strong involvement during the negative films in all themes. For the sexual and traffic themes, involvement was higher for the negative film than for the other films. The positive film in the physical theme matched the involvement level of the negative film in that theme, whereas higher involvement was reported for the positive than for the negative food film. High involvement is an important factor for affective research and in the trauma film paradigm, where participants are often encouraged to imagine themselves being in the situation they are observing. Interestingly, a different pattern to involvement was observed for attention in all themes. These results may show that involvement and attention are two distinct categories that might be affected by different characteristics of the films used, e.g., self-relevance evoking involvement (Brewin & Burgess, 2014; Holland & Kensinger, 2010) and motivational intensity capturing attention (Gable & Harmon-Jones, 2010; Harmon-Jones & Gable, 2009).

Physiological and delayed responses also differed among the films in each theme. Our hypotheses regarding heart rate were

confirmed by finding bradycardia for the negative physical film (compared to the neutral film in that theme) and the negative traffic film (compared to the neutral and positive films in that theme), as well as increased HR during the negative sexual film (compared to the positive film in that theme). No differences were observed for the films in the food theme. Relative heart rate decreases have been suggested to be indicative for freezing (Hagenaars, Oitzl, & Roelofs, 2014; Holmes et al., 2004), which would mean that the negative physical and traffic films elicit freezing-like behavior, whereas the negative sexual and food films do not. Note that the negative films did not differ in terms of valence and arousal, which might indicate that physiology responds to factors above and beyond valence and arousal, such as the topic (i.e., physical assault), for example. It was indeed found previously that some threatening situations evoke immobility more than others (Hagenaars, 2016; Kalaf et al., 2015). Although immobility is frequently reported after sexual trauma (Hagenaars, 2016; Kalaf et al., 2015; Marx, Forsyth, Gallup, Fusé, & Lexington, 2008), a sexual film in the laboratory may actually be arousing and enhance attentive processing. Indeed, affiliative pictures elicited an “immobility-without-fear” response in a previous study (Facchinetti, Imbiriba, Azevedo, Vargas, & Volchan, 2006).

Lastly, as expected, negative films resulted in more intrusive memories than positive and neutral films. Some participants did have intrusive memories of the positive and neutral films, though. To our knowledge, positive films have not been used in research on intrusion development, however, positive intrusions may help to understand factors that are relevant in intrusion development in general and are also important to examine (Edwards & Dickerson, 1987).

3.2. Comparison of negative films

The second aim of our experiment was to examine the unique response patterns to different negative films. All negative films elicited similar valence and arousal levels. This would suggest that it does not make a difference which negative film is selected for research in the trauma film paradigm. However, the elicited emotional response did differ between films. For example, levels of immobility, distress, disgust, and embarrassment were distinct across the negative films, and so were involvement and attention.

A recent meta-analysis showed that various discrete emotions might have a different effect on cognitive, physiological and behavioral responses (Lench, Flores, & Bench, 2011). Further, some emotional responses might have a specific contribution to the development of longer lasting post-traumatic responses (disgust, Bomyea & Amir, 2012; guilt, Bovin et al., 2014; immobility, Heidt, Marx, & Forsyth, 2005). Therefore, we urge researchers to carefully select the film stimuli in their experiments based on their research aims. For example, films depicting sexual violence elicit higher levels of embarrassment than films with other contents, which may interfere with specific research questions and measurement methods (e.g., self-report). Similarly, highly disgusting films may result in participants diverting their attention away from the film in order to regulate distress. This might interfere with research questions that merit sufficient attention to the film (e.g., recall). Also, heart rate changes should be addressed with care. Our data might indicate that distress can be associated with freezing-like responses for some negative content (e.g., physical harm), but not for others (e.g., sexual violence). Thus, heart rate increases or decreases as a simple indicator of distress may depend on the trauma type depicted in the film. We also recommend that researchers consider using control stimuli, which can control for effects of arousal, along with their traumatic films, as has been done in previous published research on trauma processing (e.g.,

Hagenaars et al., 2010) and as it is the standard for research with valenced picture material.

As noted earlier, the physical and traffic negative films elicited bradycardia, whereas the food and sexual films did not. Note that these heart rate findings do not match with subjective immobility reports, which were high for all negative films. One explanation could be that people are not good at estimating immobility. Alternatively, the subjective experience of immobility may be highly relevant and at the same time different from the physiological response.

