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The effects of state anxiety on analogue peritraumatic encoding and event memory: introducing the stressful event segmentation paradigm

Andrew M. Sherrill[a], Christopher A. Kurby[b], Michelle M. Lilly[c] and Joseph P. Magliano[c*]

[a]Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine, Atlanta, GA, USA; [b]Department of Psychology, Grand Valley State University, Allendale, MI, USA; [c]Department of Psychology, Northern Illinois University, DeKalb, IL, USA

ABSTRACT
Cognitive theories of PTSD argue that poor recall of trauma memories results from a stress-induced shift toward perceptual processing during encoding. The present study assessed the extent to which self-reported state anxiety affects event segmentation and its subsequent impact on memory performance (recall and recognition). Event segmentation is the cognitive process of condensing continuous streams of spatiotemporal information into discrete elements. In this study, undergraduates without PTSD used a computer programme to segment a stressful film and a non-stressful film and then they completed memory tasks for each film. For the stressful film, low memory performance was associated with high segmentation performance. A meditational analysis revealed high segmentation performance mediated a negative relationship between state anxiety and memory performance. Additionally, ad-hoc analyses suggest perceptual processing primarily drives segmentation of the stressful film and conceptual processing primarily drives segmentation of the non-stressful film.

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Posttraumatic stress disorder (PTSD) is often viewed as a disorder of trauma memory disturbance, which is characterised by two coupled problems (Brewin, 2011, 2014). First, conceptual components of the trauma memory are often disorganised and difficult to retrieve voluntarily. Second, the perceptual components of the trauma memory are often vivid and retrieved involuntarily. Cognitive theories of PTSD suggest pathology begins when affect disrupts the initial encoding of the traumatic experience (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000). These theories argue that the usual balance between perceptual processing and conceptual processing is biased toward perceptual processing, resulting in encoded perceptual information that is not adequately elaborated or contextualised within one's autobiographical memory. However, this assumption has received mixed empirical support. Given that most psychotherapies for PTSD help patients make adaptive changes to how they understand the traumatic event (Cusack et al., 2016), clinical theories of PTSD may benefit from a greater understanding of the role of stress during the initial formation of these memories. The current study used a paradigm novel to PTSD research to investigate the effect of state anxiety on the initial processing of a stressful experience. Most notably, the paradigm uses a moment-to-moment assessment of an encoding system called event segmentation.

This study specifically investigated trauma memory fragmentation, defined as a general lack of narrative coherence characterised by an absence of important details such as victim and perpetrator actions and narrative sequence (Foa, Molnar, & Cashman, 1995; Huntjens, Wessel, Postma, van Wees-Cieraad, & de Jong, 2015; van der Kolk & Fisler, 1995). While memory fragmentation is documented as characteristic of PTSD (e.g., Jelinek, Randjbar, Seifert, Kellner, & Moritz, 2009), the empirical findings are mixed (O'Kearney & Perrott, 2006; Segovia, Strange, & Takarangi, 2016). Most research examining the aetiology of memory fragmentation has investigated the role of retrospective, self-reported information processing (e.g., peritraumatic dissociation; Buck, Kindt, & van den Hout, 2006; Kindt & van den Hout, 2003; Kindt, van den Hout, & Buck, 2005). However, this literature has failed to demonstrate a causal link between self-reported peritraumatic encoding and objectively measured memory fragmentation (Bedard-Gilligan & Zoellner, 2012; Moulds & Bryant, 2005; Murray, Ehlers, & Mayou, 2002). One possibility is the impact of stress on encoding may not be available to conscious awareness, thus limiting the accuracy of self-report.

Researchers have attempted to disrupt encoding by simultaneously exposing a participant to a stressful film and a concurrent cognitive load task that consumes working memory resources, followed by a test of event

CONTACT Andrew M. Sherrill andrew.m.sherrill@emory.edu Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine, 12 Executive Park Drive, Suite 300, Atlanta, GA 30329, USA
*Present address — Department of Learning Sciences, Georgia State University, Atlanta, GA, USA.

memory. However, these laboratory-induced encoding disruption studies have found mixed results as well (Brewin, 2014). Several studies found significant decreases in voluntary recall and recognition of stressful films if the participants counted backwards or engaged in a spatial tapping task (e.g., Bourne, Frasquilho, Roth, & Holmes, 2010; Krans, Langner, Reinecke, & Pearson, 2013; Nixon, Nehmy, & Seymour, 2007). However, studies have failed to replicate these demonstrations of encoding disruption (e.g., Deeprose, Zhang, DeJong, Dalgleish, & Holmes, 2012; Holmes, Brewin, & Hennessy, 2004). These concurrent cognitive load tasks have limited ecological validity and provide no insights to understanding how encoding disruption may emerge from stress.

Rather than using a proxy of encoding disruption (e.g., self-reported peritraumatic dissociation) or inducing encoding disruption (e.g., counting backwards), researchers can use moment-to-moment assessments of cognitive functioning to detect changes in encoding processes that might occur organically in response to stress. To identify a change in an encoding process, the researcher can assess a cognitive function at baseline (e.g., during a non-stressful stimulus) and then under stress (e.g., during a stressful stimulus). One promising methodology for this strategy comes from an area of increasing interest in applied cognitive science called *event segmentation* (Richmond, Gold, & Zacks, 2017; Sherrill & Magliano, 2017).

Event segmentation

Humans perceive and remember the world not as a continuous stream of information but rather a contiguous series of discrete events (e.g., put on clothes, eat breakfast, brush teeth, leave home; Kurby & Zacks, 2008; Newtson, 1973; Zacks & Tversky, 2001). Events can be characterised as sequences that have a beginning and an ending and are situated in time and space (Radvansky & Zacks, 2011). Event segmentation is the process by which a person is able to identify the boundaries between smaller events that make up a larger event (Zacks, Speer, Swallow, Braver, & Reynolds, 2007).

What is the function of event segmentation? The moment-to-moment perception of extended lengths of activity into condensed elements simplifies and streamlines our understanding of our complex world as we move through it (Newtson, 1973; Zacks & Tversky, 2001). Our experiences are understood in the context of event models, defined as multimodal representations (e.g., visual, auditory, tactile) maintained by working memory of what is happening in the moment (Zacks et al., 2007). The event model guides the perception of incoming information by offering predictions for what might happen in the immediate future (e.g., if a train is moving forward, it will continue to move forward). When the content of an event model does not match the perceptual features of incoming stimuli (e.g., the train stops), an event boundary is perceived and the event model is updated by new sensory and perceptual input (e.g., physical changes in the environment; Kurby & Zacks, 2008). Event models also receive input from event knowledge, defined as semantic memory representations of previously learned features of specific domains and generalised domains. The status of an event model alternates between periods of stability and change that are perceived as events and boundaries, respectively.

