Effects of emotion-induced self-focused attention on item and source memory

Youngbin A. Jeon, Solange N. Resnik, Gabriella I. Feder, and Kyungmi Kim

Wesleyan University

March 2020
Manuscript accepted for publication in *Motivation and Emotion*

Keywords: emotion, self-focused attention, memory, affect, attentional focus

Corresponding author:
Kyungmi Kim
Department of Psychology
Wesleyan University
207 High Street
Middletown, CT 06459
kkim01@wesleyan.edu

Author note:
Youngbin A. Jeon is now at the Department of Psychology, University of Southern California; Solange N. Resnik is now at the College of Professional Studies, Northeastern University; This work was supported by Grant in Support of Scholarship (GISOS) from Wesleyan University.

Abstract

Affective states are closely linked to attention to internal aspects of the self (i.e., self-focused attention). We investigated how self-focused attention induced by emotional experiences affects memory for subsequently presented information. Prior to incidental encoding of affectively neutral target words, participants were induced to feel shame or anger through autobiographical recall (vs. no emotion-induction control condition). Memory for words (item memory) and their associated contextual feature (source memory) were subsequently assessed. Self-focused attention, measured by the private self-consciousness scale, was highest in the shame condition, followed by the anger and then control conditions. Item memory was significantly impaired in the shame condition compared to both the anger and control conditions, and self-focused attention negatively mediated the effect of emotion condition on memory performance. Source memory did not significantly differ across the emotion conditions, and we discuss possible factors contributing to this null finding. Our findings suggest that emotion-induced self-focused attention may reduce attentional resources available for encoding task-relevant external information.

Effects of emotion-induced self-focused attention on item and source memory

Self-focused attention refers to attention directed toward internal aspects of the self (e.g., thoughts, feelings, bodily sensations) rather than toward aspects of the external environment (Carver & Scheier, 1981; Duval & Wicklund, 1972). Self-focused attention can have both positive and negative affective and cognitive consequences. For example, although self-focused attention is associated with well-articulated and more accessible self-knowledge (Eichstaedt & Silvia, 2003; Nasby, 1985), greater correspondence between one's own self-perceptions and their actual behaviour (Scheier, Buss, & Buss, 1978), and increased motivation to perform well on tasks (Duval, Duval, & Mulilis, 1992), a chronically high level of self-focused attention has been linked to low self-esteem, general negative affect, and various psychological disorders such as depression and anxiety (Ingram, 1990; Mor & Winquist, 2002).

Past studies evidenced a bidirectional link between self-focused attention and emotional experience whereby self-focused attention intensifies the experience of affective states (Scheier & Carver, 1977) while affective states influence the degree of self-focused attention. Studies examining the impact of affective states on self-focused attention generally showed that negative affect increases self-focused attention (Salovey, 1992; Sedikides, 1992; Wood, Saltzberg, & Goldsamt, 1990) whereas positive affect either increases (Salovey, 1992), decreases (Green, Sedikides, Saltzberg, Wood, & Forzano, 2003) or has no effect (Sedikides, 1992; Wood et al., 1990) compared to neutral affect. Green and Sedikides (1999) subsequently proposed that "affect orientation" rather than affective valence determines the relationship between affect and self-focused attention. They hypothesised that "social" affective states (e.g., anger, thrill) heighten awareness of the external environment thereby resulting in environment-oriented cognitive and behavioural responses whereas "reflective" affective states (e.g., sadness, contentment) heighten awareness of the self thereby resulting in self-oriented cognitive and behavioural responses. Their results confirmed this hypothesis by showing that participants induced to feel anger or thrill experienced lower levels of self-focused attention than those induced to feel sadness or contentment. In addition, Panayiotou, Brown, and Vrana (2007) suggested that affective arousal rather than affective valence critically contributes to the relationship between affect and self-focused attention by showing that highly arousing emotions (e.g., fear, joy) produced a greater degree of self-focused attention compared to emotions low in arousal (e.g., sadness).

A large body of research has shown that the affective state of an individual can influence a variety of cognitive processes including attention (e.g., Fredrickson & Branigan, 2005), cognitive control (e.g., Gray, 2001), and memory (e.g., Storbeck & Clore, 2005). In particular, studies have shown that induced emotion/mood can exert its influence across different stages of memory processing (encoding, retention/storage, retrieval). For example, negative or depressed mood has been found to impair memory when the mood was induced shortly prior to encoding (e.g., Ellis, Thomas, & Rodriguez, 1984) or retrieval (e.g., Ellis, Thomas, McFarland, & Lane, 1985). When induced post-encoding (during retention), both negative and positive emotions generally enhance memory consolidation, especially for item memory, as demonstrated by improved memory performance in delayed memory tests with the retention interval of roughly 30 minutes to one week (e.g., Nielson & Bryant, 2005; Nielson & Powless, 2007; Wang, 2015; Wang & Sun, 2015). In the false memory literature, negative but not positive mood induced prior to encoding has been found to reduce false memory without affecting veridical memory (e.g., Storbeck & Clore, 2005; 2011; see also Van Damme, 2013) whereas both negative and positive moods induced prior to retrieval have been shown to reduce false memory and improve veridical memory (e.g., Mirandola & Toffalini, 2016). However, to our knowledge, none of previous studies has systematically investigated how self (inward)- vs. outward-directed attentional focus induced by emotional experiences affect subsequent memory processes, despite the strong empirical evidence that different affective states induce differential levels of self-focused attention. The present study aimed to fill this gap by examining how emotion-induced self-focused attention affects one's ability to remember subsequently presented external information. In particular, how does emotion-induced self-focused attention influence memory for affectively neutral stimuli themselves (i.e., item memory) and their associated contextual features (i.e., source memory; Johnson, Hashtroudi, & Lindsay, 1993)?

Various theoretical ideas and empirical findings provide different rationales for predicting how emotion-induced self-focused attention might affect subsequent memory. One possibility is that self-focused attention may facilitate memory performance by increasing the likelihood that the self would serve as a reference point during encoding of incoming information. Both situationally-manipulated (e.g., by placing individuals in front of a mirror) and dispositional self-focused attention has been found to be associated with an increased tendency to encode external information as self-relevant (Hull & Levy, 1979; Hull, Slone, Meteyer, & Matthews, 2002; Hull, Van Treuren, Ashford, Propsom, & Andrus, 1988), and there exist ample evidence that self-relevant information enjoys attentional and memorial advantages over comparable but non-self-relevant information (e.g., Bargh, 1982; Kesebir & Oishi, 2010). Indeed, self-focused attention is positively related to the magnitude of the memory advantage produced by self-referential compared to other encoding activities (i.e., self-reference effect; Rogers, Kuiper, & Kirker, 1977; e.g., Agatstein & Buchanan, 1984; Hull et al., 1988). Self-focused attention also enhances the accessibility of self-related information (Eichstaedt & Silvia, 2003), resulting in a tendency for the self to be involved in perception and interpretation of information as evidenced by various forms of egocentric biases (Duval & Wicklund, 1973; Fenigstein, 1984). Furthermore, individuals with high self-focus are more sensitive to nonconscious primes compared to those with low self-focus (Hull et al., 2002; Silvia, Kelly, Zibaie, Nardello, & Moore, 2013) even when the primes are generally inapplicable to the self (e.g., elderly primes among young participants), suggesting that self-focused attention may render a broad range of external cues as self-relevant. Given that self-related processing tends to enhance not only item memory but also source memory (e.g., Serbun, Shih, & Gutchess, 2011), emotion-induced self-focused attention may facilitate both item and source memory for subsequently presented items.