The negative films also had distinct delayed effects, i.e., different intrusive memory frequencies. The negative food clip resulted in the more intrusions than the negative sexual and traffic films. This might point towards the importance of disgust in the development of post-traumatic responses, which has been previously suggested (Bomyea & Amir, 2012). Alternatively, participants were confronted with reminders to this film more frequently, i.e., every time they ate, and food cues are abundant in today's society (Watson, Wiers, Hommel, Ridderinkhof, & de Wit, 2015), so it may be the case that intrusion triggers were more present for this film than for the other negative films. Furthermore, although the negative food film was not rated as more arousing than the other negative films, more than half of the sample looked away during this film (see Table 2) and involvement and attention ratings were lower than for the other negative films. This might indicate an effective arousal-reducing strategy, thereby obscuring differences on arousal between the clips. The number of intrusions did not differ among the other three negative films (physical, sexual and traffic). In conclusion, considering these emotional and physiological differences among trauma films, the thematic content of the material should be considered as an important factor, when different results are compared across studies.

Note that the number of intrusions for the individual films in this experiment may seem quite low (see for example, Hagenaars et al., 2010; Holmes et al., 2009, 2004; Krans, Näring, Holmes, & Becker, 2010). However, traditionally trauma film experiments use one film with a longer duration, or use a compilation of different clips that are presented as one film (e.g., Holmes et al., 2009). In the latter design, intrusive memories for all clips are usually added up. If we consider the twelve film fragments in this experiment as one film and add reported intrusions, as commonly done in trauma film paradigm studies, the mean number of all intrusions (4.86) reported in this experiment is comparable to those of other studies (e.g., Bomyea & Amir, 2012; James et al., 2015). One might expect that longer films would elicit higher levels of involvement, possibly necessary for analogue trauma research. However, our data do not confirm this assumption: negative mood levels elicited by our brief film clips are comparable or even higher to those reported for longer films (e.g., Krans et al., 2010; Weidmann et al., 2009), and participants rate the film clips as quite arousing, suggesting that even these short clips succeed in getting the participants involved. Self-reported involvement is also comparable to that reported for longer films (Weidmann et al., 2009). Altogether, this would suggest the brief film clips in our study would elicit similar responses as the longer versions, and findings can be transferred to the latter. Furthermore, for each of the negative films, we selected the culmination of the scene, which was the most aversive. These aversive films might be used in research paradigms, where shorter stimuli are needed (e.g., fear conditioning; Kunze et al., 2015). Experimenters, who wish to use a traumatic film with a longer duration, can easily extend the clips used in this study. Providing more context for the scene might make it even stronger in terms of valence, memory effects and involvement as previously shown (Kunze et al., 2015; Pearson, Ross, & Webster, 2012). We removed the soundtracks in our study, but

the films can easily be used with the soundtracks included. This would most likely also increase the contextual information of the clips, and increase their impact. Both previous (Lazarus & Alfert, 1964) and the current findings show that silent image sequences can also have profound effects on emotional and psychophysiological responding, though.

It is important to note that this experiment has several limitations. For example, we used distress as a general indicator of distress emotions such as fear, sadness and anger. We chose to focus on factors that may impede the use of a particular film as material in the trauma film paradigm, such as embarrassment and involvement, as well as “new” but relevant trauma responses (i.e., immobility and disgust). Also, our sample was quite homogeneous, consisting of primarily female college students, which might reduce the generalizability of the results. Future research should attempt at using larger, more heterogeneous samples. Such research might provide particularly important insights into gender differences in emotional processing and responding (e.g., Maffei, Vencato, & Angrilli, 2015) and might also offer explanations of why females are more susceptible for PTSD development (Kessler, 1995).

In conclusion, we compared neutral, positive and negative films covering four themes (physical, sexual, traffic and food) for use in the trauma film paradigm by measuring the immediate and delayed impact of the films. We included neutral and positive films within the same themes, because many designs would improve from including control film stimuli, and some paradigms even cannot miss out on these counterparts (see for example, Hagedaars, Roelofs, et al., 2014). We additionally compared the negative films among one another. We found that all four negative films could be effective research material. Moreover, different negative films result in distinct emotional and physiological responses as well as different intrusion frequencies, which suggests that the content of the stimulus used in the trauma film paradigm might have a pronounced influence on the results, that should not be ignored. Thus, future research should include carefully selected material and the content of the film stimuli should be considered when comparing experimental results and deciding whether a specific effect is robust.

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