In addition to helping us understand unfolding experience, event segmentation affects what information is encoded into long-term memory (Bailey et al., 2013; Ezzyat & Davachi, 2011; Kurby & Zacks, 2011; Sargent et al., 2013). When an event model is updated, the previous event model is replaced by the new event model in working memory and subsequently encoded into long-term memory (Radvansky & Zacks, 2011; Zacks et al., 2007). Therefore, the content of event memory is partially dependent on when and how frequently event models are updated. Event memory is expected to be more complete and accurate if event models are updated when the previous event model no longer facilitates the accurate anticipation of important incoming information.

The primary method to assess event segmentation is the event segmentation task (Newtson, 1973), which requires participants to watch a film and press a button each time they consciously perceive a boundary between meaningful events. Although event segmentation is a subjective process, there is a high degree of inter-individual and intra-individual agreement on the placement of event boundaries (Speer, Swallow, & Zacks, 2003). The level of agreement with group norms has been leveraged as a measure of event segmentation ability or quality (e.g., Zacks, Speer, Vettel, & Jacoby, 2006). To compute agreement, an individual's segmentation pattern is compared to a normative segmentation pattern based on the entire sample, using correlation. A high agreement score between the individual's pattern and the normative pattern indicates high similarity. Previous research has shown that segmentation behaviour, measured this way, is sensitive to individual differences in cognitive ability and is uniquely related to event memory (Bailey et al., 2013; Kurby & Zacks, 2011; Sargent et al., 2013; Zacks et al., 2006; Zacks, Kurby, Landazabal, Krueger, & Grafman, 2016).

Relevant to the processing of traumatic events and subsequent memory impairment, some have asked whether anxiety affects segmentation performance. Though research in this domain is limited, Eisenberg, Zacks, and Sargent (2016) investigated the relation between PTSD symptomatology and event segmentation performance for everyday activity. In their experiment, participants sampled from a general patient registry completed a self-report PTSD scale after they engaged in the event segmentation task using films of people performing mundane, everyday activities (e.g., gardening). Findings indicated fear- and arousal-based PTSD symptoms were negatively correlated with segmentation agreement. Importantly, this study used mundane stimuli that may have not activated a state of negative affect, so the relation between state anxiety and segmentation is unknown. Further, the use of self-report PTSD symptoms in a sample of participants not otherwise suspected of having PTSD obscures the presence of negative affect during experimentation. A next step in investigating the impact of stress on segmentation and event memory is to use stimuli that activate negative affect in a healthy population.

Current study and hypotheses

Given that people encode ongoing experience, in part, by segmenting it into separate events, we propose the event segmentation task can be used to understand and measure peritraumatic encoding. Specifically, we wanted to explore the level of agreement in event segmentation for traumatic events and its relationship with memory performance. This strategy allows for the study of dynamic traumatic experiences, not static images or word lists that are often used in encoding studies.

Why would stress-induced changes in encoding be observable in the context of the event segmentation task? We propose that segmentation behaviour during a stressful experience may be affected by a bias toward processing perceptual information in a bottom-up fashion due to high negative affect (e.g., state anxiety). High negative affect in several other research paradigms has been shown to bias attention toward perceptual information, perhaps as an unconscious strategy to detect threats and safety (e.g., Brewin & Mersaditabari, 2013; Brewin, Ma, & Colson, 2013; Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010). At the onset of this study, we were unclear whether or not this bias would increase or decrease segmentation agreement. No prior research provided an empirical precedent. We assumed that enhanced bottom-up processing would restrict top-down attentional processes and use of event knowledge, which would interfere with effective comprehension and storage of memory. That is, under stress, endogenous forces that guide attention (i.e., goals and mental representations; Henderson & Hollingworth, 1999) may have less of an effect on how attention is allocated, which would in turn affect segmentation. This assumption is consistent with preliminary evidence that suggests fear- and arousal-based clinical symptoms are associated with low segmentation agreement (Eisenberg et al., 2016).

In this study, we present the Stressful Event Segmentation Paradigm (SESP), which embeds the event segmentation task within a trauma analogue paradigm to provide a moment-to-moment marker of analogue peritraumatic encoding. An overview of the SESP is as follows: assessment of event knowledge using a script task, orientation to the segmentation task using a neutral film, segmentation of a non-stressful film and a stressful film, self-report post-film state anxiety, and then assessment of event memory (recall and recognition).

Three sequenced hypotheses were proposed based on cognitive theories of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000). First, it was hypothesised that stress responses directly impact encoding; therefore, post-film state anxiety should be significantly related to segmentation scores for the stressful film. Assuming stress will decrease segmentation agreement, the relationship between anxiety ratings and segmentation scores was predicted to be negative. Second, it was hypothesised that encoding disruption results in memory disturbance; therefore, segmentation scores for the stressful film should be significantly related to voluntary event memory. Assuming that normative segmentation is important for memory formation (Sargent et al., 2013), it was predicted that there would be a positive correlation between segmentation scores and memory performance (recall and recognition). Third, it was hypothesised that encoding disruption is a mediating mechanism by which stress responses cause memory disturbance; therefore, segmentation scores during the stressful film should mediate the negative relationship between post-film state anxiety and voluntary event memory (recall and recognition). Assuming normative segmentation and event memory have a positive relationship, it was predicted that low segmentation scores would mediate low memory performance.

Method

Participants

Participants were recruited from a large Midwestern university and compensated with course credit. Exclusionary criteria included younger than 18 years of age, personal history of sexual assault victimisation (any age), probable PTSD, and prior exposure to the films used in the study. At least 71 participants were required to achieve adequate power to detect moderate effect sizes in the planned mediation analyses (Fritz & MacKinnon, 2007). In total, 177 participants were recruited. The final sample included 73 participants. Excluded from analyses were 62 participants who failed to meet inclusion criteria, 28 participants who voluntarily stopped the stressful film, eight participants who did not follow segmentation task directions, and six participants who chose to discontinue voluntarily.

The final sample of 73 participants averaged 19.44 years of age ($SD = 1.82$) and was predominantly freshman (75.3%). Slightly over half the participants identified as men (54.8%) with the remainder identifying as women. The entire sample was fluent in English and 21.9% were multilingual. While the sample was racially diverse, the majority identified as either of European descent (49.3%) or African descent (30.1%).

