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The Effects of Expressive and Experiential Suppression on Memory Accuracy and Memory Distortion in Women with and Without PTSD

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Abstract

Specific emotion regulation strategies impinge on cognitive resources, impairing memory accuracy; however, their effects on memory distortion have been largely unexamined. Further, little is known about the effects of emotion regulation on memory in individuals with posttraumatic stress disorder (PTSD), who exhibit both emotion regulation and memory difficulties. We examined the effects of expressive suppression (i.e., concealing visible signs of emotion), experiential suppression (i.e., suppressing the subjective emotional experience), and control instructions on memory accuracy and distortion in trauma-exposed individuals with PTSD, those without PTSD, and psychologically healthy controls. Expressive and, to a lesser degree, experiential suppression led to poorer memory accuracy and both expressive and experiential suppression led to *less* memory distortion compared to control instructions. Participants with and without PTSD did not significantly differ. Under high cognitive load, irrelevant details may receive more processing, potentially leading to lower accuracy but improved processing of source information, preventing memory distortion.

Keywords

Emotion regulation; memory; memory distortion; suppression; PTSD

Introduction

Emotion regulation strategies appear to have consequences beyond their effects on emotional experiencing (e.g., Gross, 2002). In particular, the methods used to regulate emotions can be detrimental to memory (Richards, 2004; Richards & Gross, 2000) and mental health (e.g., Amstadter, 2008; Campbell-Sills & Barlow, 2007; Moore, Zoellner, & Mollenholt, 2008). To examine the consequences of emotion regulation strategies, Gross and colleagues have particularly focused on *expressive suppression*, or concealing expressions of emotion, because it is a commonly used strategy that occurs late in the emotion generation process (e.g., Gross, 2002). Emotion regulation strategies that occur after negative emotional responses are generated are thought to be ineffective in dampening the subjective emotional experience, increase physiological arousal, and divert cognitive resources. Indeed, expressive suppression has been shown to impair memory for information presented during suppression (Richards, 2004; Richards & Gross, 2000).

Although the diversion of cognitive resources has been implicated as a likely mechanism underlying the detrimental effects of expressive suppression on memory (Richards, 2004), the specific impact of expressive suppression on cognitive resources is uncertain. More specifically, shifted attention away from external stimuli, broadened attention, or a state of ego depletion could account for the memory impairment. First, Richards (2004) suggests an external-internal shift model, such that expressive suppression shifts attentional resources from external stimuli to monitoring of expressive behavior, which leads to poorer encoding of external stimuli. This poor encoding, then, accounts for the memory impairment. More generally, expressive suppression is thought to increase cognitive load, or the amount of demand placed on limited working memory resources (Richards & Gross, 2000). A cognitive load model delineating the consequences of cognitive load provides a second possible explanation of why expressive suppression leads to memory impairment. Increasing cognitive load is thought to impair inhibition of irrelevant information in working memory (Lavie, Hirst, de Fockert, & Viding, 2004). Lavie and colleagues (2004) argue that tasks involving high cognitive load, such as expressive suppression, lead to broadened attention, such that irrelevant information receives more processing and, therefore, processing of details directly related to the task at hand is reduced. A third possible explanation, an ego depletion model, is that self-regulation tasks such as expressive suppression leave fewer resources subsequently available for other tasks, a resource-poor state referred to as “ego depletion” (Richards, 2004). In ego depletion studies, engaging in a self-regulation task such as concealing emotions leads to poorer subsequent performance on other, often unrelated tasks (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998).

Examining errors involving memory distortion may help elucidate specific cognitive processes involved in suppression-induced memory impairment. Memory distortion refers to the tendency to unwittingly incorporate inaccurate information into memory (e.g., Koriat, Goldsmith, & Pansky 2000). Preventing memory distortion relies heavily on recalling source or contextual information (Johnson, Hashtroudi, & Lindsay, 1993), since inaccurate information is gathered from a different source. For example, if a person saw on the news that an earthquake killed four people but then erroneously heard from a friend that 40 people were killed, he or she might mis-remember that the news story said 40 people were killed. This type of memory distortion occurs when correct (i.e., four people) and incorrect (i.e., 40 people) information is not adequately connected in memory to the context in which each was learned (i.e., the news story and the friend, respectively). Susceptibility to memory distortion varies by query of central (i.e., information necessary to understanding the meaning of the stimulus) versus peripheral information (i.e., details unnecessary to understanding the basic plot) and by retention interval, with increased memory distortion to peripheral information and when testing occurs after a delay (Koriat et al., 2000; Paz-Alonso & Goodman, 2008).

If, as suggested by the external-internal shift model, expressive suppression impacts memory due to shifts in attention from external stimuli to self-monitoring, impairing overall encoding, memory accuracy and memory distortion should be similarly affected, with greater errors. The shift in attention away from external stimuli would compromise memory for both the content of the stimulus, impairing memory accuracy, and source information about it, increasing susceptibility to memory distortion. Alternatively, if expressive suppression increases cognitive load, thereby impairing inhibition of “irrelevant” information as suggested by the cognitive load model, it may have divergent effects on memory accuracy and memory distortion. Details that are irrelevant to simply viewing a stimulus may be the very same details that assist in preventing memory distortion, namely, source or contextual information (e.g., co-occurring thoughts, objects in the room; Johnson et al., 1993). Therefore, expressive suppression might impair memory accuracy while actually reducing the susceptibility toward memory distortion. Finally, if ego

depletion accounts for suppression-induced memory impairment, we might expect to see similar impairment on both types of tasks when tested immediately, but we would not expect memory impairment to be apparent after a delay since ego depletion is a temporary state induced by self-regulation tasks (Baumeister et al., 1998).

To date, research examining the cognitive consequences of emotion regulation processes that occur late in the emotion generation process has focused on expressive suppression. However, it is unclear whether other late-acting emotion regulation strategies lead to similar results. One such strategy, experiential suppression, shares features with expressive suppression but may be particularly relevant in clinical disorders involving emotion regulation difficulties (Campbell-Sills & Barlow, 2007). The term *experiential suppression* as used here refers to direct attempts to suppress the subjective emotional experience, that is, trying not to feel what you are feeling. Notably, although expressive suppression is often adaptive (Bonnano, Papa, Lalande, Westphal, & Coifman, 2004; Gross & Levenson, 1997), experiential suppression is thought to often be maladaptive and related to psychopathology (Amstadter, 2008; Campbell-Sills & Barlow, 2007). Expressive and experiential suppression may also have divergent effects on sympathetic nervous system arousal and emotional experiencing (e.g., Campbell-Sills, Barlow, Brown, & Hofmann, 2006b), with experiential suppression resulting in more prolonged or intense distress following the period of suppression. Further, experiential suppression is thought to represent a critical factor contributing to the development and maintenance of emotional disorders (e.g., Moses & Barlow, 2006). Thus, expressive and experiential suppression represent similar response-focused emotion regulation strategies that have divergent processes, where only experiential suppression impacts the actual experience of negative emotion and only expressive suppression involves a clear dissociation between expression and experience, and may have divergent effects particularly for individuals with emotional disorders. Comparing expressive and experiential suppression side-by-side would also allow examination of the generalizability of prior findings regarding expressive suppression to another late-acting strategy.

