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Investigating cultural differences in the effects of expressive suppression when processing traumatic distressing material

Amanda Nagulendran*, Peter J. Norton and Laura Jobson

School of Psychological Sciences and Turner Institute for Brain and Mental Health, Monash University, Melbourne, Victoria, Australia
*Corresponding author. Email: amanda.nagulendran@monash.edu

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Abstract

Background: While suppression is associated with detrimental post-traumatic psychological adjustment, research has not considered the effect of culture on this relationship.
Aims: This study investigated cultural differences in the effects of expressive suppression, whilst watching a traumatic film, on subjective distress, psychophysiological responses and intrusive memory.
Method: Australians of European heritage or East Asian Australian participants ($n = 82$) were randomly assigned to either a suppression group (instructed to suppress their emotions during the film) or a control group (no instructions regarding emotion management). Electrodermal activity, heart rate and heart rate variability (root mean square of the successive differences; RMSSD) were measured pre-, during and post-film. Participants reported the number of film-related intrusions in the 5 min and 7 days post-viewing.
Results: While the European Australian group did not differ significantly on RMSSD, the East Asian suppression group scored significantly higher on RMSSD during the film than the East Asian control group. Second, those in the suppression groups, regardless of cultural background, reported significantly fewer intrusions immediately post-film than controls. Third, we found that for the European Australian group, change in heart rate interacted with group (control *versus* suppression) when predicting weekly intrusions. However, for the East Asian group change in heart rate did not interact with group when predicting weekly intrusions.
Conclusions: The findings are discussed in the context of current research on culture and emotion regulation and implications for post-traumatic stress disorder.

Keywords: culture; intrusions; suppression; trauma; trauma film

Introduction

Emotion regulation, the ways in which individuals modify their own emotional experiences and expressions (Gross, 2014), has been identified as a key factor in the development and maintenance of post-traumatic stress disorder (PTSD) (Bardeen *et al.*, 2013; Seligowski *et al.*, 2015; Seligowski *et al.*, 2016). One example of an emotion regulation strategy is expressive suppression. Expressive suppression is the effort to inhibit the outward display of emotion (Seligowski *et al.*, 2015). In a recent meta-analysis, a medium effect was observed for the association between PTSD symptoms and use of expressive suppression (Seligowski *et al.*, 2015). Thus, expressive suppression is generally considered detrimental to post-traumatic psychological adjustment.

There is, however, a significant gap in this body of literature. Namely, culture has been shown to shape an individual's preference regarding the employment of emotion regulation strategies

(Ford and Mauss, 2015). Specifically, individuals are more likely to employ emotion regulation strategies that are encouraged or approved by their cultural group (Matsumoto *et al.*, 2008). The majority of this cross-cultural research has focused on differences in expressive suppression (Ford and Mauss, 2015). Suppression has frequently been identified as a strategy that is valued differently by Western and Eastern cultures. In Western independent cultures, individuals tend to define themselves based on unique, distinct personal characteristics and attributes, whilst in East Asian cultures, interdependence of the individual, relatedness and harmony with others is typically valued (Markus and Kitayama, 2010). As emotions are strong internal experiences that have potential to both disrupt social harmony and assert individuality, members of Asian interdependent cultures should be motivated to regulate and suppress their emotions more than members of Western independent cultures (Ford and Mauss, 2015). Supporting this notion, expressive suppression is more likely to be employed by members of East Asian cultures than members of Western European cultures (Ford and Mauss, 2015).

Moreover, culture shapes the adaptiveness of an emotion regulation strategy. Specifically, culture reinforces the behaviours that promote cultural values, norms and expectations. Behaviours that are aligned with a culture's values are more likely to be practised, easily implemented and socially rewarded, which in turn promotes well-being (Ford and Mauss, 2015). Therefore, expressive suppression may be adaptive when it is consistent with its cultural context, and maladaptive when it is inconsistent with cultural expectations (Ford and Mauss, 2015). Expressive suppression is typically conceptualized as maladaptive in Western cultures as it is broadly viewed as being restrictive of personal expression and freedom and has been found to be associated with poorer psychological adjustment (Aldao *et al.*, 2010) as well as avoidant attachment, reduced sharing of emotions, lower social support, lower peer-rated likeability, and reduced relationship closeness (Gross, 2002; Gross and John, 2003; John and Gross, 2004). Suppression has also been associated with increased heart rate and electrodermal activity (EDA) and decreased heart rate variability, reflecting increases in sympathetic nervous responding and decreases in parasympathetic nervous responding, respectively (Gross and Levenson, 1993). However, cross-cultural research has increasingly identified that suppression is not necessarily associated with maladaptive psychological and social functioning in East Asian cultures, and indeed may even be beneficial (Butler *et al.*, 2007; Ford and Mauss, 2015; Hu *et al.*, 2014). This difference reflects the Eastern cultural value of interpersonal harmony, which is often prioritized above self-expression (Ford and Mauss, 2015; Markus & Kitayama, 2010; Wei *et al.*, 2013). These findings question the universality of expressive suppression as maladaptive (Ford and Mauss, 2015), and thus it is timely that these findings be considered in the instance of post-traumatic psychological adjustment.