Materials

Self-report measures

Participants first completed a survey packet that included several self-report measures. Later in the study, participants completed pre- and post-film self-report measures.

Life events checklist for DSM-5 (LEC-5). The LEC-5 (Weathers, Blake, et al., 2013) is a 17-item screener for potentially traumatic events that participants may have experienced in their lifetime. Participants were screened-out of the current study using two items on the LEC-5 that assess lifetime history of sexual assault victimisation or other unwanted sexual contact. Forty-one participants were excluded (23.2%).

PTSD checklist for DSM-5 (PCL-5). The PCL-5 (Weathers, Litz, et al., 2013) is a 20-item survey that assesses all representative PTSD symptoms included within *DSM-5* diagnostic criteria. When completing the PCL-5, participants are instructed to respond to each item while keeping in mind the "worst event" specified on the LEC-5. Preliminary validation research suggests a cut-point of 33 (Wortmann et al., 2016) to indicate probable PTSD, though the current study used a conservative cut-point of 30. Thirty-seven participants were excluded (20.9%). The average score was 9.37 ($SD = 7.91$). Internal consistency was good ($\alpha = .84$).

Demographic questionnaire (DQ). Demographic information was assessed using the DQ, which contained items assessing age, gender, race, credit hours, and languages spoken.

State trait anxiety index – state, 6-item version (STAI-S6). Immediately before and after the stressful film, state anxiety was measured with the STAI-S6 (Marteau & Bekker, 1992), an abbreviated version of the original scale (Spielberger et al., 1970). The STAI-S6 has good internal reliability and construct validity (Marteau & Bekker, 1992; Tluczek, Henriques, & Brown, 2009). Pre-film STAI-S6 scores averaged 8.52 ($SD = 2.30$). Internal consistency was acceptable ($\alpha = .67$). Post-film STAI-S6 averaged 16.16 ($SD = 4.76$). Internal consistency was good ($\alpha = .90$).

Level of attentiveness. After viewing each film, participants were asked to rate the percentage of time he or she directly looked at the film, providing an index of "level of attentiveness." In *Irréversible*, participants reported looking at the screen for a mean percentage of 94.16% of the film's duration ($SD = 9.04\%$).

Scripts assessments

A script writing procedure was used to assess domain-specific event knowledge for the stressful experience (i.e., sexual assault), which was used a control variable for analyses predicting memory outcomes. This was done to partition variance in segmentation and memory performance that could be based on background knowledge associated with sexual assaults. Participants were asked to produce one script for a sexual assault within three minutes. Following previous research (e.g., Davies, Walker, Archer, & Pollard, 2013; Littleton & Axsom, 2003; Ryan, 2011), participants were asked to describe a specific but hypothetical rape of a female victim by a male perpetrator. Each participant's rape script was scored for the degree to which it resembled a "stereotypical rape" script, defined as a domain-specific knowledge structure that includes the following general narrative: a single male perpetrator derives sexual pleasure from unprotected penile penetration of an unknown, resisting, solitary, female victim within a public place and with an extensive amount of violence, often using a weapon (Ryan, 2011). Coding and scoring is described below.

Stimuli

Recent reviews support the validity and utility of exposing nonclinical samples to film clips with highly aversive content and then measuring participant reactions both during exposure and prospectively (Holmes & Bourne, 2008; Weidmann, Conradi, Gröger, Fehm, & Fydrich, 2009). Two 322-second films were used: a non-stressful film (breakfast scene in *Big Night*; Kirkpatrick, Filley, Scott, & Tucci, 1996) and a stressful film (male-to-female rape scene in *Irréversible*; Chioua, Cassel, & Noé, 2002). Both films were commercially produced and include one continuous shot with minimal zooming and panning. The order of presentation for the stressful film and non-stressful film was counterbalanced to rule-out practice effects of the segmentation task. Trauma analogue studies have demonstrated the effectiveness of the *Irréversible* rape scene to induce acute stress reactions (e.g., Weidmann et al., 2009). Additionally, the *Irréversible* rape scene was selected for experimental control (e.g., linear narrative and minimal dialog) and ecological validity (e.g., realistic and plausible depiction and minimal use of image and sound editing or other cinematic devices that influence segmentation; Cutting, Brunick, & Candan, 2012). The *Irréversible* rape scene has the following simple narrative structure: a woman walks into a dark tunnel, a male stranger physically intercepts the woman and threatens her with a knife, the man brutally assaults the woman (sexually and physically) while she attempts to escape without success. To mitigate risk, participants were informed that they could choose to stop the film at any time by pressing the ESC key. Twenty-eight of the 101 participants who started viewing the film chose to discontinue (27.72%) and were therefore were not included in the final sample.[1]

Laboratory tasks

Stressful event segmentation paradigm

Participants were introduced to the event segmentation task (Newtson, 1973) by completing a practice trial using a 155-second film of an actor building a toy boat using Legos (Sargent et al., 2013). Participants were asked to segment the film by pressing a spacebar to indicate each boundary between "meaningful units of activity." Specifically, participants were told to indicate the smallest units they found meaningful. If a given participant indicated fewer than six event boundaries, the experimenter repeated the film and asked the participant to indicate "a few more" (Sargent et al., 2013). Next, participants segmented a non-stressful film and a stressful film. Coding and scoring the segmentation task is described below.

Memory assessments

Event memory for each film was assessed using a free recall task. Participants were asked to handwrite for seven minutes everything that happened during each film in as much detail as possible and using the same sequential order of actions (Sargent et al., 2013). Coding and scoring the recall task is described below. In addition, event memory for the stressful film was assessed using a recognition task that included 20 trials in which the participant was asked to select one of two images that were taken from the film (Sargent et al., 2013). Target images were screenshots from the *Irréversible* clip and lure images were screenshots from other parts of *Irréversible* using the same actors but not included within the clip viewed by participants. Performance on this task was scored through totalling the number of correctly recognised images. The mean recognition score was 16.79 ($SD = 1.28$).

Procedures

First, participants completed self-report questionnaires (LEC-5, PCL-5, and DQ) and the script assessment. Second, participants were oriented to the event segmentation task on a desktop computer using the practice film. Third, participants viewed and segmented the film stimuli. Fourth, before and after the stressful film, participants completed the STAI-S6. Additionally, participants rated their level of attentiveness after each film. Fifth, participants completed memory assessments for each film in the same order as viewed.