Alternatively, self-focused attention could impair memory performance by reducing attentional resources available for processing incoming information. Several theories of self-focused attention posit that attention to the self and attention to the external environment are mutually exclusive (Carver, 1979; Carver & Scheier, 1981; Duval & Wicklund, 1972). Given that the amount of attentional resources at any given moment is limited (Kahneman, 1973), allocating attention to task-irrelevant self-related aspects would necessarily reduce resources available for performing a task at hand that will benefit later attempts to remember the target information. Indeed, Panayiotou and Vrana (1998) found that situationally manipulated self-focused attention under an evaluative condition was associated with poorer performance in a digit recall task, suggesting that self-focused attention may act as a “cognitive load” that interferes with performance on a concurrent task by occupying processing resources that would otherwise be devoted to the task. Empirical support for the distracting properties of self-focused attention on ongoing activity also comes from findings showing that self-focused individuals form less differentiated impressions of other people (Vallacher, 1978) and are poor at remembering various characteristics of an interaction partner (Kimble, Hirt, & Arnold, 1985; Kimble & Zehr, 1982). Given that source memory tends to require greater cognitive resources than does item memory (e.g., Troyer, Winocur, Craik, & Moscovitch, 1999), emotion-induced self-focused attention may impair both item and source memory for subsequently presented items.

Although these two accounts predict opposite patterns of the effect of emotion-induced self-focused attention on subsequent memory performance, they both suggest that the locus of the effect is likely to lie at the encoding stage of memory processing. First, the former ‘self-referential encoding’ account clearly posits that the potential beneficial effect of self-focused attention is due to the increased likelihood of using the self as a reference point at encoding (Rogers et al., 1977; Wells, Hoffman, & Enzle, 1984). Second, the potential detrimental effect of self-focused attention predicted by the latter ‘cognitive load/distraction’ account is also expected to be more pronounced at encoding than at storage or retrieval, given the ample evidence that reduced cognitive/attentional resources disproportionately affect encoding, with their markedly detrimental effects on encoding vs. the relative resiliency of the retrieval processes to resource reduction (e.g., Baddeley, Lewis, Eldridge, & Thomson, 1984; Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Naveh-Benjamin, Craik, Perretta, & Tonev, 2000).

To induce differential levels of self-focused attention, the present study used two discrete negative emotions: shame, a self-conscious emotion characterised by an experience of heightened level of self-focus and internal attributions of self-blame (Tangney & Dearing, 2002; Tracy & Robins, 2007), and anger, a non-self-conscious emotion associated with relatively more focus on the external agents/environment and external attributions of other-blame (Keltner, Ellsworth, & Edwards, 1993; Lazarus, 1993), both of which are intense emotional experiences (Frijda, Ortony, Sonnesmans, & Clore, 1992; Tangney, Miller, Flicker, & Barlow, 1996) that were shown to be associated with similar cardiovascular/physiological arousal (Herrald & Tomaka, 2002). Participants were induced to feel shame, anger, or a control/neutral emotion (i.e., no emotion/mood induction) through autobiographical recall or a simple transcribing task. Then, in an ostensibly unrelated study, participants incidentally encoded a series of affectively neutral target words. Two subsequent surprise memory tests probed participants' memory for the target words and their associated source feature (i.e., each word's location on the screen), respectively.[1] Emotion-induced self-focused attention was measured retrospectively with a modified version of the private self-consciousness scale (Fenigstein, Scheier, & Buss, 1975; Sedikides, 1992). Based on previous work on mood-induced self-focused attention (Green & Sedikides, 1999; Panayiotou et al., 2007; Wood et al., 1990), we expected that both shame and anger would induce higher levels of self-focused attention than control/neutral affective state. In addition, based on the critical role of self-awareness and self-representation in self-conscious emotions (Tracy & Robins, 2007), we expected that shame would induce higher levels of self-focused attention than anger. With respect to the item and source memory, we expected to observe either of two informative patterns of results: (a) if self-focused attention facilitates self-referential encoding, then both item and source memory accuracy would be highest in the shame condition and lowest in the control condition. Alternatively, (b) if self-focused attention serves as a cognitive load/distraction by reducing attentional resources available for encoding incoming external information, then both item and source memory accuracy would be highest in the control condition and lowest in the shame condition.

Method

Participants and Design

Two hundred and forty students from Wesleyan University (124 females; mean age = 19.225 [*SD* = 1.483]) participated in exchange for course credit or payment. The sample size was predetermined based on a meta-analysis finding of a small-to-medium effect size of the relationship between negative affect and self-focused attention in experimental designs ($d = 0.41$; Mor & Winquist, 2002) using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007; $f = .205$, $\alpha = .05$, power = .80). All participants were native English speakers and had normal or corrected-to-normal vision. Participants provided informed consent in accordance with the human subject regulations of Wesleyan University. Data from ten additional participants were excluded from analysis due to their awareness of the experimental purpose/hypothesis ($N = 5$), a computer malfunction ($N = 2$), or a premature termination of the study ($N = 3$).

The experiment had a single-factor design in which emotion (shame, anger, or control) was manipulated between participants. The participants were randomly assigned to one of the three emotion conditions ($N = 80$ each).

---

[1] Source memory can be assessed in conjunction with item memory whereby participants are first asked to determine whether or not a given item had been previously presented in the encoding phase, and then, only for the items that were determined as having been presented, to further indicate their associated source feature (e.g., Doerksen & Shimamura, 2001). Alternatively, source memory can be assessed independently of item memory by having participants indicate the source feature of all studied items, for example using a forced-choice test (e.g., Davidson, McFarland, & Glisky, 2006). In the present study, we opted to use an independent test of source memory that is not contingent on correct item recognition.

Materials

Stimuli. The stimuli were 100 affectively neutral concrete nouns (e.g., door, key) drawn from Bradley and Lang's (1999) Affective Norms for English Words (ANEW) database whose valence levels fell close to the neutral midpoint '5' on a 9-point scale (range = 4.56 – 5.98). The 100 words were divided into two separate lists. The first list included 60 words that served as critical items (i.e., "old" words) that were presented in the encoding phase. The other list included 40 words that served as "new" items in the subsequent item memory test. The old and new word lists were matched for the following characteristics using the norms from Bradley and Lang (1999) and the MRC Psycholinguistic Database (Coltheart, 1981): valence (1-9 range; $M_{\text{old}} = 5.335$ vs. $M_{\text{new}} = 5.330$), arousal (1-9 range; $M_{\text{old}} = 4.027$ vs. $M_{\text{new}} = 4.007$), dominance (1-9 range; $M_{\text{old}} = 5.076$ vs. $M_{\text{new}} = 5.023$), concreteness (100-700 range; $M_{\text{old}} = 591.750$ vs. $M_{\text{new}} = 592.225$), Kucera-Francis frequency ($M_{\text{old}} = 56.083$ vs. $M_{\text{new}} = 54.475$), familiarity (100-700 range; $M_{\text{old}} = 536.967$ vs. $M_{\text{new}} = 536.600$), imageability (100-700 range; $M_{\text{old}} = 584.733$ vs. $M_{\text{new}} = 584.525$), word length ($M_{\text{old}} = 5.267$ vs. $M_{\text{new}} = 5.200$), and syllable length ($M_{\text{old}} = 1.567$ vs. $M_{\text{new}} = 1.650$), all $t(98)$s < 0.632, all ps > .05.