In order to investigate cross-cultural differences in expressive suppression, researchers have employed experimental paradigms. In these paradigms researchers have typically recruited participants from either a Western European background or East Asian background and experimentally manipulated levels of suppression in a controlled situation, such as in relation to watching an upsetting film (e.g. Butler *et al.*, 2007). Similarly, to investigate propositions regarding post-traumatic adjustment, the trauma film paradigm (i.e. healthy participants are shown a short film depicting traumatic events) is routinely used as an experimental analogue of witnessing real trauma and of subsequent symptoms consistent with a PTSD response (e.g. intrusive memories of film content; analogue flashbacks) (Holmes and Bourne, 2008). The trauma film paradigm thus provides an ethical, experimental analogue for the development of PTSD-like symptomatology. In a review of the trauma film paradigm, Holmes and Bourne (2008) concluded that intrusions can be induced in the laboratory, and that their frequency can be increased or reduced through experimental manipulation, including instructing participants to use certain cognitive coping strategies. The trauma film paradigm

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has been used in cross-cultural research, which has demonstrated that the paradigm is able to similarly induce intrusions in both East Asian and participants of European heritage (Jobson and Dalgleish, 2014).

To date, only two studies have employed the trauma film paradigm to investigate the effects of expressive suppression on intrusions and psychological distress. In these studies participants were requested to either suppress their emotion (suppression group), accept their emotion (acceptance group), or were provided with no emotion regulation instructions (control group) whilst watching the distressing film. Researchers typically measured both subjective experience and psychophysiological responses whilst participants were watching the film and in a post-film recovery period. Adopting this approach, Campbell-Sills and colleagues (2006) found that although subjective reports of distress were similar across groups during the film, the acceptance group reported significantly less negative affect during the post-film recovery period. Furthermore, the suppression group showed increased heart rate during the film compared with the acceptance group. Contrary to expectations, no group differences were found in EDA or respiratory sinus arrhythmia. These findings suggest that acceptance was a more effective method of emotion regulation than suppression in this sample (83% Caucasian, 6.7% Asian, 1.7% Hispanic and 3.3% multi-racial).

In contrast, Dunn and colleagues (2009) found that the suppression group self-reported significantly less subjective fear relative to the acceptance and control groups. Furthermore, although no group differences were found in EDA or heart rate, the acceptance group demonstrated a significantly less marked increase in EDA from viewing to recovery than both the control and suppression groups. Additionally, whilst there were no significant group differences with respect to involuntary recall of the stimuli in the 7 days post-film, the suppression group demonstrated significantly reduced free recall memory of the film when compared with the control and acceptance groups. Dunn *et al.* (2009) interpreted these findings to indicate that healthy individuals can modulate their subjective experiences of emotion through suppression, but less so their psychophysiological responses. The cultural make-up of their sample was not reported (however, based on communication with the authors, the sample included predominantly white British participants).

These studies report somewhat mixed findings regarding the consequences of expressive suppression on psychological distress, psychophysiological responses, and the development of intrusive memories. However, both studies offer evidence to indicate that expressive suppression may not be an effective method of emotion regulation in predominantly Western samples. Furthermore, neither of the studies considered culture as a potential factor in the effects of suppression on distress and intrusive memories. Given that healthy individuals of different cultures have been shown to regulate their emotions differently (Ford and Mauss, 2015), it would follow that emotion regulation processes may also function differently in the context of psychopathology. Although use of expressive suppression has been demonstrated to differ cross-culturally, as yet no research has been conducted to explore how these differences may influence the development or maintenance of PTSD symptoms.

This study therefore aimed to explore if cultural differences in expressive suppression have differential implications for psychological distress, physiological responses and the development of intrusive memories, using a sample of Australians with European heritage (hereafter referred to as 'European Australian') and East Asian Australians (hereafter referred to as 'East Asian'). The current study was focused on expressive suppression, given the significant research that has demonstrated cultural differences in this emotion regulation strategy (Ford and Mauss, 2015) and given this was the first study in the area, an acceptance group was not included. It was hypothesized that the increased use of expressive suppression would result in (a) increased distress (as indexed by increased psychological distress, increased sympathetic nervous responding, and decreased parasympathetic nervous responding) and (b) increased film-related intrusive memories (reported both immediately post-film and in the

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7 days post-film) in the European Australian suppression group relative to the European Australian control group. In contrast, it was hypothesized that the use of expressive suppression would result in (a) decreased distress (as indexed by decreased psychological distress, decreased sympathetic nervous responding, and increased parasympathetic nervous responding) and (b) decreased film-related intrusive memories (reported both immediately post-film and in the total week post-film) in the East Asian suppression group relative to the East Asian control group.

Method

Participants

Participants were 86 healthy university students who were recruited through flyers on campus and social media. Participants were sampled from two cultural groups: individuals who identified as East Asian Australian with both parents and all four grandparents born in an East Asian country, including China, Japan, South Korea and Taiwan ($n = 41$), and European Australians with both parents and all four grandparents being born in Western countries, including Australia, the UK, New Zealand, Canada and the USA ($n = 41$). Participants were randomly assigned to either the 'suppression' group or the 'control' group. Exclusion criteria included self-reported current mental health concerns, prior exposure to traumatic events (e.g. motor vehicle accidents, drowning), or presence of a blood-injury-injection phobia that might cause fainting in response to the experimental stimulus. Participants were also excluded if they believed they would not be able to complete the tasks in English. Four participants were excluded based on not meeting these eligibility criteria, resulting in a final sample size of 82. All four participants were excluded due to having experienced a traumatic event in the past.