Qualitative data coding

Rape script assessment

Rape scripts were coded for resemblance to a stereotypical rape script using a scoring key constructed for the purposes of this study based on a review of quantitative and qualitative findings on rape scripts (e.g., Davies et al., 2013; Littleton & Axsom, 2003; Ryan, 2011). The scoring key included 17 themes covering characteristics of the setting, perpetrator, and victim. Each theme was coded for stereotypical rape (score: +1), atypical rape (score: −1), and not applicable or not included (score: 0). All 17 stereotypical rape themes were consistent with content of the stressful film. Higher total scores reflected event knowledge that closely resembles a stereotypical rape script.

A group of three research assistants were trained to use the scoring key. The final codes were selected from the most reliable coding pair as determined by Cohen's kappa. Coding discrepancies within the most reliable coding pair were resolved using codes from the third research assistant. The most reliable coding pair agreed on 90.6% of codes ($\kappa = .76$). The mean rape script score was 2.45 ($SD = 1.91$).

Non-stressful event recall

Event recall was operationalised as the total number of correctly recalled explicit events, defined as any goal-directed behaviour committed by any agent within the film. The first and fourth authors coded *Big Night* for 44 explicit events. Three research assistants were trained to code for explicit events. Coding discrepancies within the most reliable coding pair were resolved using codes from the third research assistant. The most reliable coding pair agreed on 88.0% of codes ($\kappa = .87$). Non-stressful event recall had a mean of 17.81 ($SD = 4.70$).

Stressful event recall

Event memory for the stressful film was assessed similarly with an event recall task. To construct the scoring key for *Irréversible*, the first and fourth authors coded 44 explicit events. Three research assistants were trained to code for explicit events. The most reliable coding pair agreed on 89.0% of codes ($\kappa = .88$). Stressful event recall had a mean of 15.36 ($SD = 3.51$).

Segmentation agreement coding

During the non-stressful film, participants averaged 22.53 button presses ($SD = 22.26$). The mean duration of units was 13.68 seconds. During the stressful film, participants averaged 36.25 spacebar presses ($SD = 41.07$). The mean duration of units was 8.86 seconds. Segmentation performance was operationalised by agreement score, defined as the extent to which one indicates the same event boundaries as the entire sample (Kurby & Zacks, 2011; Sargent et al., 2013). First, each participant's segmentation pattern was coded into one-second bins ("1" indicates at least event boundary and "0" indicates no event boundary). Second, point-biserial correlational coefficients (i.e., raw correlations) were calculated between each participant's segmentation pattern (i.e., binary data across 322 bins) and the aggregated normative pattern (i.e., frequency of participants who identified boundaries in each of 322 bins). Third, to correct for between-subjects differences in unit grain sizes, each participant's raw correlation (r_{raw}) was scaled based on the highest possible correlation (r_{max}) and the lowest possible correlation (r_{min}) given the number of boundaries the participant identified (i.e., scaled correlations). Specifically, scaling was accomplished using this formula: $(r_{raw} - r_{min})/(r_{max} - r_{min})$. Scaled correlations are used as the segmentation agreement score for all analyses and have a potential range of zero to one. The mean agreement score for non-stressful film was 0.52 ($SD = 0.10$). The mean agreement score for the stressful film was 0.56 ($SD = 0.12$).

Results

Preliminary analyses

Participants were expected to react to the film in several different ways. To confirm that *Irréversible* functioned as a stressful stimulus, state anxiety (STAI-S6) was measured before and after participants watched the clip. As anticipated, post-film STAI-S6 scores ($M = 16.16$, $SD = 4.76$) were significantly higher than pre-film STAI-S6 T1 scores ($M = 8.52$, $SD = 2.30$) in a paired-samples *t*-test, $t(72) = 14.09$, $p < .001$, Cohen's $d = 1.82$. Additionally, as anticipated, participants looked at the screen for a greater percentage of time in *Big Night* ($M = 98.71$, $SD = 2.53$) than *Irréversible* ($M = 94.16$, $SD = 9.04$), $t(72) = 4.39$, $p < .001$, Cohen's $d = 0.79$. Next, it was anticipated that voluntary recall would be lower in the stressful film. Consistent with predictions, recall was lower in the stressful film ($M = 15.44$, $SD = 3.45$) than the non-stressful film ($M = 17.81$, $SD = 4.70$) $t(71) = 4.61$, $p < .001$, Cohen's $d = 0.56$. Lastly, it was predicted that stressful film agreement scores would be lower than non-stressful film agreement scores. Surprisingly, segmentation agreement scores were significantly higher for the stressful film ($M = .56$, $SD = .12$) than the non-stressful film ($M = .52$, $SD = .10$) in a paired samples *t*-test, $t(72) = 2.77$, $p = .007$, Cohen's $d = 0.34$.

Next, correlation analyses were conducted to examine the relations between segmentation agreement scores (both films), post-film state anxiety, memory assessments, level of attentiveness, stereotypical rape script knowledge, and gender (Table 1).

Several significant correlations directly related to predictions should be noted. First, non-stressful event segmentation approached a significant correlation with non-stressful event recall, which is consistent with prior research (Bailey et al., 2013; Kurby & Zacks, 2011; Sargent et al., 2013). Second, and unexpectedly, stressful segmentation was negatively correlated with stressful event recognition and not significantly related to stressful event recall. Thus, the positive link between segmentation and event memory demonstrated in prior research may be altered in the context of stressful events. Third, and unexpectedly, stressful event recall was positively correlated with state anxiety, which potentially suggests a facilitative effect of negative affect on event memory.

Another set of correlations is notable and informs the selection of control variables in planned analyses. First, a significant positive correlation was found between segmentation agreement scores of the non-stressful film and the stressful film, which potentially suggests factors outside of state anxiety (e.g., individual differences in working memory, processing speed, and prediction error detection) contributed to the segmentation of the stressful film. Therefore, in planned analyses, non-stressful event segmentation was used to statistically control for segmentation ability during non-stressful experiences (see Sargent et al., 2013). Second, and similarly, non-stressful event recall and stressful event recall were positively correlated; therefore, non-stressful event recall was used to statistically control for recall ability during planned analyses involving stressful event recall. Third, stereotypical rape script knowledge was positively correlated with stressful event recall and negatively correlated with stressful event recognition, which potentially suggests that event knowledge may differentially impact recall and recognition. Therefore, stereotypical rape script knowledge was used to statistically control for event knowledge during planned analyses on stressful event memory.