Emotion and Mood Ratings. As a manipulation check for the emotion/mood induction procedure (see Procedure below), we asked participants to indicate the degree to which they felt shame, anger and sadness during the emotion/mood induction phase (1 = not at all, 7 = very strongly). In addition, the participants were asked to indicate the valence (1 = negative, 7 = positive) and intensity (1 = not at all intense, 7 = very intense) of their mood experienced during the emotion/mood induction phase. It was emphasised to the participants that their ratings should reflect what/how they actually felt during the emotion/mood induction phase not what/how they thought they should have felt.

Private Self-Consciousness (PSC) Scale (Fenigstein et al., 1975). To assess momentary rather than dispositional self-focused attention, we adapted a modified version of the PSC scale (Sedikides, 1992). This 10-item scale included statements such as "I was attentive to my inner feelings" and the participants rated the extent to which each statement characterised themselves right after they completed the emotion/mood induction phase (1 = extremely uncharacteristic, 9 = extremely characteristic).

Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988). To measure and compare various phenomenal characteristics of the autobiographical events that the participants in the Shame and Anger conditions recalled during the emotion/mood induction phase, we used a shorter version of the MCQ. Following previous studies (Schaefer & Philippot, 2005; Suengas & Johnson, 1988), we created five composite variables corresponding to Clarity, Sensory, Contextual, Time, and Thoughts and Feelings. In addition, we assessed the valence and intensity of the feelings experienced during the recalled autobiographical event using two single items. The structure of the composite variables, the corresponding items, and the Cronbach's Alphas for each composite variable are presented in Appendix A. Participants rated the extent to which each item characterised how they remembered the autobiographical event on a 7-point scale, and each composite variable was calculated as the mean of each participant's responses to all items associated with that variable. Only the participants in the Shame and Anger conditions were asked to complete this questionnaire.

Procedure

Prior to beginning the experiment, participants were told a cover story that they would be participating in two unrelated studies, one on the relationship between life experience and language processing and another on individual differences in word perception. Participants completed the experiment individually and the experiment had the following 4 phases.

Emotion/Mood Induction. Participants in the Shame and Anger conditions were asked to write about a moment in their life when they felt "very ashamed" and "very angry at someone," respectively. Participants were asked to revisit the moment as if it were actually happening to them, try to re-experience the emotions, perceptions and sensations they felt at that time, and to describe the moment as detailed as possible. Participants in the Control condition were asked to transcribe a simple recipe word for word. This phase lasted 15 minutes.

Encoding. Upon completion of the emotion/mood induction phase, participants were told that they would be moving on to the second study and began the encoding phase. In this phase, the 60 critical words were presented individually either on the top or the bottom of the screen. Each word was presented for 2 s. As a cover task to ensure attention to each word, participants were asked to indicate the location of each word (top or bottom) by pressing one of the two key buttons. Trials were separated by a 500-ms fixation period and the presentation order of words was randomized for each participant. Participants were not informed about the upcoming memory tests.

Item Memory Test. Immediately following the encoding phase, participants took an item memory test. The 60 "old" words from the encoding phase along with the 40 "new" words were presented individually in the centre of the screen. For each word, participants were asked to indicate whether or not they had seen the word in the preceding phase by pressing one of the two key buttons within 4 s (i.e., a forced-choice old/new recognition). Trials were separated by a 500-ms fixation period and the presentation order of words was randomized for each participant.

Source Memory Test. Immediately following the item memory test, participants took a source memory test. Here, only the 60 "old" words from the encoding phase were presented individually in the centre of the screen. For each word, the participants' task was to indicate the location in which the word had appeared in the encoding phase (the top or the bottom of the screen) by pressing one of the two key buttons within 4 s (i.e., a forced-choice source recognition). Trials were separated by a 500-msec fixation period and the presentation order of words was randomized for each participant.

Upon completion of the experimental phases, participants completed a series of questionnaires.[2] First, all participants completed the PSC scale. Then, the participants in the Shame and Anger conditions completed the MCQ. Then, all participants completed the emotion

---

[2] We asked participants to complete these questionnaires at the end of the experiment in an attempt to reduce the likelihood that they would be aware of the fact that their mood and the resulting self-focused attention were being manipulated or the purpose/hypothesis of the study.

and mood ratings, followed by a post-experimental questionnaire designed to assess their awareness of the experimental purpose/hypothesis. Data from five participants who correctly guessed the experimental purpose/hypothesis were excluded from analysis.

Results

Emotion and Mood Ratings

Means and standard deviations for emotion and mood ratings data are presented in Table 1. One-way analyses of variance (ANOVAs) with Emotion (shame, anger, control) as the between-subjects factor revealed a significant effect of Emotion on the ratings of shame, anger, and sadness felt during the emotion/mood induction phase, all $F(2, 237)$s > 11.591, all *p*s < .05, all η_p^2s > .089. Bonferroni-corrected post-hoc tests showed that participants in the Shame condition reported significantly more shame compared to those in the Anger, $p < .001$, or Control condition, $p < .001$, with no significant difference between the latter two conditions, $p = .137$. Similarly, participants in the Anger condition reported significantly more anger compared to those in the Shame, $p < .001$, or Control condition, $p < .001$, with no significant difference between the latter two conditions, $p = .732$. In addition, participants in the Shame condition reported significantly more sadness compared to those in the Anger, $p = .004$, or Control condition, $p < .001$, with no significant difference between the latter two conditions, $p = .434$. Repeated-measures ANOVAs performed separately for the Shame and Anger conditions with the type of felt emotions (shame, anger, sadness) as the within-subjects factor confirmed that participants in the Shame condition reported significantly more shame than either anger or sadness, $F(1.814, 143.315) = 355.690$, $p < .001$, $\eta_p^2 = .818$ (Greenhouse-Geisser corrected for nonsphericity), all Bonferroni-corrected post-hoc *p*s < .05, whereas participants in the Anger condition reported significantly more anger than either shame or sadness, $F(1.620, 128.002) = 789.574$, $p < .001$, $\eta_p^2 = .909$ (Greenhouse-Geisser corrected for nonsphericity), all Bonferroni-corrected post-hoc *p*s < .05.

For ratings of mood valence and intensity experienced during the emotion/mood induction phase, one-way ANOVAs with Emotion (shame, anger, control) as the between-subjects factor revealed a significant effect of Emotion, all $F(2, 237)$s > 120.820, all *p*s < .05, all η_p^2s > .504. Bonferroni-corrected post-hoc tests showed that mood valence was significantly less negative in the Control condition compared to both the Shame, $p < .001$, and Anger conditions, $p < .001$, with no significant difference between the latter two conditions, $p = .999$. Similarly, mood intensity was significantly less intense in the Control condition compared to both the Shame, $p < .001$, and Anger conditions, $p < .001$, with no significant difference between the latter two conditions, $p = .999$.

Collectively, these results indicate that our emotion/mood manipulation successfully induced intended emotions as well as the expected differences in mood valence and intensity between the Control condition and the Shame or Anger condition with no significant difference between the Shame and Anger conditions.

Table 1
Means (standard deviations) for emotion and mood ratings as a function of Emotion condition

	Shame	Anger	Control
Valence	1.925 (0.808)	1.838 (0.863)	3.775 (0.871)
Intensity	5.738 (0.791)	5.825 (0.689)	4.075 (0.911)
Shame	5.613 (0.879)	1.638 (0.767)	1.400 (0.565)
Anger	2.250 (1.097)	5.763 (0.815)	2.063 (1.106)
Sadness	2.013 (0.879)	1.625 (0.769)	1.450 (0.593)

Note: A 7-point scale was used for all ratings. Valence (1 = negative, 7 = positive); intensity (1 = not at all intense, 7 = very intense); emotion ratings for shame, anger, and sadness (1 = not at all, 7 = very strongly).