Given the novelty of the study, it was difficult to calculate *a priori* sample size estimates. In previous emotion-provoking film research examining the effects of emotional suppression on psychological outcomes, approaching medium effect sizes have been observed (Campbell-Sills *et al.*, 2006; Dunn *et al.*, 2009). We adopted a similar effect size for our current study, with an alpha of .05 and 80% power, which indicated that at least 20 participants per group were required.

Materials and measures

Screening measures

The Hopkins Symptom Inventory (Derogatis *et al.*, 1974) was used to measure depression symptomatology. Depression is associated with difficulties in emotion regulation (Joormann and Quinn, 2014), and as such participants who reported that one or more depression symptoms had 'extremely' bothered or distressed them in the last week were excluded from the study. Participants who reported any suicidal ideation were also excluded. The Trauma History Questionnaire (Green, 1996) was used to assess participants' previous exposure to potentially traumatic events. These measures were used to check for comparability in depressive symptomatology and previous trauma exposure across the groups.

Physiological measures

Collected together, EDA, heart rate (HR) and heart rate variability have been identified as effective, non-invasive measures of the competing influences of the sympathetic and parasympathetic nervous systems when individuals experience stress (Visnovcova *et al.*, 2013). These data were used to measure the biological aspects of participants' emotional experiences (Lewis *et al.*, 2008). Adopting the approach of Dunn and colleagues (2009), whilst participants viewed the trauma film their HR and EDA responses were continuously measured. Participants' responses were also recorded for 5 min prior to watching the film (rest period)

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and for 5 min following the film (recovery period). EDA was used to measure activation of the sympathetic nervous system (Mauss and Robinson, 2009). EDA is generated by activation of palmar sweat glands, triggered by acetylcholine released by the sympathetic nervous system (Venables and Christies, 1980). As such, increased EDA is associated with increased sympathetic nervous activity. Recording devices were placed on the proximal phalanges of the index and ring fingers of each participant's non-dominant hand. To measure heart rate, we used a five-lead ECG system with disposable, pre-gelled electrodes (diameter 35 mm; Coviden). These electrodes were placed in the region of the right collar bone, lower left ribcage and near the left collar bone. Prior to attachment, the electrode sites were cleaned with alcohol wipes. The ECG waveform was used to estimate heart rate (beats per minute). Heart rate variability readings (measured as root mean square of the successive differences; RMSSD) were used to measure activation of the parasympathetic nervous system (Lewis *et al.*, 2008; Task Force of the European Society of Cardiology, 1996). Heart rate variability is a measure of the changes in the length of time between adjacent heartbeats. EDA and heart rate variability were collected using *PowerLab 8/35* (AD Instruments) and analysed using *LabChart 7* software. Height and weight of participants were also recorded in order to calculate body mass index (BMI). BMI is often used as a covariate in analysis of physiological variables in order to account for variance in cardiovascular responding contributed by physical fitness (Task Force of the European Society of Cardiology, 1996).

Psychometric measures

The Positive and Negative Affect Schedule (PANAS; Watson *et al.*, 1988) is a 20-item self-report measure of current subjective affect. It features 20 items describing mood states and is divided into two subscales: positive and negative affect. Participants were instructed to rate the extent to which they identified with each item at the present moment on a 5-point Likert scale (1 = *very slightly or not at all* to 5 = *extremely*). The PANAS is widely used and has good reliability and validity (Mackinnon *et al.*, 1999; Watson *et al.*, 1988). In the current study, internal consistency was $\alpha = .87$ for the positive scale and $\alpha = .65$ for the negative scale.

Memory measures

The Intrusion Diary (Holmes and Bourne, 2008; Jobson and Dalgleish, 2014) was used to measure the number of image-based intrusions of film content experienced by participants over the week after viewing the film. Participants were verbally instructed (also included as written instructions in the diary) that intrusions were 'any memory of the film (or part of the film) that appear apparently spontaneously in your mind. Do not include any memories of the film that you deliberately or consciously bring to mind' (Jobson and Dalgleish, 2014). Each day of the diary was divided into three segments: morning, afternoon and evening. Participants were asked to record in these diaries all intrusions that they experienced immediately after they occurred and to set aside a regular time each day to check whether their diary was up to date. This allowed participants an opportunity to ensure intrusions had not been omitted if it had not been possible to write down an intrusion immediately after its occurrence (Jobson and Dalgleish, 2014). Participants were also instructed to record 'no intrusions' if they had not experienced any intrusions and to briefly describe the content of the intrusion so as to ensure that the intrusion was related to the film (Jobson and Dalgleish, 2014). Following Jobson and Dalgleish (2014), participants also completed a 16-item 'yes/no' forced recognition task (e.g. Scene 5: The phone smashes as it hits the ground) and a 14-item cued recall task (e.g. What explodes in the face of the children in Scene 8?) following exposure to the experimental task to assess participant's voluntary memory of the stimulus.