Individuals with PTSD exhibit both emotion dysregulation (e.g., emotional numbing, heightened reactivity, hypervigilance) and memory difficulties (e.g., intrusive memories, nightmares; APA, 2000). In addition, PTSD symptoms are associated with heightened expressive suppression (Moore et al., 2008; Roemer, Litz, Orsillo, & Wagner, 2001) as well as with experiential and thought suppression (Marx & Sloan, 2005), and with significant memory impairment (Buckley, Blanchard, & Neill, 2000; Johnsen & Asbjornsen, 2008; Moore, 2009); therefore, this is a particularly critical disorder in which to examine the relationship between emotion regulation and memory processes. Notably, *experiential suppression* may be directly related to a cardinal symptom of PTSD, emotional numbing. Emotional numbing symptoms involve a perceived reduction in the capacity to feel emotions, e.g., restricted range of affect (APA, 2000; Litz & Gray, 2002; Roemer et al., 2001). These symptoms differentiate trauma survivors with and without PTSD (e.g., Breslau & Davis, 1992) and have been linked to the development of PTSD (e.g., Feeny, Zoellner, Fitzgibbons & Foa, 2000; Foa, Riggs, & Gershuny, 1995; Riggs, Rothbaum & Foa, 1995). Strategic experiential suppression is thought to at least partially account for emotional numbing in PTSD (Roemer et al., 2001). Thus, given the clear symptoms of emotion dysregulation in PTSD, notably emotional numbing, and their relationship with experiential suppression, the exploration of both expressive suppression and experiential suppression processes is critical.

Expressive and, particularly, experiential suppression may especially impact memory processes for individuals with PTSD. The cognitive resources of individuals with PTSD are likely already taxed by symptoms such as intrusive memories and hypervigilance (e.g.,

Twamley et al., 2009; Vythilingam et al., 2007). Indeed, individuals with PTSD demonstrate attentional biases towards trauma-relevant stimuli that involve a diminished ability to refocus attention away from these stimuli (e.g., Buckley et al., 2000; Vythilingam et al., 2007). In addition, individuals with PTSD often show impaired executive functioning compared to those without the disorder (e.g., Aupperle, Melrose, Stein, & Paulus, in press; Buckley et al., 2000; Leskin & White, 2007). Interestingly, decrements in source memory processes are also evident in PTSD, with increased susceptibility to memory distortion relative to healthy controls (e.g., Tapia, Clarys, El Hage, Belzung, & Isingrini, 2007; Zoellner, Foa, Brigidi, & Przeworski, 2000). The use of expressive and experiential suppression may further impinge on the strained cognitive resources of individuals with PTSD. Given its relevance to PTSD, experiential suppression in particular may have a greater impact on memory performance for individuals with PTSD relative to those without the disorder.

In the present study, we utilized a distressing film paradigm (e.g., Holmes & Bourne, 2008) to examine memory accuracy and memory distortion following expressive suppression, experiential suppression, or no emotion regulation instructions. Using a memory distortion task (Lindsey & Johnson, 1989), a misinformation narrative including both correct and incorrect information about the film was presented and film memory tested immediately and after 48 hours. The goals were twofold: First, we sought to examine memory accuracy and memory distortion following expressive and experiential suppression instructions. If expressive and experiential suppression impact memory due to shifts in attention that impair encoding as suggested by the external-internal shift model, suppression should lead to poorer performance on both tasks, that is, *lower* memory accuracy and *higher* memory distortion compared to control instructions. Alternatively, if suppression instructions increase cognitive load, thereby impairing inhibition of “irrelevant” information as would be suggested by a cognitive load model, memory accuracy should be *poorer* while memory distortion may be *improved*. In other words, we hypothesized that experiential and expressive suppression would decrease memory accuracy; in contrast, suppression may have a detrimental or facilitative impact on memory distortion as described above. Second, we sought to examine whether memory performance following suppression differs in individuals with PTSD compared to controls and trauma-exposed individuals without PTSD. The inclusion of a trauma-exposed group without PTSD allowed us to directly examine the relative importance of trauma exposure alone versus posttraumatic stress symptoms in the impact of emotion regulation on memory processes. We hypothesized that experiential suppression would particularly impact individuals with PTSD, resulting in poorer memory accuracy and exaggeration of memory distortion effects relative to the other groups.

Method

Participants

Participants were recruited from community advertisements and subject pool from a large urban university. General inclusion criteria included being literate in English and between 18 and 65 years old. Exclusion criteria included current substance abuse or dependence, imminent suicidality, and evidence of psychosis or bipolar disorder. Further inclusion/exclusion criteria were group specific.

The PTSD group consisted of 35 women with a primary diagnosis of chronic, assault-related PTSD (sexual assault: $n = 28$, physical assault: $n = 7$) as assessed by the PTSD Symptom Scale-Interview (PSS-I; Foa, Riggs, Dancu, & Rothbaum, 1993) and the Structured Clinical Interview for the DSM-IV (SCID-IV; First, Spitzer, Gibbon, & Williams, 1994). Co-occurring diagnoses were permitted if PTSD was primary.

The no PTSD group consisted of 27 women reporting prior assault-related trauma (sexual assault: $n = 21$, physical assault: $n = 6$) who did not meet criteria for current, chronic PTSD on the PSS-I (Foa et al., 1993). To assure that individuals in this group did not exhibit elevated psychopathology, they were excluded if they met criteria for any current psychological disorder according to SCID-IV (First et al., 1994), scored higher than 10 on the Beck Depression Inventory (BDI; Beck, Rush, Shaw, & Emery, 1979), or scored higher than 40 on the State-Trait Anxiety Inventory-Trait subscale (STAI-Trait; Spielberger, 1988).

The control group consisted of 35 women who had never experienced a criterion A traumatic event (APA, 2000) according to the Posttraumatic Stress Diagnostic Scale (PDS; Foa, Cashman, Jaycox, & Perry, 1997) and SCID-IV, did not meet criteria for any current psychological disorder according to the SCID-IV, scored 10 or less on the BDI, and scored 40 or less on the STAI-Trait subscale.

See Table 1 for sample characteristics. Unexpectedly, groups significantly differed by age; however, age was minimally correlated with the dependent variables ($r_s = -.03$ to $.09$). Since the difference in age across groups probably did not occur by chance as is required for ANCOVA (Miller & Chapman, 2001), age was not a suitable covariate to include in the analyses of group effects. Trauma exposure was an exclusion criterion for the control group, and logically, older individuals have had more opportunity to experience trauma.