Self-Focused Attention

Participants' self-focused attention following the emotion/mood induction phase was calculated as the mean of their responses to the PSC items after reverse-coding negatively worded items. A one-way ANOVA with Emotion (shame, anger, control) as the between-subjects factor revealed a significant effect of Emotion on self-focused attention, $F(2, 152.568) = 35.447$, $p < .001$, $\eta_p^2 = .260$ (Welch-corrected for heterogeneity of variances). As shown in Figure 1A, Bonferroni-corrected post-hoc tests revealed that self-focused attention was significantly higher in the Shame condition ($M = 6.496$, $SD = 1.225$) compared to both the Anger ($M = 5.546$, $SD = 0.958$), $p < .001$, and Control conditions ($M = 4.679$, $SD = 1.532$), $p < .001$. In addition, self-focused attention was significantly higher in the Anger condition compared to the Control condition, $p < .001$. These results indicate that our emotion/mood manipulation successfully induced differential levels of self-focused attention within the three emotion conditions.

Memory Characteristics

Means and standard deviations for the five MCQ composite variables (Clarity, Sensory, Contextual, Time, Thoughts and Feelings) and the two single items measuring the valence and intensity of feelings experienced during the recalled autobiographical event are presented in Table 2. Independent-samples t-tests revealed no significant difference between the Shame and Anger conditions for any of the MCQ composite variables, all $t(158)$s < 1.138, all ps > .05. In addition, neither the valence nor the intensity of feelings experienced during the recalled autobiographical event significantly differed between the Shame and Anger conditions, all $t(158)$s < 0.865, all ps > .05. This lack of significant difference in phenomenal memory characteristics suggests that our emotion/mood manipulation did not create unwanted, potentially confounding memory-based differences between the Shame and Anger conditions.

Table 2
Means (standard deviations) for MCQ composite variables and two single items in the Shame and Anger conditions, respectively

Composite Variables/Items	Shame	Anger
Clarity	5.465 (1.010)	5.471 (0.971)
Sensory	2.503 (1.085)	2.569 (1.147)
Contextual	5.775 (1.071)	5.833 (1.066)
Time	5.078 (1.264)	5.285 (1.343)
Thoughts and Feelings	6.003 (0.865)	6.144 (0.690)
Valence of Feelings*	1.750 (0.935)	1.763 (0.917)
Intensity of Feelings*	6.063 (1.060)	6.194 (0.851)

Note: * The Intensity of Feelings and the Valence of Feelings were assessed using single items.

Encoding Task Performance

Encoding task accuracy was calculated as the proportion of trials associated with correct location judgments. The mean response time was calculated based on correct trials only. The proportion of missing responses (i.e., failure to respond within a given response window) did not significantly differ across the Emotion conditions (Shame: $M = .001$, $SD = .008$; Anger: $M = .001$, $SD = .008$; Control: $M = .000$, $SD = .000$), $F(2, 237) = 0.958$, $p = .385$. Missing responses were counted as incorrect responses. One-way ANOVAs with Emotion (shame, anger, control) as the between-subjects factor revealed no significant effect of Emotion on task accuracy (Shame: $M = .993$, $SD = .015$; Anger: $M = .993$, $SD = .024$; Control: $M = .996$, $SD = .097$) or response time (in milliseconds; Shame: $M = 488.953$, $SD = 137.445$; Anger: $M = 483.978$, $SD = 115.529$; Control: $M = 474.325$, $SD = 100.432$), all $F(2, 237)$s < 0.936, all ps $> .05$.

Item Memory

Participants' hit rates and false-alarm rates were calculated by computing the proportion of "old" words correctly recognised as old and the proportion of "new" words incorrectly identified as old, respectively (Table 3). The proportion of missing responses (Shame: $M = .004$, $SD = .007$; Anger: $M = .004$, $SD = .009$; Control: $M = .004$, $SD = .007$) did not significantly differ across the Emotion conditions, $F(2, 237) = 0.122$, $p = .885$. Missing responses were counted as incorrect responses. The corrected hit rates were calculated by subtracting the false-alarm rates from the hit rates.[3] One-sample t-tests showed that corrected hit rates were significantly above chance performance level of zero across all Emotion conditions, all $t(79)$s > 15.784, all ps $< .05$. A one-way ANOVA conducted on corrected hit rates with Emotion (shame,

[3] A parallel set of analyses using d-prime (*d'*) as the dependent measure produced exactly the same pattern of results. Complete statistical analyses and results are presented in Appendix B.

Table 3
Mean proportion (standard deviation) of hits and false-alarms for item memory as a function of Emotion condition

	Shame	Anger	Control
Hit	.544 (.138)	.593 (.130)	.568 (.140)
False-Alarm	.279 (.150)	.252 (.114)	.244 (.123)

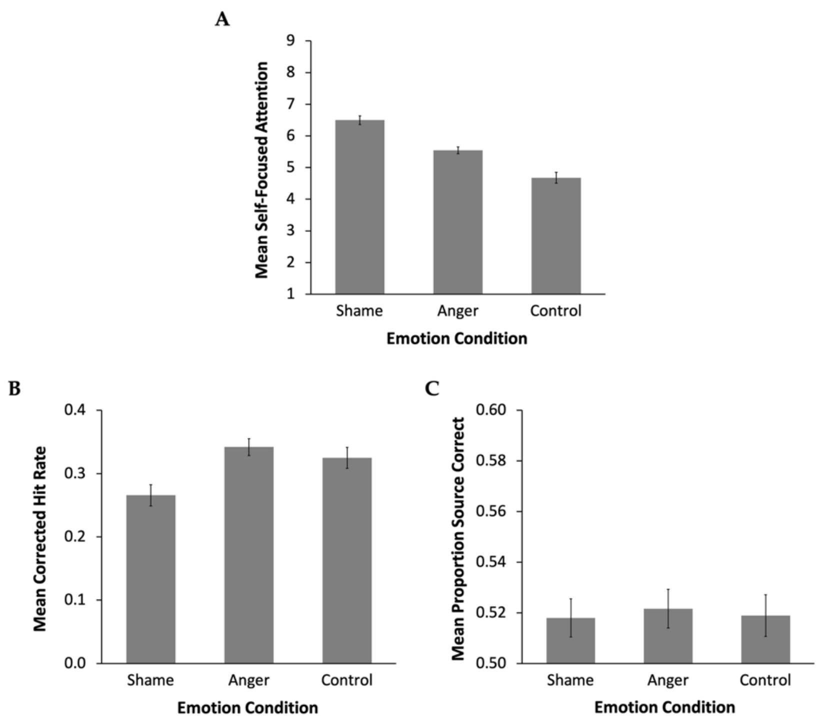

Figure 1. (A) Self-reported levels of self-focused attention experienced following the emotion/mood induction phase, (B) item memory performance ,and (C) source memory performance as a function of Emotion condition. Error bars represent standard error of the mean. For panels (B) and (C), the lowest value on the y-axis represents chance-level performance.

anger, control) as the between-subjects factor revealed a significant effect of Emotion, $F(2, 237) = 6.559$, $p = .002$, $\eta_p^2 = .052$. As shown in Figure 1B, Bonferroni-corrected post-hoc tests revealed that item memory was significantly impaired in the Shame condition ($M = .265$, $SD = .150$) compared to both the Anger ($M = .342$, $SD = .121$), $p = .002$, and Control conditions ($M = .324$, $SD = .147$), $p = .025$. Item memory did not significantly differ between the Anger and Control conditions, $p = .999$.