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Procedure

Following informed consent, study eligibility was assessed using the Hopkins Symptom Inventory (Derogatis *et al.*, 1974) and the Trauma History Questionnaire (Green, 1996). Eligible participants then completed the PANAS (Watson *et al.*, 1988). Following this, participants were randomly allocated to either the suppression or control group by the experimenter. The experimenter attached the physiological recording equipment and explained the purpose of each device. After a 5 min baseline recording period, participants were told that they would be viewing a short film, and were given one of two possible sets of instructions. Participants assigned to the suppression groups were told: 'If you have any emotional responses to the film, I would like you to do your best not to let those feelings show. In other words, I would like you to behave in such a way that if someone was watching you, they would not be able to tell what you were thinking or feeling at all', replicating instructions used by Gross (1998). Participants in the control groups received no emotion regulation instructions. Both groups were advised to say 'stop' if they felt distressed and wanted to discontinue their involvement in the study.

A trauma film based on Holmes *et al.* (2009) and extended by Jobson and Dalgleish (2014) was used. The film consisted of ten extracts of footage of traumatic content. Four scenes depicted car accidents, two scenes depicted surgery, and the remaining scenes depicted drowning, genocide, an electricity pylon accident and a firework explosion. The film was displayed on a 14-inch colour monitor in a dark room and viewing distance was approximately 50 cm.

Immediately following the film, the PANAS was re-administered and all participants were asked to indicate on a visual analogue scale (ranging from 1 = *not at all* to 5 = *completely*) how hard they had tried to suppress their emotions during the film. This served as a self-report measure of suppression effort and was based on a similar measure used by Campbell-Sills and colleagues (2006). The experimenter then explained to participants the definition of an intrusion of film content and checked participants' understanding prior to completing the intrusion task. Participants used tally marks to report the number of film-related intrusions experienced during a 5 min recording period. The experimenter then removed the physiological equipment, and participants completed the recognition and recall task. Finally, the experimenter explained the intrusions diary to participants, and organized another meeting for the following week. The second meeting was arranged to allow participants to return the intrusion diary and collect AUS$20 reimbursement for their involvement in the research.

Data analysis plan

To assess subjective psychological distress, two 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) × 2 (time: baseline, post-film) mixed model analysis of variances (ANOVAs) were used to explore changes in PANAS-negative and PANAS-positive. To assess psychophysiological responses, three 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) × 3 (time: baseline, during, post-film) ANOVAs were used to explore EDA, HR and RMSSD. When BMI scores were included as covariates, a similar pattern of results to that reported below was found. To assess intrusions, we first conducted a 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) ANOVA with number of intrusions retrieved within the 5 min window immediately post-film as the dependent variable. Second, we conducted a 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) ANOVA with the total number of intrusions retrieved within the week post-film as the dependent variable.

Exploratory data analyses

Based on the inconsistent findings, we decided to conduct *post-hoc* exploratory analyses in an attempt to better understand whether the proposed mechanisms (i.e. suppression, cultural group) influenced

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Table 1. Group characteristics for demographic variables and study variables

	European Australian control ($n = 20$)	European Australian suppression ($n = 21$)	East Asian Australian control ($n = 21$)	East Asian Australian suppression ($n = 20$)
Age	22.60 (6.06)	21.76 (5.15)	23.05 (4.82)	22.05 (2.86)
Gender F:M	10:10	15:6	11:10	16:4
Years in Australia	20.65 (8.35)	20.57 (5.68)	3.18 (4.85)	3.62 (4.99)
Body mass index[a]	21.71 (3.07)	22.35 (4.31)	20.96 (1.96)	21.33 (3.66)
Self-rated suppression	2.45 (.94)	3.86 (1.01)	2.81 (1.03)	3.55 (.76)
Depression	1.24 (0.17)	1.33 (0.27)	1.27 (0.22)	1.30 (0.22)
Recognition	11.40 (1.85)	11.38 (1.43)	10.10 (2.07)	10.60 (1.79)
Free recall	10.65 (1.18)	10.43 (1.43)	9.14 (1.49)	9.10 (1.68)
Subjective emotion				
PANAS-P pre-film	30.60 (7.74)	30.05 (5.48)	27.57 (6.46)	25.30 (8.14)
PANAS-P post-film	23.40 (8.03)	23.62 (7.29)	23.19 (7.74)	18.40 (6.73)
PANAS-N pre-film	12.30 (2.52)	11.29 (1.27)	12.15 (2.41)	13.35 (3.57)
PANAS-N post-film	15.45 (3.76)	14.05 (4.12)	16.50 (4.54)	18.30 (7.43)
Psychophysiological responses				
EDA pre-film	3.80 (3.72)	2.40 (3.10)	2.06 (3.14)	1.95 (2.59)
EDA during film	9.10 (6.95)	6.07 (7.56)	4.62 (5.76)	5.20 (3.25)
EDA post-film	12.27 (7.70)	8.91 (7.54)	7.34 (5.56)	7.71 (2.47)
RMSSD pre-film	45.54 (26.06)	49.03 (24.61)	39.72 (20.73)	50.05 (31.06)
RMSSD during film	46.48 (20.30)	44.72 (20.40)	40.71 (12.77)	57.48 (28.44)
RMSSD post-film	45.62 (17.93)	53.25 (27.34)	45.17 (24.38)	52.95 (27.83)
Heart rate pre-film	78.89 (12.73)	74.52 (10.62)	80.94 (10.50)	75.47 (9.19)
Heart rate during film	77.74 (11.92)	73.92 (9.95)	79.20 (10.30)	73.28 (9.27)
Heart rate post-film	81.17 (11.26)	76.63 (10.76)	82.33 (9.20)	77.16 (8.52)
Intrusions				
Intrusions 5 min	6.15 (5.31)	3.76 (2.41)	5.90 (7.16)	3.70 (4.65)
Intrusions week	7.36 (7.97)	7.62 (7.97)	5.08 (6.47)	5.23 (5.03)