Memory Distortion Task

Modeled after Lindsay and Johnson (1989), the task contained three phases: film presentation, misinformation narrative, and multiple-choice test (immediate, 48 hrs later). A film clip was selected for its relevance to women with a history of assault, ability to elicit a distressing emotional state, and unfamiliarity. To create memory items, pilot participants viewed the film and were instructed to write down all of the events they remembered from the film. Candidate memory items were then piloted to remove ceiling or floor effects. Using Koriatic et al. (2000) definition of central and peripheral details, 18 items were selected, with 9 assessing central information, or events required to understand the plot (e.g., the girl escapes), and 9 assessing peripheral information, or details that were not central to the understanding the plot (e.g., she carried a jacket). Paralleling the memory items, plausible, inaccurate items, referred to here as “incorrect responses,” were developed for use as misinformation. A general narrative was then created to be used a template for the misinformation manipulation.

Film presentation—A 5 min distressing film was selected that depicted a young women being coerced to take off her clothes under threat of possible assault (additional information available by request).

Misinformation narrative—Six versions of the narrative were developed to counterbalance for specific item effects. Each version contained 6 *misleading items* (3 central, 3 peripheral), where the incorrect information directly contradicting the original film information was included; 6 *non-misleading items* (3 central, 3 peripheral), where neither original event information nor incorrect, contradictory information was included in the narrative; and 6 *accurate items* (3 central, 3 peripheral), where event items were re-presented. Narrative versions were between 341 and 372 words in length and appear in Appendix A.

Multiple choice test (immediate, 48 hours)—The same 18-item, forced-choice test was utilized for all participants, with response coding based on counterbalancing, e.g., 6 questions queried misleading items (3 central, 3 peripheral), 6 questions queried non-

misleading items (not presented in the narrative; 3 central, 3 peripheral), and 6 questions queried accurate information presented in both the film and narrative (3 central, 3 peripheral). The instructions asked participants to disregard the narrative and answer questions based on the film only. The same test was re-administered by phone approximately 48 hours later. Central and peripheral items were combined in the analyses to increase response variability and because responses were similar across both types of items.

Correct and incorrect responses were used to quantify memory accuracy and memory distortion as follows: More correct responses to non-misleading items (referred to hereafter as “correct/non-misled”) indicated higher memory accuracy, while more correct responses to misleading items (“correct/misled”) indicated less memory distortion. Similarly, more incorrect responses to non-misleading items (“incorrect/non-misled”) indicated poorer memory accuracy, while more incorrect responses to misleading items (“incorrect/misled”) indicated higher memory distortion. Please note that the incorrect responses referred to here consist of the information that, for misleading items, was presented incorrectly in the narrative; however, for non-misleading items, these responses were not included in the narrative at all and quantify the likelihood of selecting a particular incorrect response in the absence of misinformation.

We first computed proportion correct and proportion incorrect responses for non-misled and misled items. Next, d' estimates for correct and incorrect responses were computed using the algorithm from Smith (1982) for 4-alternative forced-choice tests based on the Luce choice model. Since d' cannot be computed with proportions equaling 0 or 1, values of 0 and 1 were replaced by $1/(2N)$ and $1 - 1/(2N)$, respectively, where N is equal to the maximum possible number of false alarms (Macmillan & Creelman, 1991).

Suppression Instructions

Instructions to suppress expression or subjective emotion were based on Richards and Gross (2000, pp. 412-413). All sets of instructions began, “In just a moment, I am going to play a film clip that I would like you to watch and listen to carefully. Please try to pay full attention to the film.” In the control condition, no additional instructions were given. In the expressive suppression condition, additional instructions included:

In addition, it is extremely important that if you begin to have any emotional responses to the film clip, please try your best not to let those feelings show. In other words, as you watch the film clip, please try to behave in such a way that a person watching you would not know you are feeling anything at all.

In the emotion expression condition, additional instructions included:

In addition, it is extremely important that if you begin to have any emotional responses to the film clip, to please try your best to stop those feelings and instead feel neutral. In other words, as you watch the film clip, please try not to feel emotional at all.

State Emotion Measures and Manipulation Check

To assess the effectiveness of the expressive suppression instruction, a seven-point Likert scale (0 = *not at all*, 6 = *a great deal*) was used to gauge the extent to which participants expressed negative emotion while watching the film (Richards & Gross, 2000). A second Likert scale assessed the extent to which participants felt negative emotion while watching the film.

To gauge changes in state emotion during the study, we administered the STAI-State subscale (Spielberger, 1988) and the Positive and Negative Affect Schedule (PANAS;

Watson, Clark, & Tellegen, 1988) to assess state anxiety and negative affect, respectively. To simplify reporting, these measures were combined (STAI-S and the negative affect scale of the PANAS) into a composite “emotional distress” score by summing the *z*-scores; the pattern of results was identical when these variables were analyzed separately.

Procedure

Following informed consent, participants completed self-report questionnaires (PDS, BDI, STAI-T, baseline STAI-S, baseline PANAS) and relevant diagnostic interviews (SCID-IV, PSS-I). Trained, Master’s level clinicians conducted interviews in PTSD and no PTSD groups. Because interviews in the control group solely assessed lack of diagnostic status, they were conducted by research assistants who underwent extensive training, including practice interviews. Eligible participants were randomly assigned to an emotion regulation instruction condition for viewing the film: expressive suppression, experiential suppression, or control. Following the film segment, participants again completed the state emotion measures (STAI-S, PANAS) and were given the misinformation narrative. Narratives were presented audibly in a recorded female voice and in written form. Participants were then given the immediate memory test. Participants were compensated financially (\$15 per hour) or with course credit. Approximately 48 hrs later, the memory test was readministered via telephone.

Results

Effects of Emotion Regulation Instruction on State Emotion

To examine whether the instruction set had the desired effect on expression of emotion, we conducted a Group (PTSD, No PTSD, Control) by Instruction (Expressive Suppression, Experiential Suppression, Control) ANOVA with the Likert rating of expression of negation emotion during the film as the dependent variable. For self-reported expression of emotion during the film, there was a main effect for group, $F(2, 88) = 3.47, p = .04, f = .26$, a main effect of instruction, $F(2, 88) = 5.63, MSE = 2.50, p = .005, f = .34$, and no group $\times$ instruction interaction. As expected, individuals in the expressive suppression condition reported less emotional expression ($M = 1.50, SD = 1.45$) compared to those in the control ($M = 2.87, SD = 1.81$), $t(56) = 3.15, p = .003, d = .84$, and experiential suppression conditions ($M = 2.44, SD = 1.55$), $t(65) = 2.50, p = .015, d = .63$. Also as expected, individuals with PTSD ($M = 2.83, SD = 1.81$) reported less emotional expression compared to psychologically healthy controls ($M = 1.83, SD = 1.52$), $t(68) = 2.50, p = .02, d = .60$, and trauma-exposed individuals without PTSD falling in between ($M = 2.22, SD = 1.58$) and not different from either of the other groups.