To examine whether self-focused attention mediated the effect of Emotion condition on item memory performance, we conducted two mediation analyses with PROCESS macro for

SPSS (model 4; Hayes, 2018) using bootstrapping procedures with 10,000 samples. In the first analysis, dummy coding was used to examine the relative direct effect, indirect effect (i.e., mediation), and total effect (i.e., the sum of the direct and indirect effects) of the Shame condition and Anger condition, respectively, relative to the Control condition (i.e., reference group). In the second analysis, two orthogonal contrasts were used to examine the relative direct, indirect, and total effects of (a) the Shame and Anger conditions collectively (i.e., Emotions) relative to the Control condition (contrast coded as Shame = 1/3, Anger = 1/3, Control = –2/3) and (b) the Shame condition relative to the Anger condition (contrast coded as Shame = 1/2, Anger = –1/2, Control = 0), respectively.

As shown in Figure 2A, relative to the Control condition, the Shame condition had a significant negative indirect effect on item memory accuracy via self-focused attention (estimate = –0.042, bootstrap 95% CI = [–0.076, –0.013]) as well as a significant negative total effect (B = –0.059, p = .008, 95% CI = [–0.102, –0.015]), but a nonsignificant direct effect (B = –0.017, p = .505). Relative to the Control condition, the Anger condition also had a significant negative indirect effect on item memory accuracy via self-focused attention (estimate = –0.020, bootstrap 95% CI = [–0.040, –0.005]) but a nonsignificant total effect (B = 0.018, p = .427), suggesting that the nonsignificant yet positive direct effect (B = 0.038, p = .096) counteracted the negative indirect effect (see Hayes, 2009; 2018 for discussion of the absence of a significant total effect with a significant direct and/or indirect effect).

In addition, as shown Figure 2B, relative to the Control condition, the two emotion conditions (Shame and Anger) collectively had a significant negative indirect effect on item memory accuracy via self-focused attention (estimate = –0.031, bootstrap 95% CI = [–0.057, –0.009]), but a nonsignificant direct (B = 0.010, p = .621) or total effect (B = –0.021, p = .283). Relative to the Anger condition, the Shame condition had a significant indirect effect on item memory accuracy via self-focused attention (estimate = –0.022, bootstrap 95% CI = [–0.041, –0.006]) as well as significant direct (B = –0.055, p = .017, 95% CI = [–0.099, –0.010]) and total effects (B = –0.077, p < .001, 95% CI = [–0.120, –0.033]), all of which were in a negative direction.

Source Memory

Source memory accuracy was calculated as the proportion of old words that were attributed to the correct source (i.e., source-correct responses divided by the total number of old words).[4] The proportion of missing responses (Shame: M = .004, SD = .009; Anger: M = .005, SD = .010; Control: M = .004, SD = .009) did not significantly differ across the Emotion conditions, F(2, 237) = 0.246, p = .782. Missing responses were counted as incorrect responses. One-sample t-tests showed that source memory accuracy was significantly above chance

[4] The same null results were obtained when source memory accuracy was conditionalised on correct item recognition (i.e., the proportion of correctly recognised old items that were attributed to their correct source, P(source correct | hit)). Complete statistical analyses and results are presented in Appendix C.

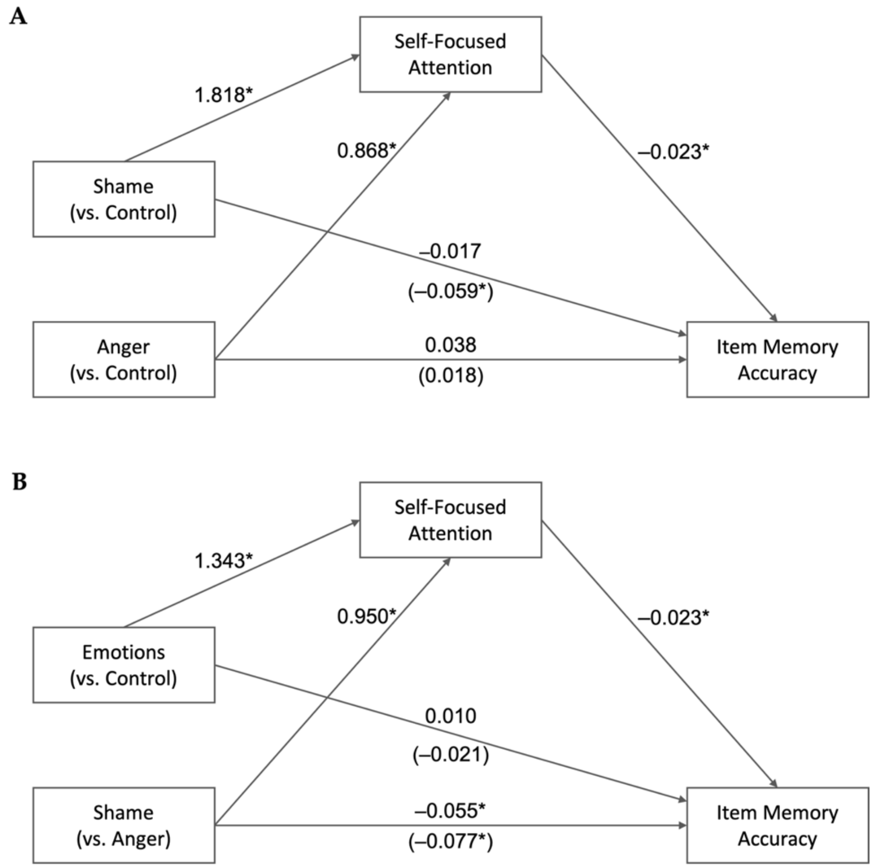

Figure 2. Relative direct, indirect, and total effects of Emotion condition on item memory accuracy: (A) the effects of the Shame condition and Anger condition, respectively, relative to the Control condition; (B) the effect of the combined Shame and Anger conditions (i.e., Emotions) relative to the Control condition and the effect of the Shame condition relative to the Anger condition, respectively. Numbers along the paths are unstandardized regression coefficients. Values in parentheses represent the relative total effects (i.e., the sum of the corresponding relative direct and indirect effects). Asterisks represent statistical significance (p < .05).

performance level of .50 across all Emotion conditions, all $t(79)$s > 2.277, all ps < .05. A one-way ANOVA with Emotion (shame, anger, control) as the between-subjects factor revealed no significant effect of Emotion on source memory accuracy, $F(2, 237) = 0.081$, $p = .922$ (Shame: $M = .517$, $SD = .067$; Anger: $M = .522$, $SD = .068$; Control: $M = .519$, $SD = .073$) (Figure 1C).

To test potential mediating effects of self-focused attention in the relationship between Emotion conditions and source memory performance, we ran two mediation analyses with PROCESS macro for SPSS (model 4; Hayes, 2018) using the same procedure and coding scheme as those used for item memory. As shown in Table 4, the results of these analyses revealed that none of the direct, indirect, or total effects was statistically significant.

Table 4

Regression coefficients for mediation analyses examining the effect of Emotion condition on source memory accuracy via self-focused attention.