PANAS-P, Positive and Negative Affect Scale-Positive; PANAS-N, Positive and Negative Affect Scale-Negative; EDA, electrodermal activity; RMSSD, root mean square of the successive differences [a]Body mass index did not correlate significantly with any of the physiological variables, with negligible effects observed.

the relationship between distress and intrusions. We conducted a series of moderated moderation analyses examining whether group (suppression *versus* control) moderated the relationship between distress (subjective and physiological) and weekly total number of intrusions, and whether cultural group had an additional moderating effect. Subjective psychological distress was examined using change (i.e. during film–baseline) scores. Physiological distress was examined using change (i.e. recovery–during film) scores, controlling for baseline physiological data (Dunn *et al.*, 2009). In terms of the physiological data, we also examined change scores using the during film scores minus baseline scores.

Results

Group characteristics

Table 1 presents group characteristics. These characteristics were examined using a series of 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) ANOVAs. No between-group differences were found for age, BMI or depressive symptomatology. While the four groups did not differ significantly in terms of gender distribution, χ^2 (3, $n = 82$) = 6.55, $p = .09$, when comparing the suppression and control groups, females were over-represented in the suppression group, χ^2 (1, $n = 82$) = 6.46, $p = .01$. Therefore, gender was controlled for in our analyses. Unsurprisingly, individuals who identified as European Australian reported having lived in Australia for a significantly longer period of time

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than those who identified as East Asian Australian, F (1,78) = 162.46, $p < .001$, $\eta_p^2 = .68$. The group main effect and interaction were both non-significant for time in Australia. As expected, the suppression group reported using greater suppression than the control group, F (1,78) = 26.43, $p < .001$, $\eta_p^2 = .25$. The culture main effect and interaction were both non-significant.

Two 2 (culture: East Asian, European Australian) × 2 (group: suppression, control) ANOVAs found significant cultural main effects for both recognition, F (1,77) = 6.71, $p = .01$, $\eta_p^2 = .08$, and free recall, F (1,77) = 19.02, $p < .001$, $\eta_p^2 = .20$, with East Asian participants scoring significantly lower on both measures than European Australians. The group main effect and interaction were both non-significant; group main effects: recognition, F (1,77) = .64, $p = .43$, $\eta_p^2 = .01$; free recall, F (1,77) = .10, $p = .75$, $\eta_p^2 < .01$; interaction effects: recognition, F (1,77) = .44, $p = .51$, $\eta_p^2 = .01$; free recall, F (1,77) = .08, $p = .78$, $\eta_p^2 = .001$. When recognition and free recall scores were included as covariates in the below hypothesis-related analyses, a similar pattern to that reported emerged, suggesting that group differences in these variables did not account for the findings presented below.

Subjective psychological distress

For PANAS-negative, as expected, there was a significant time main effect, F (1,76) = 45.77, $p < .001$, $\eta_p^2 = .38$, whereby negative mood was found to be significantly greater post-film when compared with pre-film mood ratings, indicating that the film was effective in increasing negative affect in participants. The culture main effect was significant; F (1, 76) = 7.99, $p < .01$, $\eta_p^2 = .10$; the East Asian group scored significantly higher than the European Australian group. The culture × suppression interaction was non-significant, F (1,76) = 2.89, $p = .10$, $\eta_p^2 = .04$.

For PANAS-positive, as expected, there was a significant time main effect, F (1,77) = 99.68, $p < .001$, $\eta_p^2 = .56$, whereby positive affect was found to be significantly lower post-film when compared with pre-film mood ratings. The cultural main effect was also found to be significant, F (1,77) = 4.99, $p = .03$, $\eta_p^2 = .06$; with the European Australian group scoring significantly higher than the East Asian group. The suppression main effect, F (1,77) = 1.22, $p = .27$, $\eta_p^2 = .02$, and culture × suppression interaction, F (1,77) = 1.30, $p = .26$, $\eta_p^2 = .02$, were both non-significant. Given these cultural differences, when we also included PANAS scores as covariates in the below hypothesis-related analyses, a similar pattern to that reported emerged.