To examine the impact of instruction conditions on negative emotion reported during the film, we conducted a Group (PTSD, No PTSD, Control) by Instruction (Expressive Suppression, Experiential Suppression, Control) ANOVA with the Likert rating of experience of negative emotion during the film as the dependent variable. There was a main effect of group, $F(2, 88) = 8.29, MSE = 2.18, p < .001, f = .42$, a trend-level main effect of instruction, $F(2, 88) = 2.57, p = .08, f = .21$, and no group $\times$ instruction interaction. Individuals with PTSD reported feeling more negative emotion during the film ($M = 5.11, SD = 1.23$) compared to the Control ($M = 3.86, SD = 1.44$), $t(68) = 3.93, p < .001, d = .93$, and No PTSD groups ($M = 3.93, SD = 1.80$), $t(60) = 3.09, p = .003, d = .77$, which did not significantly differ from each other. None of the pairwise comparisons between instruction conditions approached significance; however, means were in the expected direction, with lower negative emotion during the film reported by individuals in the experiential suppression condition ($M = 4.00, SD = 1.82$) compared to expressive suppression ($M = 4.61, SD = 1.45, d = -.37$) and control instructions ($M = 4.50, SD = 1.31, d = -.32$).

For the main composite measure of state distress (STAI-S, PANAS-negative affect), a Group (PTSD, No PTSD, Control) by Instruction (Expressive Suppression, Experiential Suppression, Control) by Time (Pre-film, Post-film) repeated measures ANOVA was conducted, with repeated measures on time. A consistent pattern was found for composite emotional distress. See Table 2. There was a significant main effect of time on emotional distress, $F(1, 86) = 44.58$, $MSE = .77$, $p < .001$, $f = .65$, modified by an instruction $\times$ time interaction, $F(2, 86) = 4.95$, $p = .003$, $f = .31$. To break down the interaction, instruction sets were examined separately. Individuals in the expressive suppression, $t(26) = -5.99$, $p < .001$, $d = -1.31$, and control conditions, $t(29) = -5.14$, $p < .001$, $d = -.99$, reported increased emotional distress from baseline to post-film. As would be expected, in the experiential suppression condition, emotional distress did not reliably change from pre- to post-film, $t(37) = -1.12$, *ns*. There was also a significant main effect of group, $F(2, 86) = 45.61$, $MSE = 2.77$, $p < .001$, $f = .99$, with significantly higher emotional distress reported by individuals in the PTSD group compared to the control, $t(68) = 8.77$, $p < .001$, $d = 2.09$, and no PTSD groups, $t(60) = 7.29$, $p < .001$, $d = 1.92$, which did not significantly differ from each other. However, groups did not differ by instruction manipulation, nor was there a significant group by time interaction.

Overall, as expected, expressive suppression decreased expression of emotion while the other conditions did not. Also, as expected, emotional distress increased from pre to post-film for individuals receiving expressive suppression and the control instructions but did not increase for individuals receiving the experiential suppression instructions. Finally, individuals with PTSD reported more efforts to conceal emotion and more distress across instruction set than psychologically healthy controls.

Effects of Emotion Regulation Instructions on Memory Performance Across PTSD, no PTSD, and Controls

To examine the effects of suppression and PTSD on memory accuracy and memory distortion, we conducted Group (PTSD, No PTSD, Control) by Instruction (Expressive Suppression, Experiential Suppression, Control) by Item Type (Non-Misled, Misled) repeated measures ANOVAs. For clarity, immediate and delayed tests were examined in separate analyses. Item type was included as a within-subjects factor to ensure that the narrative effectively impacted performance, i.e., that performance was poorer for misled items compared to non-misled items. Therefore, we hypothesized that there would be a main effect of item type across the analyses. The dependent variables were d' for correct responses and incorrect responses at the immediate and delayed tests, respectively.

Effects on correct responses—We hypothesized that experiential and expressive suppression would lead to decreased memory accuracy as evidenced by lower d' of correct/non-misled responses compared to the control condition at immediate and delayed tests. Further, if expressive and experiential suppression led to increased memory distortion, we hypothesized that suppression instructions would result in lower d' of correct/misled responses relative to the control condition at immediate and delayed tests. Alternatively, if expressive and experiential suppression led to *decreased* memory distortion, suppression instructions would result in higher d' of correct/misled responses relative to the control condition at immediate and delayed tests. Finally, we hypothesized that experiential suppression would particularly impact individuals with PTSD, resulting in lower d' of correct/non-misled responses and exaggeration of memory distortion effects relative to the other instructions and groups.

For means and standard deviations, see Table 3 and Figure 1.

Correct responses at the immediate film memory test—With d' of correct responses at the immediate test as the dependent variable, there was no main effect of group or instruction. However, there was a main effect of item type, $F(1, 88) = 4.22, p = .04, f = .21$, modified by an instruction $\times$ item type interaction, $F(2, 88) = 3.42, p = .04, f = .27$. As expected, d' for correct responses was higher to non-misled compared to misled items. No other interactions approached significance. To examine the instruction $\times$ item type interaction, non-misled and misled items were examined separately.

For non-misled items, consistent with our hypothesis, expressive suppression ($M = 1.94, SE = .13$) led to fewer correct/non-misled responses compared to control instructions ($M = 2.22, SE = .11$) at a trend level, $t(56) = 1.66, p = .10, d = .43$. No other differences emerged. Thus, individuals in the expressive suppression condition were less accurate than those receiving control instructions, at a trend level.

For misled items, consistent with lessened memory distortion following suppression instructions, there was a trend towards more correct/misled responses in the expressive suppression ($M = 2.02, SE = .11$), $t(56) = -1.90, p = .06, d = .50$, and experiential suppression conditions ($M = 2.01, SE = .11$), $t(67) = -1.94, p = .06, d = .46$, compared to control instructions ($M = 1.65, SE = .16$). Expressive and experiential suppression conditions did not significantly differ from each other, $t(65) = .04, ns$. Thus, individuals in both the expressive and experiential suppression conditions were actually *less* prone to memory distortion than those receiving control instructions, at a trend level.

Correct responses at the delayed film memory test—With d' of correct responses at the delayed test as the independent variable, there was no main effect of group or instruction. Similar to the immediate memory test, there was a significant main effect of item type, $F(1, 88) = 15.24, p < .001, f = .39$, modified by an instruction $\times$ item type interaction, $F(1, 88) = 5.18, p = .007, f = .31$. As expected, d' for correct responses was higher to non-misled compared to misled items. No other interactions approached significance. To examine the instruction $\times$ item type interaction, non-misled and misled items were examined separately.

For non-misled items, consistent with our hypothesis, expressive suppression led to fewer correct/non-misled responses, ($M = 2.08, SE = .13$) compared to control instructions at a trend level ($M = 2.35, SE = .10$), $t(56) = 1.67, p = .10, d = .43$. No other differences emerged. Thus, similar to the immediate memory test, individuals in the expressive suppression condition were less accurate than those receiving control instructions, at a trend level.