Regression	*B*	*SE*	*t*	*p*	LLCI	ULCI
			Relative total effects			
Shame (vs. Control)	–0.002	0.011	–0.152	.880	–0.023	0.020
Anger (vs. Control)	0.003	0.011	0.247	.806	–0.019	0.024
Emotions (vs. Control)	0.005	0.010	0.055	.956	–0.018	0.019
Shame (vs. Anger)	–0.004	0.011	–0.398	.691	–0.026	0.017
			Relative direct effects			
Shame (vs. Control)	0.009	0.013	0.698	.486	–0.016	0.034
Anger (vs. Control)	0.008	0.011	0.680	.497	–0.015	0.030
Emotions (vs. Control)	0.008	0.011	0.782	.435	–0.013	0.029
Shame (vs. Anger)	0.001	0.012	0.099	.921	–0.021	0.024

	Relative indirect effects			
	Estimate	Boot *SE*	Boot LLCI	Boot ULCI
Shame (vs. Control)	–0.011	0.007	–0.026	0.003
Anger (vs. Control)	–0.005	0.004	–0.013	0.002
Emotions (vs. Control)	–0.008	0.006	–0.019	0.003
Shame (vs. Anger)	–0.006	0.004	–0.014	0.002

Note: *B* = unstandardized regression coefficient; *SE* = unstandardized standard error; LLCI = lower-limit confidence interval; ULCI = upper-limit confidence interval; Boot = bootstrap.

Discussion

The present study examined the effects of emotion-induced self-focused attention on memory for subsequently presented neutral stimuli. As expected, shame induced the highest level of self-focused attention, followed by anger, and then the control/neutral emotion. Item memory for target words was impaired in the shame condition compared to both the anger and control conditions. Although item memory did not significantly differ between the anger and control conditions, self-focused attention negatively mediated the effect of emotion condition on item memory accuracy. Unlike item memory, source memory did not significantly differ across the three emotion conditions, and self-focused attention did not significantly mediate the relationship between the emotion conditions and source memory accuracy. Of note, the shame and anger conditions did not significantly differ in terms of both the phenomenal memory characteristics associated with the recalled autobiographical events as well as the valence and intensity of mood experienced during the emotion/mood induction phase, suggesting that the observed item memory results are unlikely to be accounted for by any unintended, potentially confounding memory-based or global mood-related differences between these two conditions.

Our finding that self-focused attention negatively mediated the effects of induced emotions on item memory performance is consistent with the theoretical accounts and empirical findings suggesting that increased focus toward task-irrelevant internal aspects of the self inherently coincides with less attention toward task-relevant external information thereby functioning as a cognitive load (Carver & Scheier, 1981; Duval & Wicklund, 1972; Kimble & Zehr, 1982; Kimble et al., 1985; Panayiotou & Vrana, 1998; Vallacher, 1978). Given that high levels of self-focused attention such as that experienced in depression and anxiety has been suggested to result in excessive rumination (i.e., a repetitive and passive focus on negative personal concerns; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008) that interferes with an individual's ability to deal effectively with external information (Ingram, 1990; Hamilton, 1975), the present findings of impaired item memory suggest that the participants with high self-focus might have engaged in a greater degree of ruminative processing than those with low self-focus. For example, participants with high self-focus might have experienced ruminating thoughts about their emotion and/or recalled autobiographical events during the encoding phase, which could have at least partially drained available cognitive resources for the encoding of the to-be-remembered target items (Watkins & Brown, 2002). Support for this possibility comes from a recent finding showing that individuals engage in ruminative processing following negative emotional experience (i.e., reading a negatively-valenced narrative excerpt) which in turn impairs their performance on a subsequent working memory task (Curci, Lanciano, Soleti, & Rimé, 2013). Indirect support for the link between the emotional experience and reduced cognitive resources via rumination/rehearsal is also provided by a finding that recollecting emotional autobiographical memories impairs subsequent working memory performance (Allen, Schaefer, & Falcon, 2014).

It should be noted that our use of a fairly easy cover task at encoding together with performance at ceiling (over .99 mean proportion accuracy and a mean response time of 482 ms for a 2-s response time window) prevented us from providing direct evidence for the relative allocation of attention to task-irrelevant self-related thoughts vs. task-relevant target stimuli. In this regard, it is worth noting that constraining the focus of attention during encoding has been shown to alleviate the negative effects of self-focused thoughts on subsequent memory recall in both clinically depressed and non-depressed individuals (Hertel, Benbow, & Geraerts, 2012; Hertel & Rude, 1991). For example, Hertel and Rude (1991) found that depressed individuals recalled fewer target words than did the non-depressed individuals when their focus of attention was unconstrained during encoding (i.e., presentation of a target word for the entire trial duration without participants' having to report the target) but that these depressive deficits in memory were eliminated when the encoding task placed constraints on the focus of attention (i.e., participants' having to repeat the target word aloud following its brief appearance). These findings suggest that when the focus of attention is unconstrained by the encoding task, depressed individuals let their minds to wander rather than engaging in further processing of the target stimulus. In the present study, the encoding task was cognitively undemanding, likely allowing some degree of variations in participants' focus of attention. This could mean that the participants with high self-focus might have spent the remaining trial duration with their mind wandering toward task-irrelevant self-related thoughts rather than carrying out further stimulus processing. Whether the magnitude of the negative impact of emotion-induced self-focused attention on subsequent memory for external stimuli would be modulated by attentional focus constraints at encoding (e.g., brief stimulus presentation, shorter trial duration) is an interesting possibility to be tested in future research.

Despite the observed negative mediating role of self-focused attention on the relationship between induced emotions and item memory performance, our finding of impaired item memory in the shame condition but not in the anger condition compared to the control condition warrants discussion. Shame and anger may differ not only in the degree of self-focused attention that they induce but also in other dimensions such as motivational direction (approach vs. avoidance) and intensity (see Gable & Harmon-Jones, 2010). Indeed, whereas shame has generally been found to be associated with avoidance tendencies such as withdrawal (e.g., Scherer & Wallbott, 1994), anger has been shown to be associated with an approach motivation that can facilitate behaviour (e.g., Carver & Harmon-Jones, 2009). Approach motivation is suggested to be less cognitively draining than avoidance motivation (Roskes, Elliot, Nijstad, & De Dreu, 2013). In addition, affects high in motivational intensity (e.g., anger, threat) have been shown to enhance memory for centrally presented information whereas those low in motivational intensity (e.g., sadness) enhance memory for peripherally presented information compared to neutral mood (Threadgill & Gable, 2019). Thus, one possibility for the absence of a significant difference in item memory between the anger and control conditions is that the detrimental effect of anger-induced self-focused attention on external stimulus encoding might have been counteracted by the beneficial effect of high approach motivation on the encoding of central task-relevant information. Future studies may systematically vary the motivational direction and intensity of emotions to explore potential interactions between emotion-induced self-focused attention and motivational factors in influencing memory for external stimuli.

Contrary to our prediction that both item and source memory for external stimuli would be similarly affected by emotion-induced self-focused attention, self-focused attention did not significantly affect source memory. This null finding is quite puzzling given that reduced attentional resource at encoding and/or retrieval (e.g., divided attention) has been found to impair source memory to a greater extent than item memory (e.g., Troyer et al., 1999). Although one must be extremely cautious in attempting to explain null findings, we reasoned that there are at least two factors that might have contributed to this null finding. First, although source memory performance was significantly above chance level (.50) in all emotion conditions, the performance was overall very low with a mean proportion accuracy of .52. This clear tendency toward a floor effect might have prevented the detection of any source memory differences between different emotion conditions, rendering the present source memory test insensitive. Alternatively, though less likely, drawing participants' attention to the to-be-tested source feature (i.e., spatial location of the target items) at encoding by the cover task might have inadvertently affected item-source binding processes, potentially obscuring the detrimental effects of self-focused attention on memory. Future research using a source memory test of lower difficulty (e.g., by using a smaller number of target stimuli), different types of encoding tasks, and/or different contextual features (i.e., those that are intrinsic [e.g., colour, shape] vs. extrinsic [e.g., location, background colour] to an item) may uncover the reasons for the present null finding and further clarify the relationship between emotion-induced self-focused attention and source memory.