Psychophysiology

Psychophysiological responses are presented in Table 1. The four groups did not differ significantly at baseline in terms of psychophysiological responding, EDA, F (3,75) = 1.20, $p = .32$, $\eta_p^2 = .05$; HR, F (3,73) = 2.07, $p = .11$, $\eta_p^2 = .08$; or RMSSD, F (3,73) = .64, $p = .59$, $\eta_p^2 = .03$.

For EDA, the time main effect was significant, F (2,150) = 59.64, $p < .001$, $\eta_p^2 = .44$, whereby EDA was significantly higher during the film than at baseline, F (1,78) = 29.81, $p < .001$, $\eta_p^2 = .28$, and in the recovery period compared with during the film, F (1,78) = 61.38, $p < .001$, $\eta_p^2 = .44$. The time × culture interaction was also significant, F (2,150) = 3.15, $p < .05$, $\eta_p^2 = .04$. Follow-up analyses showed that while the two cultural groups did not differ significantly at baseline, F (1,77) = 1.69, $p = .20$, $\eta_p^2 = .02$, the European Australian group had higher EDA than the East Asian group during the film, F (1,77) = 3.86, $p = .05$, $\eta_p^2 = .05$, and in the recovery period, F (1,77) = 4.86, $p = .03$, $\eta_p^2 = .06$. The suppression group main effect, F (1,75) = .07, $p = .80$, $\eta_p^2 = .001$, group × culture, F (1,75) = 2.13, $p = .15$, $\eta_p^2 = .03$, time × group, F (2,150) = .13, $p = .88$, $\eta_p^2 < .01$, and three-way interaction, F (2,150) = 1.37, $p = .26$, $\eta_p^2 = .02$, were all non-significant.

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For HR, the time main effect was significant, F (2,146) = 16.19, $p < .001$, $\eta_p^2 = .18$, whereby HR was significantly lower during the film than at baseline, F (1,76) = 4.18, $p = .04$, $\eta_p^2 = .05$, but was significantly higher in the recovery period when compared with during the film, F (1,76) = 30.13, $p < .001$, $\eta_p^2 = .28$, and baseline, F (1,76) = 14.07, $p < .001$, $\eta_p^2 = .16$. The group main effect was also significant, F (1,73) = 5.14, $p = .03$, $\eta_p^2 = .07$; the control group scored significantly higher than the suppression group. The cultural main effect, F (1,73) = .37, $p = .54$, $\eta_p^2 = .01$, and group × culture, F (1,73) = .01, $p = .93$, $\eta_p^2 < .001$, time × culture, F (2,146) = 2.28, $p = .11$, $\eta_p^2 = .03$, time × group, F (2,146) = .53, $p = .59$, $\eta_p^2 < .01$, and three-way interaction, F (2,146) = 1.75, $p = .18$, $\eta_p^2 = .02$, were all non-significant.

For RMSSD, the time × culture × group interaction was approaching significant, F (2,146) = 2.84, $p = .06$, $\eta_p^2 = .04$. Follow-up analyses found that during the film the culture × group interaction was significant, F (1,73) = 4.91, $p = .03$, $\eta_p^2 = .06$; whilst the European Australian suppression group did not differ significantly from the European Australian control group, F (1,37) = .77, $p = .39$, $\eta_p^2 = .02$, as predicted, the East Asian suppression group scored significantly higher on RMSSD (i.e. indicating increased parasympathetic nervous responding) during the film than the East Asian control group, F (1,35) = 4.85, $p = .03$, $\eta_p^2 = .12$. Additionally, whilst the European Australian and East Asian control groups did not differ significantly, F (1,36) = 1.10, $p = .30$, $\eta_p^2 = .03$, the East Asian suppression group scored higher than the European Australian suppression group, F (1,36) = 3.98, $p = .05$, $\eta_p^2 = .10$. For the baseline and recovery data the main effects and interactions were all non-significant; baseline group main effect, F (1,73) = .77, $p = .38$, $\eta_p^2 = .01$, culture main effect, F (1,73) = .41, $p = .53$, $\eta_p^2 = .01$, interaction, F (1,73) = .73, $p = .40$, $\eta_p^2 = .06$; post-film group main effect, F (1,73) = 1.64, $p = .21$, $\eta_p^2 = .02$, culture main effect, F (1,73) = .15, $p = .70$, $\eta_p^2 = .002$, interaction, F (1,73) = .001, $p = .98$, $\eta_p^2 < .001$.

Intrusions

The mean number of intrusions recalled immediately post-film and in the week post-film are presented in Table 1.

Immediate intrusions

For the number of intrusions retrieved immediately post-film, the group main effect was significant, F (1,77) = 4.92, $p = .03$, $\eta_p^2 = .06$, whereby, those in the suppression group reported significantly fewer intrusions than those in the control group. The culture main effect, F (1,77) = .03, $p = .87$, $\eta_p^2 < .001$ and interaction, F (1,77) = .01, $p = .94$, $\eta_p^2 < .001$, were both non-significant.

Total weekly intrusions

For the total number of intrusions retrieved in the week post-film, the group main effect, F (1,76) = .50, $p = .48$, $\eta_p^2 = .01$, culture main effect, F (1,76) = 3.59, $p = .06$, $\eta_p^2 = 0.05$ (although this was approaching significance with the European Australian group reporting greater intrusions than the East Asian group), and interaction, F (1,76) = .18, $p = .67$, $\eta_p^2 < .01$, were all non-significant.