Group differences were assessed between counterbalanced conditions and participant gender. First, independent samples *t*-tests comparing randomly assigned counterbalanced conditions (*Big Night* first vs. *Irréversible* first) were conducted on all variables listed in Table 1. No significant differences were found (all *p*-values > .17), indicating that the order of films did not meaningfully impact study variables. Second, independent samples *t*-tests comparing genders were conducted. Women reported a significantly lower level of attentiveness during the stressful film ($M = 91.58$, $SD = 10.74$) than men ($M = 96.30$, $SD = 6.78$), $t(71) = 2.27$, $p = .025$, Cohen's $d = 0.54$. Additionally, there were marginally significant gender differences in post-film anxiety, as women reported higher levels ($M = 17.24$, $SD = 4.74$) than men ($M = 15.28$, $SD = 4.64$), $t(71) = -1.79$, $p = .078$, Cohen's $d = 0.42$. Together, these differences suggest that gender may be related to how participants responded to the stressful film. Thus, gender was used as a control variable in planned analyses.

Hypothesis testing

Hypothesis 1. The first hypothesis assumes that anxiety predicts peritraumatic encoding disruption. Following this hypothesis, it was predicted that post-film state anxiety would be negatively related to agreement scores for the stressful film. A multiple regression analysis using forced entry was conducted to predict agreement score using post-film state anxiety (STAI-S6) and the following controls: stereotypical rape script knowledge, non-stressful film agreement score, and gender. The regression model was significant, $R^2 = .25$, $F(4, 68) = 5.56$, $p < .001$. However, in the opposite direction to expectations, state anxiety significantly and positively predicted agreement scores, $\beta = .24$, $t(68) = 2.12$, $p = .038$. Non-stressful event segmentation was the only control variable that significantly predicted stressful event segmentation, $\beta = .45$, $t(68) = 4.18$, $p < .001$.

Hypothesis 2. The second hypothesis assumes that peritraumatic encoding disruption predicts event memory disturbance. Following this hypothesis, it was predicted that agreement scores would positively predict event recall and recognition for the stressful film. As planned, two separate multiple regression analyses using

Table 1. Correlation matrix of primary variables of interest.

	Variable	1	2	3	4	5	6	7
1	Stressful Segmentation	–						
2	Non-Stressful Segmentation	.41***	–					
3	State Anxiety	.18	−.14	–				
4	Stressful Event Recognition	−.25*	−.01	.00	–			
5	Stressful Event Recall	−.07	.05	.27*	.18	–		
6	Non-Stressful Event Recall	.13	.20†	−.01	−.12	.47***	–	
7	Level of Attentiveness	−.05	.06	−.26*	.08	−.09	−.02	–
8	Stereotypical Rape Knowledge	.18	.03	.19	−.25*	.27*	−.03	.01

†$p < .10$; *$p < .05$; ***$p < .001$.

forced entry were conducted using agreement score as a predictor of recall and recognition scores. Control variables included gender, stereotypical rape script knowledge, and non-stressful event agreement score. The recall model also included non-stressful event recall as a control.

First, the multiple regression model investigating stressful event recall was significant (Table 2). However, contrary to expectations, segmentation agreement scores approached a significantly negative relationship with event recall. Additionally, stressful event recall was significantly and positively predicted by two control variables: domain-specific event knowledge and non-stressful event recall. Second, the multiple regression model investigating stressful event recognition was significant (Table 2). However, in the opposite direction of predictions, segmentation agreement scores significantly and negatively predicted stressful event recognition. No control variables were significant.

Hypothesis 3. The third hypothesis assumes that encoding disruption is a mediating mechanism by which state anxiety causes event memory disturbance. Following this hypothesis, it was predicted that state anxiety would negatively predict recall and recognition indirectly through low segmentation agreement. As planned, two separate mediational analyses were conducted, each with post-film STAI-S6 as the independent variable (X), stressful film agreement score as the mediator (M), and either recall score or recognition score as the dependent variable (Y). The controls (C_i) were gender, non-stressful film agreement score, and stereotypical rape script knowledge. The recall model also included non-stressful event recall as a control. The indirect effect was tested using confidence intervals (CIs) derived from bias-corrected bootstrapping using 10,000 resampling iterations (Hayes, 2013).

First, the indirect effect of state anxiety on stressful event recall through segmentation was statistically significant, though in the opposite direction as predicted (Table 3). Specifically, the mediational analysis found state anxiety was positivity related to greater segmentation agreement scores, which negatively predicted recall. The indirect link was significant. Further, the direct link between state anxiety and recall was significant and positive.

Second, the indirect effect of state anxiety on stressful event recognition through event segmentation was statistically significant, though in the opposite direction as predicted (Table 3). Specifically, the mediational analysis found that state anxiety was positivity related to greater segmentation agreement scores, which negatively predicted recognition. The indirect link was significant. Further, the direct link between state anxiety and recognition was not significant.

Ad-hoc analyses

At the onset of this study, we predicted state anxiety would produce low segmentation agreement scores. Findings indicated the exact opposite. Our anticipation was based on the assumption that anxiety would result in a bias toward perceptual processing at the cost of restricting top-down attentional processes and the use of event knowledge, which would diminish segmentation agreement. However, it is possible a bias toward perceptual processing did indeed occur during the stressful film and a byproduct was increased agreement. This claim is in concert with the data indicating segmentation agreement was higher for the stressful film than the non-stressful film. This may be due to the fact that the perceptual features are the same across all viewers of the same stimulus, whereas the conceptual features are inferred and may vary from viewer to viewer. To explore the possibility that viewing the stressful film caused a shift towards segmenting based on perceptual change, we predicted participants' segmentation behaviour using two predictors that reflected perceptual processing and conceptual processing.

To compute the perceptual change predictor, we first extracted the frames from each movie, and resized them to 360×640 pixels. Second, for a given frame, for each pixel, the RGB values (i.e., a digital index of red, green, and blue colours) were extracted. Third, for each pixel on an image, a three-dimensional Euclidean distance was taken between the RGB values and the corresponding pixel from the previous frame. Fourth, this process was repeated across all pixels for each image. Fifth, an average was taken across all 230,400 pixel locations to arrive at the average visual perceptual change of that frame from the previous frame. The larger the value, the larger the visual perceptual change. Last, the average pixel change values were averaged by one-sec time bins to arrive at the average amount of change per second of each movie.

The conceptual change predictor of each film was constructed using goal structures coded by the first and fourth authors. There is considerable evidence that segmentation

Table 2. Multiple regression models predicting recall and recognition of stressful film.