The present study has several limitations that can be addressed in future research. First, the present study only included negative emotions. Thus, the question remains as to whether the detrimental effects of self-focused attention shown with negative emotions in the present study would generalize to positive emotions (e.g., pride, contentment, excitement). In this regard, it would also be interesting to see whether manipulating the attentional focus of the same emotion (e.g., anger toward [happiness for] *oneself* vs. *someone else*) would produce results similar to those observed with discrete emotions.

Second, although the locus of the negative effects of self-focused attention on item memory is likely at encoding given the relative resiliency of the retrieval processes to reduced cognitive/attentional resources (Baddeley et al., 1984; Craik et al., 1996; Naveh-Benjamin et al., 2000) and our use of immediate memory tests with little or no retention interval, the present study cannot conclusively ascertain whether or not retention- and/or retrieval-related processes, at least partly, contributed to the observed effects. It has been noted that induced emotions/moods last for a relatively short time period, especially after an intervening task (e.g., no effects of induced mood after a 4-min intervening task; Isen & Gorgoglione, 1983). Thus, we believe that it is unlikely that the induced emotions in the present study have sustained until after the intervening encoding task to affect subsequent retention or retrieval processes. Nevertheless, future research should systematically determine the relative contribution of the encoding vs. retention or retrieval processes to the emergence of the negative impact of emotion-induced self-focused attention on memory by manipulating whether emotion/mood induction phase takes place before encoding or just prior to retrieval or by varying the retention interval while repeatedly assessing mood/emotion at different stages of memory processing. For example, if the observed item memory impairment is partly due to the effects of emotion-induced self-focused attention operating at retrieval, then introducing a longer retention interval (e.g., hours, days) within the current study procedure should reduce the magnitude of the memory impairment as induced emotion/self-focused attention is likely to have returned to baseline at the time delayed memory tests are administered.

Third, the present study used two different tasks, autobiographical recall and a transcribing task, to induce shame and anger vs. control/neutral emotion, respectively. Thus, the shame and anger conditions differed from the control condition not only in the induced mood valence/intensity and self-focused attention but also in terms of the requirement for memory-related operations during emotion/mood induction. Given our finding of a negative mediating effect of self-focused attention in the shame vs. anger conditions that were matched for memory-related operations and various memory characteristics, we believe that the memory-related qualitative difference between the two emotion conditions and the control condition is unlikely to be the major factor contributing to the observed negative effects of self-focused attention on memory. Nonetheless, replication of the present findings with a "true" control condition (e.g., by having the participants recall a neutrally-valenced event such as a daily routine) is clearly desirable to provide further evidence for the negative impact of emotion-induced self-focused attention on subsequent memory processes.

Finally, although demonstrating a detrimental effect of emotion-induced self-focused attention on subsequent item memory, the present study does not directly elucidate the mechanisms involved. Future research is warranted to explore the precise mechanisms (e.g., ruminative processing, mind wandering) through which emotion-induced self-focused attention negatively affects subsequent memory processes by directly assessing the amount of rumination or mind-wandering engaged during the encoding of subsequently presented external information.

References

Agatstein. F. C., & Buchanan, D. B. (1984). Public and private self-consciousness and the recall of self-relevant information. *Personality and Social Psychology Bulletin*, *10*, 314-325. doi:10.1177/0146167284102019

Allen, R. J., Schaefer, A., & Falcon, T. (2014). Recollecting positive and negative autobiographical memories disrupts working memory. *Acta Psychologica*, *151*, 237-243. doi:10.1016/j.actpsy.2014.07.003

Bargh, J. A. (1982). Atttention and automaticity in the processing of self-relevant information. *Journal of Personality and Social Psychology*, *43*, 425-436. doi:10.1037/0022-3514.43.3.425

Baddeley, A. D., Lewis, V., Eldridge, M., & Thomson, N. (1984). Attention and retrieval from long-term memory. *Journal of Experimental Psychology: General*, *13*, 518-540. doi:10.1037/0096-3445.113.4.518

Bradley, M. M., & Lang, P. J. (1999). *Affective Norms for English Words (ANEW): Instruction manual and affective ratings* (Technical Report C-1). Gainesville, FL: The Center for Research in Psychophysiology, University of Florida. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.306.3881

Carver, C. S. (1979). A cybernetic model of self-attention processes. *Journal of Personality and Social Psychology*, *37*, 1251-1280. doi:10.1037/0022-3514.37.8.1251

Carver, C. S., & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin*, *135*, 183-204. doi:10.1037/a0013965

Carver, C. S., & Scheier, M. F. (1981). *Attention and self-regulation: A control theory approach to human behavior*. New York, NY: Springer.

Craik, F. I. M., Govoni, R., Naveh-Benjamin, M., & Anderson, N. D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *Journal of Experimental Psychology: General*, *125*, 159-180. doi:10.1037/0096-3445.125.2.159

Cortheart, M. (1981). The MRC Psycholinguistic Database. *Quarterly Journal of Experimental Psychology*, *33A*, 497-505. doi:10.1080/14640748108400805

Curci, A., Lanciano, T., Soleti, E., & Rimé, B. (2013). Negative emotional experiences arouse rumination and affect working memory capacity. *Emotion*, *13*, 867-880. doi:10.1037/a0032492

Davidson, P. S. R., McFarland, C. P., & Glisky, E. L. (2006). Effects of emotion on item and source memory in young and old adults. *Cognitive, Affective, & Behavioral Neuroscience*, *6*, 306-322. doi:10.3758/CABN.6.4.306

Doerksen, S., & Shimamura, A. P. (2001). Source memory enhancement for emotional words. *Emotion*, *1*, 5-11. doi:10.1037/1528-3542.1.1.5

Duval, S., Duval, V. H., & Mulilis, J. P. (1992). Effects of self-focus, discrepancy between self and standard, and outcome expectancy favorability on the tendency to match self to standard or to withdraw. *Journal of Personality and Social Psychology*, *62*, 340-348. doi:10.1037/0022-3514.62.2.340

Duval, S., & Wicklund, R. A. (1972). *A theory of objective self-awareness*. New York, NY: Academic Press.

Duval, S., & Wicklund, R. A. (1973). Effects of objective self-awareness on attribution of causality. *Journal of Experimental Social Psychology*, *9*, 17-31. doi:10.1016/0022-1031(73)90059-0

Eichstaedt, J., & Silvia, P. J. (2003). Noticing the self: Implicit assessment of self-focused attention using word recognition latencies. *Social Cognition*, *21*, 349-361. doi:10.1521/soco.21.5.349.28686

Ellis, H. C., Thomas, R. L., McFarland, A. D., & Lane, J. W. (1985). Emotional mood states and retrieval in episodic memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *11*, 363-370. doi:10.1037/0278-7393.11.2.363

Ellis, H. C., Thomas, R. L., & Rodriguez, I. A. (1984). Emotional mood states and memory: Elaborative encoding, semantic processing, and cognitive effort. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *10*, 470-482. doi:10.1037/0278-7393.10.3.470

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power3: A flexible statistical power analysis program for the social, behavioural, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191. doi:10.3758/BF03193146

Fenigstein, A. (1984). Self-consciousness and the overperception of self as a target. *Journal of Personality and Social Psychology*, *47*, 860-870. doi:10.1037/0022-3514.47.4.860

Fenigstein, A., Scheier, M. F., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology*, *43*, 522-527. doi:10.1037/h0076760

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion*, *19*, 313-332. doi:10.1080/02699930441000238

Frijda, N. H., Ortony, A., Sonnemans, J., & Clore, G. L. (1992). The complexity of intensity: Issues concerning the structure of emotion intensity. In M. Clark (Ed.), *Emotion: Review of personality and social psychology* (Vol. 13, pp. 60-89). Newbury Park, CA: Sage.