Exploratory analyses: moderated moderations

As shown in Table 2, the only significant findings were for heart rate change. Test of conditional heart rate change × group interaction at values of cultural group revealed that for the European Australian group, change in heart rate interacted with group when predicting weekly intrusions, $b = 2.33$, F (1, 68) = 10.42, $p = .002$. However, for the East Asian group change in heart rate did

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Table 2. Results of the moderated moderation models

	b	*SE*	*t*	LLCI	ULCI
Negative affect					
Group	−2.09	3.48	−.60	−9.04	4.86
Change negative affect	−.45	.54	−.83	−1.53	.63
Cultural group	−5.41	3.47	−1.56	−12.34	1.52
Group × Change negative affect	−.05	.75	−.06	−1.55	1.45
Group × Cultural group	.34	4.63	.07	−8.90	9.58
Cultural group × Change negative affect	.42	.65	.64	−.89	1.72
Cultural group × Group × Change negative affect	.32	.86	.37	−1.40	2.04
EDA					
Group	−.21	3.70	−.06	−7.58	7.16
Change EDA	−.46	.53	−.87	1.53	.60
Cultural group	−4.16	3.45	−1.21	−11.05	2.72
Group × Change EDA	−.67	.92	−.73	−2.51	1.17
Group × Cultural group	−1.35	5.10	−.26	−11.52	8.82
Cultural group × Change EDA	−.13	.83	−.15	−1.78	1.53
Cultural group × Group × Change EDA	1.18	1.36	−1.43	−6.47	1.26
Heart rate					
Group	−10.24	3.29	−3.11**	−16.80	−3.69
Change heart rate	−2.23	.62	−3.58**	−3.47	−.99
Cultural group	−10.89	3.67	−2.97**	−18.20	−3.57
Group × Change heart rate	2.33	.71	3.26*	.90	3.76
Group × Cultural group	8.33	5.26	1.58	−2.18	18.83
Cultural group × Change heart rate	1.94	.86	2.25*	.22	3.66
Cultural group × Group × Change heart rate	−2.13	1.18	−1.80[a]	−4.48	.23
RMSSD					
Group	−3.10	2.68	−1.16	−8.44	2.25
Change RMSSD	−.003	.09	−.03	−.19	.18
Cultural group	−4.14	2.58	−1.61	−9.29	1.06
Group × Change RMSSD	.10	.14	.70	−.18	.38
Group × Cultural group	2.07	3.83	.54	−5.57	9.72
Cultural group × Change RMSSD	.005	.13	.04	−.25	.26
Cultural group × Group × Change RMSSD	−.04	.26	−.16	−.56	.48

For Group, 0 = control and 1 = suppression; for Cultural group, 0 = European Australian and 1 = East Asian. LLCI, 95% lower level of confidence interval; ULCI, 95% upper level of confidence interval. [a]p = .08, *$p < .05$; **$p < .01$.

not interact with group (suppression *vs* control) when predicting weekly intrusions, $b = .20$, F (1,68) = .05, $p = .83$. When examining just the European Australian group, using the Johnson-Neyman technique, we identified two regions of significance. First, suppression was significantly and negatively associated with weekly intrusions when heart rate change was approximately 0.50*SD* below the mean, $b = -7.34$, $SE = 3.61$, 95% CI [−14.68, −.00011], $p = .05$. Second, suppression was significantly and positively associated with weekly intrusions when heart rate change was approximately 2.5*SD* above the mean, $b = 11.87$, $SE = 5.85$, 95% CI [.001, 23.73], $p = .05$. In terms of the physiological data, we also examined change scores for during the film minus baseline. None of these moderated moderations was significant.

Discussion

This study investigated cultural differences in the effects of expressive suppression, whilst watching a traumatic film, on subjective psychological distress, psychophysiological responses and intrusive memory development. First, there was no evidence to support our hypothesis regarding a culture and group interaction for subjective psychological distress. We found that across all groups, subjective negative affect increased and subjective positive affect reduced after watching the trauma film. Furthermore, the East Asian group reported significantly greater negative affect and significantly lower levels of positive affect than the European

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Australian group. Second, there was some support for our hypothesis concerning physiological responding; the East Asian suppression group had significantly increased parasympathetic responding while viewing the film relative to the East Asian control group, but no such difference was observed between the European Australian groups. However, there was no support for hypothesis in terms of sympathetic nervous responding (HR and EDA). Third, contrary to that hypothesized, the suppression group, regardless of cultural background, reported fewer intrusive memories in the 5 min window immediately after viewing the film compared with the control group. Fourth, there was no support for our hypothesis in terms of weekly intrusions; the cultural group main effect, suppression main effect and culture × suppression interaction were all non-significant. Finally, the exploratory analyses revealed that for the European Australian group, change in heart rate (recovery–during film) interacted with group (suppression *vs* control) in predicting weekly intrusions. However, for the East Asian group, change in heart rate did not interact with group in predicting weekly intrusions.