For misled items, consistent with lessened memory distortion following suppression instructions, individuals given experiential suppression instructions ($M = 2.03, SE = .09$), $t(67) = -2.70, p = .009, d = .64$, and, at a trend level, expressive suppression instructions ($M = 1.93, SE = .14$), $t(56) = -1.71, p = .09, d = -.44$, provided more correct/misled responses compared to those given control instructions ($M = 1.60, SE = .14$). Expressive and experiential suppression conditions did not significantly differ from each other, $t(65) = -.63, ns$. Thus, individuals in the experiential suppression condition, and at a trend level in the expressive suppression condition, were actually *less* prone to memory distortion than those receiving control instructions.

In summary, across immediate and delayed tests, memory accuracy was lower following expressive suppression compare to control instructions, while accuracy following experiential suppression did not significantly differ from control instructions. In addition, results were consistent with lower memory distortion following expressive and experiential

suppression compared to control instructions. PTSD status did not significantly impact performance.

Effects on incorrect responses—We hypothesized that experiential and expressive suppression would lead to decreased memory accuracy as evidenced by higher d' of incorrect/non-misled responses compared to the control condition at immediate and delayed tests. Further, if expressive and experiential suppression led to increased memory distortion, we hypothesized that suppression instructions would result in higher d' of incorrect/misled responses relative to the control condition at immediate and delayed tests. Alternatively, if expressive and experiential suppression led to decreased memory distortion, suppression instructions would result in lower d' of incorrect/misled responses relative to the control condition at immediate and delayed tests. Finally, we hypothesized that experiential suppression would particularly impact individuals with PTSD, resulting in lower d' of correct/non-misled responses and exaggeration of memory distortion effects relative to the other instructions and groups.

For means and standard deviations, see Table 3 and Figure 2.

Incorrect responses at the immediate film memory test—With d' of incorrect responses at the immediate test as the independent variable, there was no main effect of group or instruction. However, there was a significant main effect of item type, $F(1, 88) = 12.76, p < .001, f = .37$, modified by a trend-level instruction $\times$ item type interaction, $F(2, 88) = 2.51, p = .09, f = .22$. As expected, d' for incorrect responses was lower to non-misled compared to misled items. No other interactions approached significance. To examine the instruction $\times$ item type interaction, non-misled and misled items were examined separately.

For non-misled items, d' did not substantially differ between control and expressive, $t(56) = -1.06, ns$, or experiential suppression conditions, $t(67) = -.28, ns$, nor between the two suppression conditions, $t(65) = .92, ns$. Thus, there were no differences in memory accuracy across instruction conditions for incorrect/non-misled responses at the immediate test.

For misled items, consistent with lessened memory distortion following suppression, d' for incorrect/misled responses at immediate test was significantly lower in the expressive suppression condition ($M = -.59, SE = .08$) compared to control instructions ($M = -.30, SE = .11$), $t(56) = 2.01, p = .05, d = .53$. However, experiential suppression and control conditions did not substantially differ, $t(67) = 1.41, ns$, nor did expressive and experiential suppression conditions, $t(65) = -.53, ns$. Thus, individuals in the expressive suppression condition were actually *less* prone to memory distortion than those receiving control instructions.

Incorrect responses at the delayed film memory test—With d' of incorrect responses at the delayed test as the independent variable, there was no main effect of group or instruction. However, there was a significant main effect of item type, $F(1, 88) = 14.81, p < .001, f = .39$, modified by an instruction $\times$ item type interaction, $F(1, 88) = 5.08, p = .008, f = .31$. As expected, d' for incorrect responses was lower to non-misled compared to misled items. No other interactions approached significance. To examine the instruction $\times$ item type interaction, non-misled and misled items were examined separately.

For non-misled items, d' for correct/non-misled responses at delayed test was higher in the expressive ($M = -.65, SE = .10$), $t(56) = -2.09, p = .04, d = -.54$, and experiential suppression conditions ($M = -.67, SE = .07$), $t(67) = -2.26, p = .03, d = .56$, relative to control instructions ($M = -.88, SE = .05$). The two suppression conditions did not substantially differ, $t(65) = .16, ns$. Thus, individuals in the expressive and experiential

suppression conditions showed worse memory accuracy than those receiving control instructions.

For misled items, consistent with *lessened* memory distortion following suppression, d' for incorrect/misled responses at delayed test was significantly lower in the experiential suppression condition ($M = -.58$, $SE = .08$), $t(67) = 2.40$, $p = .02$, $d = .56$ and trended lower in the expressive suppression condition ($M = -.53$, $SE = .70$), $t(56) = 1.79$, $p = .08$, $d = .46$, compared to control instructions ($M = -.25$, $SE = .68$). Experiential and expressive suppression conditions did not substantially differ, $t(65) = .38$, *ns*. Thus, individuals in the experiential suppression condition, and at a trend level in the expressive suppression condition, were actually *less* prone to memory distortion than those receiving control instructions.

In summary, consistent with poorer memory accuracy following suppression, incorrect/non-misled responses at the delayed test were higher following both suppression conditions compared to control instructions. In addition, compared to control instructions, results were consistent with lower memory distortion following expressive suppression at the immediate test and lower memory distortion following both suppression conditions at the delayed test. PTSD status did not significantly impact performance.

Number Needed to See an Effect for PTSD on Memory Accuracy and Distortion

To further examine the null result for Group, we conducted additional posthoc power analyses to determine the number of participants per cell that would be needed to detect the hypothesized interaction at the observed effect size (Cohen, 1988).

For correct responses, effect sizes of the Group by Instruction by Item Type interaction were small (immediate: $f = .14$, delayed: $f = .11$). Adjusting for the average effect size, with nine cells in the between-subjects design, we would need 174 participants per cell or 1566 participants total to detect an effect with .80 power (Cohen, 1988).

For incorrect responses, effect sizes of the Group by Instruction by Item Type interaction were also small (immediate: .09, delayed: .11). Adjusting for the average effect size, with nine cells in the between-subjects design, we would need 240 participants per cell or 2160 participants total to detect an effect with .80 power (Cohen, 1988). The pattern of results suggests that the null finding for PTSD group can likely be considered robust.

Discussion

Concealing expression of emotions and, to a lesser extent, experiential suppression resulted in poorer memory accuracy at both immediate and delayed tests compared to control instructions. This impairment in memory accuracy following expressive suppression is consistent with prior research (e.g., Richards, 2004; Richards & Gross, 2000). Notably, the results for memory distortion were in the opposite direction. Rather than increasing memory distortion, both expressive and experiential suppression led to less memory distortion. That is, compared to control instructions, regulating one's emotions actually helped prevent the production of memory errors both immediately and after a delay, possibly due to attentional alterations produced by suppression. Therefore, in addition to its cognitive costs, there may be cognitive benefits of emotion regulation through expressive and also experiential suppression. Understanding the complexity of cognitive consequences following specific emotion regulation strategies may help elucidate underlying relationships between emotional processes and memory errors. Notably, there were no strong effects of either PTSD or trauma exposure on these relationships, suggesting that although individuals with PTSD

may use these strategies more frequently, they confer quantitatively similar benefits and costs for individuals with and without the disorder.