	Effects					Model		
	b	*SE*	*β*	*t*	*p*	R^2	*F*	*p*
Segmentation → Recall	–	–	–	–	–	.34	6.65	**<.001**
Constant	9.87	2.35		4.21	**<.001**	–	–	–
Gender	0.45	0.72	0.07	0.62	.54	–	–	–
Segmentation (Non-Stress)	0.90	3.71	0.03	0.24	.81	–	–	–
Stereotypical Rape Knowledge	0.55	0.19	0.31	2.97	**<.01**	–	–	–
Non-Stressful Recall	0.35	0.08	0.48	4.59	**<.001**	–	–	–
Segmentation (Stress)	−5.72	3.25	−0.20	−1.76	*.08*	–	–	–
Segmentation → Recognition	–	–	–	–	–	.13	2.49	**.05**
Constant	18.36	0.93	–	19.79	**<.001**	–	–	–
Gender	−0.30	0.29	−0.12	−1.03	.31	–	–	–
Segmentation (Non-Stress)	1.45	1.55	0.12	0.94	.35	–	–	–
Stereotypical Rape Knowledge	−0.13	0.08	−0.19	−1.67	.10	–	–	–
Segmentation (Stress)	−2.79	1.37	−0.26	−2.05	**.04**	–	–	–

Notes: Significant *p*-values are bolded. Marginal *p*-values are italicised.

Table 3. Mediation analyses predicting stressful event recall (Analysis 1) and recognition (Analysis 2).

Analysis 1: Mediation of Segmentation on Effect of Anxiety on Recall

	Effects				Model		
	coeff.	*SE*	*t*	*p*	R^2	*F*	*p*
Prediction: Stressful Event Segmentation (M)	–	–	–	–	.25	4.42	**<.01**
Constant	0.19	0.09	2.09	**.04**	–	–	–
Gender (C_1)	−0.03	0.03	−1.00	.32	–	–	–
Stereotypical Rape Knowledge (C_2)	0.01	0.01	1.25	.21	–	–	––
Non-Stressful Event Segmentation (C_3)	0.50	0.13	3.95	**<.01**	–	–	–
Non-Stressful Event Recall (C_4)	0.00	0.00	0.62	.54	–	–	–
State Anxiety (*X*)	0.01	0.09	2.10	**.04**	–	–	–
Prediction: Stressful Event Recall (Y)	–	–	–	–	.41	7.4	**<.001**
Constant	7.05	2.45	2.88	**.01**	–	–	–
Gender (C_1)	−0.01	0.70	−0.02	.99	–	–	–
Stereotypical Rape Knowledge (C_2)	0.49	0.18	2.75	**.01**	–	–	–
Non-Stressful Event Segmentation (C_3)	−3.52	3.65	0.96	.34	–	–	–
Non-Stressful Event Recall (C_4)	0.36	0.07	4.91	**<.001**	–	–	–
State Anxiety (*X*)	0.21	0.07	2.82	**.01**	–	–	–
Stressful Event Segmentation (*M*)	−7.96	3.19	−2.50	**.02**	–	–	–

	Effects				95% CI	
	coeff.	*SE*	*t*	*p*	Lower	Upper
Prediction: Direct and Indirect Effects	–	–	–	–	–	–
Anxiety (X) → Recall (Y)	0.21	0.07	2.82	**.01**	**0.06**	**0.36**
Anxiety (*X*) → Segmentation (*M*) → Recall (*Y*)	−0.05	0.03	–	–	**−0.13**	**−0.01**

Analysis 2: Mediation of Segmentation on Effect of Anxiety on Recognition

	Effects				Model		
	coeff.	*SE*	*t*	*p*	R^2	*F*	*p*
Prediction: Stressful Event Segmentation (M)	–	–	–	–	.25	5.56	**<.001**
Constant	0.21	0.08	2.50	**.01**	–	–	–
Gender (C_1)	−0.02	0.03	−0.92	.36	–	–	–
Stereotypical Rape Knowledge (C_2)	0.01	0.01	1.23	.22	–	–	–
Non-Stressful Event Segmentation (C_3)	0.52	0.12	4.18	**<.001**	–	–	–
State Anxiety (*X*)	0.01	0.00	2.12	**.04**	–	–	–
Prediction: Stressful Event Recognition (Y)	–	–	–	–	.14	2.26	*.06*
Constant	17.86	1.02	17.48	**<.001**	–	–	–
Gender (C_1)	−0.38	0.30	−1.26	.21	–	–	–
Stereotypical Rape Knowledge (C_2)	−0.14	0.08	−1.80	*.08*	–	–	–
Non-Stressful Event Segmentation (C_3)	1.93	1.60	1.20	.23	–	–	–
State Anxiety (*X*)	0.04	0.03	1.14	.26	–	–	–
Stressful Event Segmentation (*M*)	−3.19	1.41	−2.27	**.03**	–	–	–

	Effects				95% CI	
	coeff	*SE*	*t*	*p*	Lower	Upper
Prediction: Direct and Indirect Effects	–	–	–	–	–	–
Anxiety (*X*) → Recognition (*Y*)	0.04	0.03	1.14	.26	−0.03	0.10
Anxiety (*X*) → Segmentation (*M*) → Recognition (*Y*)	−0.02	0.01	–	–	**−0.05**	**<−0.01**

Note: Significant *p*-values and CIs are in bolded.

in narrative films is positively correlated with changes in the goals of the prominent characters (e.g., Magliano, Taylor, & Kim, 2005). To make the goal structures, we first listed all agents' goal-directed actions. Many actions were repeated and coded as separate goal episodes (e.g., in *Big Night*, multiple eggs cracked by the cook; in *Irréversible*, multiple attempts of the victim to remove the perpetrator's hand from her mouth). Second, a spreadsheet was created with 322 one-second bins, representing the 322-second duration of each film. Third, within each bin, the total number of action beginnings and action endings were coded. Given that some actions had ambiguous and slow onsets (e.g., perpetrator starting to pull victim toward ground takes about four seconds), all beginnings and endings were coded for at least two bins (i.e., two seconds). The final conceptual change predictor for each film was the total amount of goal beginnings and endings per second.

Segmentation for narrative films appears to be robustly correlated with conceptual change (e.g., Magliano et al., 2005). Therefore, for the non-stressful film, we predicted that the conceptual change predictor should better predict segmentation than the perceptual change predictor. However, for the stressful film, given anxiety has been shown to bias attention toward perceptual information (Brewin et al., 2013; Brewin & Mersaditabari, 2013; Pacheco-Unguetti et al., 2010), we predicted the perceptual change predictor should better predict segmentation than the conceptual change predictor. Additionally, the perceptual change predictor should be more strongly related to segmentation for the stressful film than the non-stressful film.