In terms of subjective responding, our cultural findings – East Asians reporting greater negative affect and less positive affect than European Australians – align with previous cross-cultural research. Research has demonstrated that given the influence of dialectical philosophies in Asian cultures (Bagozzi *et al.*, 1999; De Vaus *et al.*, 2017), members of Asian cultures tend to be accepting of negative emotions (Bagozzi *et al.*, 1999; De Vaus *et al.*, 2017), whilst members of Western cultures tend to prioritize positive emotions when compared with those from East Asian cultures (Kitayama *et al.*, 1997; Kuppens *et al.*, 2008; Mesquita and Karasawa, 2002). Suppression was not found to influence subjective affect in either cultural group. Campbell-Sills and colleagues (2006) also found that subjective reports of distress were similar across the control and suppression groups during the film and during the post-film recovery period. However, our findings are in contrast to those of Dunn *et al.* (2009), who found that the suppression group self-reported significantly less subjective fear relative to the control group. Given Dunn and colleagues' (2009) findings we also explored individual items on the PANAS negative affect subscale. However, in each instance there was no evidence to suggest group main effects or group × culture interactions. It is unclear why the effect observed by Dunn *et al.* (2009) was not replicated in the present study.

Regarding psychophysiological responses, increased parasympathetic responding has typically been interpreted to suggest that participants are using a more effective emotion regulation strategy (Campbell-Sills *et al.*, 2006; Dunn *et al.*, 2009). That is, increased activity in the parasympathetic nervous system is associated with participants' bodies working to return their physiological activity from initiation of the fight-or-flight response to the typical rest-and-digest processes, reflecting a decreased sense of threat (Visnovcova *et al.*, 2013). Increased parasympathetic response makes sense in the context of suppression being more culturally accepted in East Asian countries, and therefore more familiar to East Asian Australian participants. However, it is unclear why the expected findings were not observed in terms of sympathetic responding. Campbell-Sills *et al.* (2006) and Dunn *et al.* (2009) also found no group differences in EDA, and Dunn *et al.* found no group differences in HR. Interestingly, however, we found that for the European Australian group suppression may moderate the relationship between physiological arousal (i.e. heart rate in the recovery period relative to during the film) and weekly intrusions. High levels of physiological arousal combined with suppression may be associated with the experience of greater frequency of intrusions, while low levels of arousal combined with suppression may be associated with fewer intrusions. In contrast, for the East Asian group suppression did not moderate the association between heart rate and weekly intrusions. However, these findings were only observed for heart rate, and thus need to be further examined before firm conclusions are drawn.

In sum, the findings of this study are somewhat inconsistent and demonstrate a need for greater research in this area. We found no evidence that culture and suppression interacted in terms of subjective distress, highlighting the need for future research to include both

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subjective and physiological measures of distress. In terms of parasympathetic responding, it seems that suppression was specifically beneficial for the East Asian group during the film. When considering sympathetic responding, we found that for the European Australian group suppression may moderate the relationship between physiological arousal (heart rate during the recovery period relative to during the film) and weekly intrusions. In contrast, for the East Asian group this moderating effect was not observed. In terms of intrusions it appears that in the short-term suppression may be a beneficial emotion regulation strategy, regardless of cultural group. However, there was no evidence to indicate that for either cultural group being instructed to suppress emotion influenced the total number of intrusions experienced over the week. Thus, the effects of suppression on intrusions in the longer term may need further exploration.

The shortcomings of this study are acknowledged. First, this study was conducted in Australia, a predominantly Western cultural environment. This may result in East Asian participants being more likely to have Western cultural characteristics than those living in their countries of birth, given potential acculturation. Second, it is recognized that samples recruited largely from a university campus may result in a sample with above average education levels and socioeconomic status relative to participants' countries of birth. This is particularly relevant with respect to countries such as China, where significant proportions of the population live in rural areas. Furthermore, future studies may benefit from a larger sample size. Third, as with all cross-cultural research, language and task understanding must be considered. The trauma film, while developed to be culturally appropriate for Asian participants, is presented predominantly in English, and retrieving memories in a non-native language may impact memory retrieval. Fourth, self-rated suppression effects can be influenced by response and desirability effects. Thus, the lack of observed differences in RMSSD in the European Australian group may reflect the European Australian groups not employing differential emotion strategies as instructed. Finally, future research could examine any lasting effects by exploring memory (free recall and recognition) and distress at the 1-week follow-up point. Future research could also examine the intrusion content and subjective distress induced by the intrusions. Despite these limitations, this study provides an important first step in exploring cross-cultural differences in the development of intrusive memories. The findings suggest that further research is warranted to understand these differences in a clinical population and consider the implications for treatment of PTSD in trauma survivors from East Asian backgrounds.

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Conflicts of interest. Amanda Nagulendran, Peter J. Norton and Laura Jobson declare they have no conflicts of interest.

Ethical statements. All procedures performed in this study involving human participants were in accordance with the ethical standards of the Monash University Human Research Ethics Committee (MUHREC reference number: 2017-0502-14872) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.
Informed consent was obtained from all individual participants included in this study.

Data availability. The data that support the findings of this study are available from the corresponding author upon reasonable request.

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