The observed dissociation wherein suppression impaired memory accuracy and also reduced memory distortion may be accounted for by high cognitive load resulting in the broadening of attention (e.g., Lavie et al., 2004). Regulating one's emotions through suppression is an effortful task that likely increases cognitive load (Richards, 2004), and conditions of high cognitive load may result in details irrelevant to the current task, such as source information, receiving more processing while relevant details receive less (Lavie et al., 2004). Increased processing of source information would lessen memory distortion effects, as source information is critical to protecting memories from distortion (Johnson et al., 1993). In contrast, this broadened attentional focus would lead to poorer overall memory accuracy. Information encountered during suppression is likely more weakly encoded, and, if not subsequently elaborated, would quickly degrade. However, for the memory distortion items, the presentation of contradictory information in the narrative may signal individuals to further elaborate and compartmentalize relevant recollections from the film. This may facilitate binding of contextual details to information from the film, helping to distinguish the two sources and improving source memory (Johnson et al., 1993). Therefore, suppression may lead to key shifts in attentional focus that account for the cognitive costs and benefits of this regulation strategy.

The current results are not as easily accounted for by overall poorer encoding or ego depletion explanations of memory impairment following suppression (Baumeister et al., 1998; Richards, 2004). If suppression led to impoverished encoding overall, both memory accuracy and memory distortion should have been negatively impacted. In addition, since ego depletion is a temporary state, performance on immediate, but not delayed, tasks should be affected. Ego depletion is thought to primarily affect persistence on tasks following an act of self-regulation. Memory measures such as those employed in the current study and in prior studies of expressive suppression and memory (e.g., Richards, 2004; Richards & Gross, 2000) likely do not constitute self-regulatory or persistence-based tasks of the type impacted by ego depletion (Baumeister et al., 1998). In other words, although suppression involves significant self-regulation, the state of "ego depletion" that follows suppression may not impact memory performance *per se*.

An alternative explanation of the pattern of results is that the distinctiveness of the memory of the film clip was heightened by suppression occurring during film presentation but not during narrative presentation. Factors that increase one's ability to differentiate between sources (i.e., the film and the narrative) reduce memory distortion effects (Johnson et al., 1993), and suppression during encoding of only one of the sources (i.e., the film) may have increased the ease of differentiation between sources. Increased differentiation between sources would then lead to less memory distortion while not assisting with overall memory accuracy. However, this account does not explain why suppression results in poorer memory accuracy.

Contrary to our hypothesis, emotion regulation instructions impacted memory accuracy and distortion similarly across trauma-exposed individuals with and without PTSD and controls. Although individuals with PTSD likely engage in these emotion regulation strategies more frequently compared to the other groups (Marx & Sloan, 2005; Moore et al., 2008; Roemer et al., 2001) and reported more intense distress and anxiety overall, the effects on memory did not substantially differ between groups. Likewise, emotion regulation instructions similarly impacted individuals with and without PTSD across domains of self-reported emotional experience, self-reported expressive behavior, memory accuracy, and memory distortion. However, regardless of instructions, individuals with PTSD did report more

inhibition of emotional expression and higher intensity of negative emotional experiencing during the distressing film than psychologically healthy controls. The similarity between effects of intentional emotion regulation in individuals with and without PTSD is consistent with prior studies comparing clinical and non-clinical groups (e.g., Campbell-Sills, Barlow, Brown, & Hoffman, 2006a; Feldner et al., 2003; Gratz, Rosenthal, Tull, & Lejuez, 2006; Tull & Roemer, 2007). Although particular emotion regulation strategies may have a similar immediate impact across clinical and non-clinical groups, the accumulated effect of habitually or rigidly engaging in emotion regulation strategies such as expressive and experiential suppression may be associated with psychopathology. In other words, it may not be *which* strategies are used but instead *flexibility* in responding that is key to the relationship between emotion regulation and psychopathology (e.g., Bonanno, Papa, Lalande, Westphal, & Coifman, 2004; Cisler, Olatunji, Feldner, & Forsyth, 2010; Kashdan, Barrios, Forsyth, & Steger, 2006). Alternatively, the use of a threat-relevant stimulus may have impaired our ability to detect memory impairment in PTSD. In individuals with PTSD, threat-relevant information tends to receive more attentional processing compared to individuals without PTSD (e.g., Vythilingam et al., 2007), potentially obscuring the effects of the emotion regulation instructions. Examining experiential and expressive suppression during positive stimuli or negative, non-threat relevant stimuli may elicit different results. Indeed, prior studies utilizing neutral stimuli have found evidence of impaired source memory in PTSD (e.g., Tapia et al., 2007; Zoellner et al., 2000).

The pattern of observed dissociation between memory accuracy and distortion was most apparent in the expressive suppression condition and less so in the experiential suppression condition. Although only expressive suppression led to fewer correct/non-misled responses, individuals in both the expressive and experiential suppression conditions chose more incorrect/non-misled responses at the delayed test. This finding is consistent with poorer memory accuracy following suppression. The lack of a stronger effect of experiential suppression may be attributable to the instructions. When asked to suppress emotions, some individuals in this condition may have engaged in adaptive strategies such as cognitive reappraisal as a means of feeling less emotional, potentially diluting the effect. To date, there is little research on the impact of experiential suppression on cognitive performance; future studies should seek ways of ensuring that participants are indeed engaging in experiential suppression rather than using other methods of emotion regulation.

Several limitations should be noted. First, this study represents an initial investigation with a relatively small sample and should be interpreted tentatively in the absence of replication, particularly given possible ceiling and floor effects on the memory tests. Second, this study focused on the impact of emotion regulation on episodic memory for negative, threat-relevant stimuli and did not systematically manipulate valence of the stimuli. As noted above, this may have actually interfered with our ability to detect differences between groups. We also did not include supplemental physiological measures to evaluate the effects of suppression on arousal, potentially helping to further differentiate between expression and experiential suppression. That said, it has already been established that emotion regulation instructions such as these lead to objectively quantifiable alterations in behavioral, autonomic, and brain response domains (e.g., Gross, 2002), arguing against the importance of these supplemental indices. In addition, we did not include an early-acting emotion regulation strategy such as cognitive reappraisal and therefore cannot determine whether the effects on memory are unique to late-acting or suppression-based emotion regulation strategies (Gross, 2002). Finally, demand and more general cognitive load effects cannot be ruled out, and including a bogus instruction manipulation that would not influence emotional expression or experience but would heighten cognitive load instead of a no instruction control would help examine this hypothesis. We chose an attention-only control based on prior literature examining the effects of emotion regulation strategies on memory (e.g.,

Gross, 2002; Richards & Gross, 2000). Since we utilized a within-subjects design on item type, we also did not include any condition in which participants regulated emotion but did not receive any misinformation.