To test these predictions, for each film, we first binned participants' segmentation behaviour into one-second time bins, and recorded whether or not a participant segmented in each individual bin. We then, for each movie separately, ran a logistic mixed-effect model that predicted the likelihood of segmenting based on the per-bin perceptual change predictor and the per-bin conceptual change predictor. These predictors were entered simultaneously as fixed effects and subject was entered as a random effect. The perceptual change predictor was log transformed prior to analysis to correct for positive skew (skew = 2.8 for stressful film; skew = 4.59 for non-stressful film).

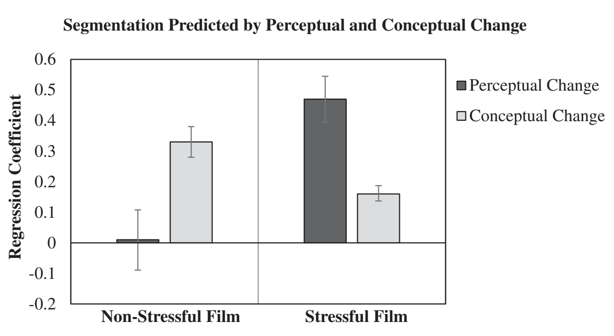

Figure 1. Changes in segmentation in relation to perceptual change and conceptual change. The error bars are 95% confidence intervals.

Results were consistent with expectations. Specifically, for the non-stressful film, the regression coefficient (log odds ratio) was significant for the conceptual change predictor ($b = .33$, $z[23504] = 12.96$, $p < .001$) and non-significant for the perceptual change predictor ($b = .01$, $z[23504] = 0.13$, $p = .90$).[2] For the stressful film, the regression coefficient was significant for the conceptual change predictor ($b = .16$, $z[23504] = 13.61$, $p < .001$) and the perceptual change predictor ($b = .47$, $z[23504] = 12.22$, $p < .001$). As can be seen in Figure 1, the 95% confidence intervals of the perceptual change predictor do not overlap between the stressful film and non-stressful film, indicating that they are significantly different from each other. Additionally, the conceptual change predictors are significantly different from each other between the stressful film and non-stressful film. This pattern of results is consistent with the possibility that state anxiety enhances attention to perceptual change, which may account for higher agreement scores in the stressful film than the non-stressful film.

Discussion

Cognitive theories of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000) argue that increases in affect disrupt standard encoding processes, namely with an attentional bias toward perceptual information and away from conceptual information. Further, these theories assume stress-induced encoding disruption forms event memory representations that are neither cohesive nor elaborated effectively within one's autobiographical memory. However, this assumption has received mixed empirical support. The current study extends the empirical literature by introducing event segmentation as a peritraumatic encoding process that can be measured within a trauma analogue design, specifically, the SESP.

As expected, in this initial use of the SESP, there were significant relationships between post-film state anxiety, segmentation agreement, and voluntary event memory (recall and recognition). Surprisingly, each significant effect was in the opposite direction of predictions. The directionality of each prediction was based on two theoretically informed assumptions that had no empirical precedent: (a) stress will decrease segmentation agreement and (b) segmentation agreement and event memory will have a positive relationship during stressful experiences. Moreover, preliminary evidence suggests trait-like fear and arousal symptomatology are associated with low segmentation agreement (Eisenberg et al., 2016). In contrast, findings of the current study indicate that state anxiety increased segmentation agreement. Further, mediation analyses revealed a significant indirect influence of high segmentation agreement on the negative effect of anxiety on memory. While these findings are consistent with the assumption that event segmentation is a conduit through which stress negatively impacts memory, it was predicted that the indirect effect would be mediated by low segmentation agreement. Thus, it appears that anxiety enhanced segmentation performance, yet this enhancement does not translate to stronger memory performance.

No previous study using non-stressful materials has shown that high segmentation agreement predicts low memory performance (Bailey et al., 2013; Kurby & Zacks, 2011; Sargent et al., 2013). In the current study, there was a marginally significant positive relationship between segmentation of the non-stressful film and subsequent recall of the non-stressful film. One provocative interpretation is that the relationship between segmentation and memory systems may be different for stressful experiences than non-stressful experiences. As indicated in the ad-hoc analyses, perceptual processing impacted segmentation of the stressful film but not the non-stressful film. These findings are interpreted with caution and require additional empirical scrutiny.

Two possibilities might explain why segmentation agreement was higher in the stressful film than the non-stressful film. The first possibility is that differences in segmentation agreement between the stressful film and non-stressful film are the result of differences in the way the films were shot. Commercially produced films, including *Irréversible* and *Big Night*, are typically shot using techniques to capture attentional processes and direct the audience to certain narrative events (Loschky, Larson, Magliano, & Smith, 2015). These techniques are used selectively to narrow or broaden attentional focus, as well as maintain or disrupt gaze duration. Although an effort was made to closely match pre-existing film clips on cinematic techniques, the stressful film may have a meaningfully greater number of these features than the non-stressful film. The stressful film (*Irréversible*) used several nuanced techniques that changed across the duration of the scene such as alterations to lighting, camera movement, actor choreography, and sound editing. In comparison, the non-stressful film (*Big Night*) used a more static camera and the choreography was less of a salient force to direct attention – as a result, the viewer's eye in *Big Night* may have been more free to wander across the scene. If *Irréversible* was more successful in modulating the viewer's attention than *Big Night*, then greater segmentation agreement scores would be expected. Differences between the stimuli highlight the need for future studies to control for material content.

The second possibility is that state anxiety may indeed facilitate segmentation processes. It was originally assumed that the primary impact of anxiety would be to diminish top-down conceptual processing (Brewin et al., 2013; Brewin & Mersaditabari, 2013; Pacheco-Unguetti et al., 2010), thus reducing segmentation agreement (Zacks et al., 2006). However, as the ad-hoc analyses suggest, the primary impact of anxiety may simply be to enhance bottom-up perceptual processing without substantially disrupting top-down processes. The segmentation system is set up to expect perceptual continuity of action and it is when there is an error in that expectation that people perceive an event boundary. It may be that bottom-up processes are largely responsible for the identification of event boundaries (Kurby & Zacks, 2008; Zacks et al., 2006). The increase in segmentation agreement resulting from anxiety could be interpreted as being consistent with cognitive theories of PTSD (Brewin et al., 1996; Ehlers & Clark, 2000), but not in the manner that was assumed at the outset of the design of this study. If stressful experiences engender greater attention to perceptual processing, then it is reasonable to expect that under stress, one could be more sensitive to perceptual change and, thus, more likely to perceive event boundaries. This view is consistent with recent evidence indicating that the anxiety characteristic of "checking proneness" predicts event segmentation behaviour based on low-level perceptual cues (Belayachi & van der Linden, 2015).