In summary, the use of emotion regulation strategies involving suppression is accompanied by both affective and cognitive consequences, and whether these consequences are detrimental or beneficial depends on the task at hand. Both expression suppression and experiential suppression actually reduced episodic memory distortion errors. Although late-acting emotion regulation strategies such as expressive suppression and experiential suppression appear to have many potentially destructive effects (Amstadter, 2008; Campbell-Sills et al., 2006b; Gross, 2002), they also have benefits by reducing memory distortion. Understanding the cognitive benefits of emotion regulation strategies may help illuminate additional underlying mechanisms of errors in emotional memory, potentially including changes in attentional processes during emotion regulation.

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Appendix A: Misinformation Narratives

Note. Underlines and italics were added to show information types. Accurate information from the film is underlined; misinformation is italicized.

NARRATIVE VERSION 1

Three boys and an older man are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As a part of the plan, the blond boy says that he got the bullets that the man wanted him to get. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. All of the boys and the man look concerned and distressed when they hear the knock. The older man takes his *knife* and hides it. Kyle goes to the door and *Melissa* comes in. She is carrying a *flashlight*. The blond boy tells the girl that the older man is his uncle from Michigan. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around, and the *older man* passes the bottle to the girl. Over the next few minutes, the girl takes one or two sips from the bottle. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up and jokes with them, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. At first, she thinks he is kidding, but after a little while she realizes that he means it. The man keeps demanding that she take her shirt off. She says that she is going to leave and starts walking towards the door, but the man *kisses her*. She looks afraid. She starts to unbutton her shirt. The girl finally gets out of the situation by *hitting the man with a bottle and running away*.

NARRATIVE VERSION 2

Three boys and an older man are sitting in a hideout in the woods. They are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. The older man takes his *knife* and hides it. The man tells Kyle to let her in. Kyle goes to the door and *Melissa* comes in. She is carrying a *flashlight*. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around, and the *older man* passes the bottle to the girl. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. She is wearing a striped button-down shirt. At first, she thinks he is kidding, but after a little while she realizes that he means it. The man tells one of the boys to turn down the music. She says that she is going to leave and starts walking towards the door, but the man *kisses her*. She looks afraid. Eventually, the situation becomes more intense, and the man becomes angry and more demanding. She starts to unbutton her shirt. Towards the end of the film, the girl escapes before anyone can coerce her to take off her clothes. The girl finally gets out of the situation by *hitting the man with a bottle and running away*.

NARRATIVE VERSION 3

Three boys and an older man are sitting in a hideout in the woods. They are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As a part of the plan, the blond boy says that he got the *money* that the man wanted him to get. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. All of the boys and the man look *excited and pleased* when they hear the knock. The man tells Kyle to let her in. Kyle goes to the door. The blond boy tells the girl that the older man is his uncle from *Montana*. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around. Over the next few minutes, the girl takes *about 10 sips* from the bottle. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up and *asks for another drink from the bottle*, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. She is wearing a striped button-down shirt. At first, she thinks he is kidding, but after a little while she realizes that he means it. The *man and the boys* keep demanding that she take her shirt off. The man tells one of the boys to turn down the music. She says that she is going to leave. She looks afraid. Eventually, the situation becomes more intense, and the man becomes angry and more demanding. She starts to unbutton her shirt. Towards the end of the film, the girl escapes before anyone can coerce her to take off her clothes.

NARRATIVE VERSION 4

Three boys and an older man are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As a part of the plan, the blond boy says that he got the *money* that the man wanted him to get. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. All of the boys and the man

look *excited and pleased* when they hear the knock. The older man takes his gun and hides it. Kyle goes to the door and Megan comes in. She is carrying a jacket. The blond boy tells the girl that the older man is his uncle from *Montana*. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around, and Kyle passes the bottle to the girl. Over the next few minutes, the girl takes *about 10 sips* from the bottle. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up and *asks for another drink from the bottle*, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. At first, she thinks he is kidding, but after a little while she realizes that he means it. The *man and the boys* keep demanding that she take her shirt off. She says that she is going to leave and starts walking towards the door, but the man stands in her way. She looks afraid. She starts to unbutton her shirt. The girl finally gets out of the situation by running away when the man isn't looking.

NARRATIVE VERSION 5

Three boys and an older man are sitting in the *basement of a house*. They are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. The older man takes his gun and hides it. The man tells Kyle to *make her go away*. Kyle goes to the door and Megan comes in. She is carrying a jacket. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around, and Kyle passes the bottle to the girl. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. She is wearing a *solid blue button-down shirt*. At first, she thinks he is kidding, but after a little while she realizes that he means it. The man tells one of the boys to *get his weapon*. She says that she is going to leave and starts walking towards the door, but the man stands in her way. She looks afraid. Eventually, the situation becomes more intense, and the man becomes angry and *slaps her and threatens her with a weapon*. She starts to unbutton her shirt. Towards the end of the film, the girl *is forced to take off some of her clothes*. The girl finally gets out of the situation by running away when the man isn't looking.

NARRATIVE VERSION 6

Three boys and an older man are sitting in the *basement of a house*. They are talking about the dark-haired boy's date with a girl, and then they begin discussing a plan. As a part of the plan, the blond boy says that he got the bullets that the man wanted him to get. As they are talking, there they hear a knock at the door and a girl's voice calling for Kyle, the dark-haired boy. All of the boys and the man look concerned and distressed when they hear the knock. The man tells Kyle to *make her go away*. Kyle goes to the door. The blond boy tells the girl that the older man is his uncle from Michigan. She walks across the room with Kyle and they both sit down. A bottle of alcohol is being passed around. Over the next few minutes, the girl takes *one or two sips* from the bottle. The older man asks the boys, "Since when do we let women in here?" The girl makes a joke, pointing at pictures of women on the wall and saying, "Those girls on the wall, they seem welcome enough." The blond boy

and the older man say that those women are allowed here because they aren't wearing shirts, and that the rule is, "no women, unless those women are wearing no tops." The girl stands up and jokes with them, and she says that she is drunk. As she starts to sit down again, the older man stops her and asks what she is doing. He says that she has to take her shirt off. She is wearing a *solid blue button-down shirt*. At first, she thinks he is kidding, but after a little while she realizes that he means it. The man keeps demanding that she take her shirt off. The man tells one of the boys to *get his weapon*. She says that she is going to leave. She looks afraid. Eventually, the situation becomes more intense, and the man becomes angry and *slaps her and threatens her with a weapon*. She starts to unbutton her shirt. Towards the end of the film, the girl *is forced to take off some of her clothes*.

Appendix B: Example Film Memory Test Items

Test Item	Central or Peripheral?
What kind of weapon does the man have? <ul style="list-style-type: none"> a. He has a baseball bat. b. <u>He has a gun.</u> c. He does not have a weapon. d. He has a knife. 	Central
What happens to the girl near the end of the film? <ul style="list-style-type: none"> a. the girl is seriously hurt b. the girl is forced to take off some of her clothes, but then escapes c. the girl is allowed to stay without taking her clothes off d. <u>the girl escapes before anyone can force her to take her clothes off</u> 	Central
When the girl walks in, what is she carrying? <ul style="list-style-type: none"> a. a book b. a bottle c. a flashlight d. <u>a jacket</u> 	Peripheral
Where does one of the boys say the older man is from? <ul style="list-style-type: none"> a. Montana b. Minnesota c. Mississippi d. <u>Michigan</u> 	Peripheral

Note. As in the narratives, correct responses are underlined; misinformation responses are italicized.

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Figure 1.

Correct responses at the immediate and delayed tests by instruction condition. Error bars attached to each column represent standard errors. Higher numbers for non-misled items indicate higher memory accuracy; higher numbers for misled items indicate lower memory distortion.

Figure 2.

Incorrect responses at the immediate and delayed tests by instruction condition. Error bars attached to each column represent standard errors. Lower numbers for non-misled items indicate higher memory accuracy; lower numbers for misled items indicate lower memory distortion.

Table 1
Participant Characteristics by Group

	PTSD			No PTSD			Control		
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range
Age	33.26 _a	13.13	18-58	29.58 _a	13.39	18-63	21.29 _b	4.90	18-39
Years of Education	14.39	2.32	6-18	14.58	1.94	10-19	14.09	2.06	12-18
Race (%)									
African-American	2.9			3.7			5.7		
Asian	2.9			11.1			17.1		
Caucasian	74.3			59.3			68.8		
Other	17.1			18.5			8.6		
Depression (BDI)	21.50 _a	8.48	4-46	3.89 _b	3.18	0-10	2.77 _b	2.89	0-10
State Anxiety (STAI)	53.36 _a	10.49	34-70	34.31 _b	7.72	24-61.05	33.49 _b	6.20	21.05-52
Trait Anxiety (STAI)	55.30 _a	9.97	33-75	32.40 _b	4.78	22-40	31.63 _b	5.23	21-40
PTSD (PSS-I)	25.63 _a	5.24	14-36	3.19 _b	3.43	0-14	–	–	–
PTSD (PDS)	29.66 _a	8.39	11.69-46	6.29 _b	5.56	0-25	–	–	–

Note. Means in the same row that do not share subscripts differ at the $p < .05$ level. Only trauma-exposed groups were included in analyses of PTSD symptom measures (i.e., PSS-I, PDS). BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; PSS-I = PTSD Symptom Scale-Interview; PDS = Posttraumatic Stress Diagnostic Scale.

Table 2
State Emotion Measures by Emotion Regulation Condition and Group

	<u>Emotional Distress Composite Score</u>	
	Pre-film <i>M</i> (<i>SD</i>)	Post-film <i>M</i> (<i>SD</i>)
Expressive Suppression		
PTSD	.06(1.70)	1.86(1.90)
No PTSD	−1.45(.37)	−.40(1.04)
Control	−1.25(.67)	.01(1.61)
Experiential Suppression		
PTSD	1.60(1.88)	1.81(1.56)
No PTSD	−.75(1.16)	−.37(1.93)
Control	−1.14(1.04)	−.91(1.02)
Control Instructions		
PTSD	1.26(1.51)	2.58(1.25)
No PTSD	−1.50(.49)	−.35(1.09)
Control	−1.57 (.85)	−1.14(.94)

Note. PTSD = Posttraumatic stress disorder.

Table 3
Correct and Incorrect Responses (d') by Emotion Regulation Condition, Group, and Item Type

	d' Correct, Immediate Test		d' Correct, Delayed Test		d' Incorrect, Immediate Test		d' Incorrect, Delayed Test	
	Correct/ Non-Misled $M(SD)$	Correct/ Misled $M(SD)$	Correct/ Non-Misled $M(SD)$	Correct/ Misled $M(SD)$	Incorrect/ Non-Misled $M(SD)$	Incorrect/ Misled $M(SD)$	Incorrect/ Non-Misled $M(SD)$	Incorrect/ Misled $M(SD)$
Express. Supp.	1.94(.69)	2.02(.58)	2.08(.69)	1.93(.72)	-.66(.54)	-.59(.44)	-.65(.52)	-.53(.52)
PTSD	1.94(.76)	2.14(.40)	1.92(.74)	1.92(.71)	-.67(.48)	-.68(.34)	-.52(.55)	-.36(.67)
No PTSD	1.87(.75)	1.71(.72)	2.03(.88)	1.73(.82)	-.53(.70)	-.52(.56)	-.59(.58)	-.54(.53)
Control	2.00(.64)	2.19(.53)	2.26(.44)	2.14(.63)	-.77(.46)	-.58(.44)	-.83(.44)	-.68(.32)
Experi. Supp.	2.11(.57)	2.01(.69)	2.13(.61)	2.03(.56)	-.76(.39)	-.52(.63)	-.67(.45)	-.58(.47)
PTSD	1.89(.60)	1.97(.73)	2.03(.65)	2.07(.43)	-.75(.41)	-.46(.67)	-.61(.53)	-.61(.39)
No PTSD	2.39(.47)	2.07(.68)	2.38(.57)	1.93(.67)	-.77(.46)	-.45(.63)	-.81(.44)	-.51(.42)
Control	2.16(.57)	2.02(.71)	2.07(.59)	2.06(.65)	-.78(.32)	-.64(.61)	-.64(.32)	-.59(.60)
Control Instr.	2.22(.60)	1.65(.87)	2.35(.55)	1.60(.77)	-.79(.40)	-.30(.63)	-.88(.28)	-.25(.68)
PTSD	2.20(.73)	1.44(.68)	2.21(.71)	1.41(.64)	-.63(.56)	-.19(.53)	-.77(.33)	-.09(.47)
No PTSD	2.39(.50)	1.99(.72)	2.71(.00)	1.99(.72)	-.95(.23)	-.37(.62)	-.103(.00)	-.45(.56)
Control	2.13(.57)	1.60(1.07)	2.22(.50)	1.50(.85)	-.82(.31)	-.35(.74)	-.87(.29)	-.25(.88)

Note. Express. Supp. = Expressive Suppression; Experi. Supp. = Experiential Suppression; Control Instr. = Control Instructions; PTSD = Posttraumatic stress disorder. Higher d' s for correct/non-misled responses and lower d' s for incorrect/non-misled responses indicate better memory accuracy. Lower d' s for correct/misled responses and higher d' s for incorrect/misled responses indicate higher memory distortion.