The current findings indicate post-film state anxiety had an overall facilitative effect on recall, which is consistent with basic research (e.g., Henckens, Hermans, Pu, Joëls, & Fernández, 2009; Porter & Peace, 2007), yet recall diminishes to the extent that state anxiety increases segmentation agreement. Memory systems beyond cognitive encoding mechanisms, and specifically event segmentation, can account for the positive relationship between recall and anxiety (e.g., evaluated cortisol levels; Schwabe, Joëls, Roozendaal, Wolf, & Oitzl, 2012). However, the current findings are especially curious given that high segmentation agreement typically predicts high memory performance (Bailey et al., 2013; Kurby & Zacks, 2011; Sargent et al., 2013). An intriguing possibility to pursue within the SESP and other paradigms is that negative affect may interfere with fundamental memory processes (e.g., encoding, storage, and retrieval). Future research can explore the possibility that normative segmentation during stressful experiences is the result of an anxiety-related shift in the allocation of attentional resources. As indicated by the ad-hoc analyses, stressful responding may cue executive control (i.e., Cowan, 1988; Engle, 2002) to shift from understanding the narrative and toward detecting perceptual changes, which may manifest as enhanced segmentation behaviour but not necessarily enhanced memory.

One theoretical account of peritraumatic encoding disruption is Ehlers and Clark's (2000) idea of "data-driven processing," meaning the anxiety-enhanced processing of sensory impressions and perceptual characteristics rather than processing the event's underlying meaning in an organised way. To the extent that negative affect increases one's sensitivity to detect perceptual change and thus increase segmentation performance while diminishing voluntary memory, anxiety-enhanced segmentation can be viewed as a form of data-driven processing. Basic memory research has shown that attending to sensory impressions of experimental stimuli results in weaker memory performance than attending to the conceptual meaning of experimental stimuli (García-Bajos, Migueles, & Aizpurua, 2014; Jacoby, 1983; Morris, Bransford, & Franks, 1977; Roediger, 1990). In the context of stressful experiences, studies using a self-report measure of data-driven processing support the prediction that data-driven processing results in trauma-related memory disturbance (Halligan, Clark, & Ehlers, 2002; Halligan, Michael, Clark, & Ehlers, 2003). If anxiety-enhanced segmentation is viewed as a form of data-driven processing, these findings are consistent with the current result that anxiety-enhanced segmentation negatively impacted voluntary memory.

At this time, the current findings indicate the SESP may provide a useful moment-to-moment marker of encoding disruption or data-driven processing to better understand peritraumatic processes and the antecedents and consequences thereof (Sherrill & Magliano, 2017). The current findings further demonstrate the utility of the event segmentation task to elucidate memory phenomena associated with PTSD (Eisenberg et al., 2016) and other psychopathology and brain injuries (e.g., Richmond et al., 2017; Zacks et al., 2016). Additional research applying the SESP to the processing and memory of traumatic experiences is clearly warranted.

It is important to note that standardised stimuli were not used, thus limiting the extent to which the SESP reliably induced anxiety and elicited analogue levels of trauma-related memory disturbance. Given that many performance tasks are affected by stress in a curvilinear fashion (e.g., Yerkes & Dodson, 1908), one possibility is that segmentation behaviour may be facilitated by moderate levels of stress but then diminish markedly at extreme levels of stress. If so, the non-stressful film in this study may have been under-stimulating for the event segmentation task while the stressful film may have been stimulating enough to elicit peak performance. To better control the dose of stress, future research can investigate the impact of stress on segmenting non-stressful stimuli by comparing healthy samples to clinical samples (e.g., anxiety disorders) or administering substances such as hydrocortisone to elevate participants' cortisol levels (e.g. van Ast, Cornelisse, Meeter, Joëls, & Kindt, 2013).

Lastly, it must be acknowledged that a major limitation of this study is its operation of stress (i.e., self-reported state anxiety using STAI-S6). The SESP requires validation using objective measures of stress. Feasible strategies include the collection of psychophysiological markers (e.g., electrodermal activity) and endocrinological markers (e.g., cortisol levels). Using objective markers that can be measured continuously during the stressful film would be particularly advantageous because doing so would allow researchers to observe the moment-to-moment relationship between stress and event segmentation. When subjective self-report of stress is used with the SESP, researchers should consider collecting data before and after each film, as well as assessing trait variables (e.g., trait anxiety) and contextual variables (e.g., caffeine use) that might contribute to current levels of stress. These data can help statistically isolate subjectively reported stress that is induced by the film. Until further validation and extensions of the SESP are achieved, clinical implications should be tempered. However, a better understanding of how stress impacts the initial formation of trauma memories may provide important insights to psychotherapies that focus on processing these memories.

Conclusion

This study executed a novel paradigm to test the hypothesis that stress affects encoding of an unfolding experience, which then results in diminished event memory (Brewin et al., 1996; Ehlers & Clark, 2000). Event segmentation was introduced as a potentially useful moment-to-moment marker of encoding processes during stress. Significant results were found in the opposite direction of predictions. State anxiety predicted high segmentation agreement, which in turn predicted low event memory. The negative relationship between segmentation of a stressful experience and memory performance is markedly different from the effects found for non-stressful experiences, which typically demonstrate a positive relationship (Bailey et al., 2013; Kurby & Zacks, 2011; Sargent et al., 2013). Ad-hoc analyses suggest state anxiety promotes perceptual processing, which in turn heightens segmentation agreement. This finding is consistent with the theory that data-driven, perceptual processing interferes with effective memory storage, thus resulting in weak voluntary memory (Ehlers & Clark, 2000). Replication and extension of the SESP can further assess this theoretical perspective and gain a better understanding of the aetiology of trauma-related memory disturbance.

Notes

1. To explore potential systematic biases in the decision to stop the film, a series of independent samples *t*-tests were conducted to compare participants who stopped the film to participants who watched the entire film. Specifically, participants were compared using t-tests on age, PTSD symptoms (PCL-5), domain knowledge (sexual assault), post-film state anxiety (STAI-S6), and level of attentiveness. No tests were statistically significant (all $ps > .05$). Additionally, a chi-squared analysis indicated that participant gender did not predict stopping the film, X^2 $(1, N = 101) = 0.57$, $p = .45$.
2. The regression coefficient for perceptual change predictor was significant ($b = .18$, $p < .001$) when entered into the model without the conceptual change predictor.

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