Gable, P., & Harmon-Jones, E. (2010). The motivational dimensional model of affect: Implications for breadth of attention, memory, and cognitive categorization. *Cognition and Emotion*, *24*, 322-337. doi:10.1080/02699930903378305

Gray, J. (2001). Emotional modulation of cognitive control: Approach-withdrawal states double-dissociate spatial from verbal two-back task performance. *Journal of Experimental Psychology: General*, *130*, 436-452. doi:10.1037/0096-3445.130.3.436

Green, J. D., & Sedikides, C. (1999). Affect and self-focused attention revisited: The role of affect orientation. *Personality and Social Psychology Bulletin*, *25*, 104-119. doi:10.1177/0146167299025001009

Green, J. D., Sedikides, C., Saltzberg, J. A., Wood, J. V., & Forzano, L. A. B. (2003). Happy mood decreases self-focused attention. *British Journal of Social Psychology*, *42*, 147-

157. doi:10.1348/014466603763276171

Hamilton, V. (1975). Socialization anxiety and information processing: A capacity model of anxiety-induced performance deficits. In I. G. Sarason & C. D. Spielberger (Eds.), *Stress and anxiety* (Vol. 2, pp. 45-68). New York, NY: Wiley.

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed). New York, NY: Guilford.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, *76*, 408-420. doi:10.1080/03637750903310360

Herrald, M. M., & Tomaka, J. (2002). Patterns of emotion-specific appraisal, coping, and cardiovascular reactivity during an ongoing emotional episode. *Journal of Personality and Social Psychology*, *8*, 434-450. doi:10.1037//0022-3514.83.2.434

Hertel, P. T., Benbow, A. A., & Geraerts, E. (2012). Brooding deficits in memory: Focusing attention improves subsequent recall. *Cognitive and Emotion*, *26*, 1516-1525. doi:10.1080/02699931.2012.668852

Hertel, P. T., & Rude, S. S. (1991). Depressive deficits in memory: Focusing attention improves subsequent recall. *Journal of Experimental Psychology: General*, *120*, 301-309. doi:10.1037/0096-3445.120.3.301

Hull, J. G., & Levy, A. S. (1979). The organizational functions of the self: An alternative to the Duval and Wicklund model of self-awareness. *Journal of Personality and Social Psychology*, *37*, 756-768. doi:10.1037/0022-3514.37.5.756

Hull, J. G., Slone, L. B., Meteyer, K. B., Matthews, A. R. (2002). The nonconsciousness of self-consciousness. *Journal of Personality and Social Psychology*, *83*, 406-424. doi:10.1037//0022-3514.83.2.406

Hull, J. G., Van Treuren, R. R., Ashford, S. J., Propsom, P., & Andrus, B. W. (1988). Self-consciousness and the processing of self-relevant information. *Journal of Personality and Social Psychology*, *54*, 452-465. doi:10.1037/0022-3514.54.3.452

Ingram, R. E. (1990). Self-focused attention in clinical disorders: Review and a conceptual model. *Psychological Bulletin*, *109*, 156-176. doi:10.1037/0033-2909.107.2.156

Isen, A. M., & Gorgoglione, J. M. (1983). Some specific effects of four affect-induction procedures. *Personality and Social Psychology Bulletin*, *9*, 136-143. doi:10.1177/0146167283091019

Johnson, M. K., Foley, M. A., Suengas, A. G., & Raye, C. L. (1988). Phenomenal characteristics of memory for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General*, *117*, 371-376. doi:10.1037/0096-3445.117.4.371

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, 114, 3-28. doi:10.1037/0033-2909.114.1.3

Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice Hall.

Keltner, D., Ellsworth, P. C., & Edwards, K. (1993). Beyond simple pessimism: Effects of sadness and anger on social perception. *Journal of Personality and Social Psychology*, *64*, 740-752. doi:10.1037/0022-3514.64.5.740

Kesebir, S., & Oishi, S. (2010). A spontaneous self-reference effect in memory: Why some birthdays are harder to remember than others. *Psychological Science*, *21*, 1525-1531. doi:10.1177/0956797610383436

Kimble, C. E., Hirt, E. R., & Arnold, E. M. (1985). Self-consciousness, public and private self-awareness, and memory in a social setting. *The Journal of Psychology*, *119*, 59-69. doi:10.1080/00223980.1985.9712607

Kimble, C. E., & Zehr, H. D. (1982). Self-consciousness, information load, self-presentation, and memory in a social situation. *The Journal of Social Psychology*, *118*, 39-46. doi:10.1080/00224545.1982.9924416

Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual Review of Psychology*, *44*, 1-22. doi:10.1146/annurev.ps.44.020193.000245

Mirandola, C., & Toffalini, E. (2016). Arousal—but not valence—reduces false memories at retrieval. *PLoS ONE*, *11*, e0148716. doi:10.1371/journal.pone.0148716

Mor, N., & Winquist, J. (2002). Self-focused attention and negative affect: A meta-analysis. *Psychological Bulletin*, *128*, 638-662. doi:10.1037//0033-2909.128.4.638

Nasby, W. (1985). Private self-consciousness, articulation of the self-schema, and recognition memory of trait adjectives. *Journal of Personality and Social Psychology*, *49*, 704-709. doi:10.1037/0022-3514.49.3.704

Naveh-Benjamin, M., Craik, F. I. M., Perretta, J. G., & Tonev, S. T. (2000). The effects of divided attention on encoding and retrieval processes: The resiliency of retrieval processes. *The Quarterly Journal of Experimental Psychology*, *53A*, 609-625. doi:10.1080/713755914

Nielson, K. A., & Bryant, T. (2005). The effects of noncontingent extrinsic and intrinsic rewards on memory consolidation. *Neurobiology of Learning and Memory*, *84*, 42-48. doi:10.1016/j.nlm.2005.03.004

Nielson, K. A., & Powless, M. (2007). Positive and negative sources of emotional arousal enhance long-term word-list retention when induced as long as thirty minutes after learning. *Neurobiology of Learning and Memory*, *88*, 40-47. doi:10.1016/j.nlm.2007.03.005

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*, 400-424. doi:10.1111/j.1745-6924.2008.00088.x

Panayiotou, G., Brown, R., & Vrana, S. R. (2007). Emotional dimensions as determinants of self-focused attention. *Cognition and Emotion*, *21*, 982-998. doi:10.1080/02699930701319170

Panayiotou, G., & Vrana, S. R. (1998). Effect of self-focused attention on the startle reflex, heart rate, and memory performance among socially anxious and nonanxious individuals. *Psychophysiology*, *35*, 328-336. doi:10.1017/S0048577298960875

Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology*, *35*, 677-688. doi:10.1037/0022-3514.35.9.677

Roskes, M., Elliot, A. J., Nijstad, B. A., & De Dreu, C. K. (2013). Avoidance motivation and conservation of energy. *Emotion Review*, *5*, 264-268. doi:10.1177/1754073913477512

Salovey, P. (1992). Mood-induced self-focused attention. *Journal of Personality and Social Psychology*, *62*, 699-707. doi:10.1037/0022-3514.62.4.699

Sedikides, C. (1992). Mood as a determinant of attentional focus. *Cognition and Emotion*, *6*, 129-148. doi:10.1080/02699939208411063

Schaefer, A., & Phillippot, P. (2005). Selective effects of emotion on the phenomenal characteristics of autobiographical memories. *Memory*, *13*, 148-160. doi:10.1080/09658210344000648

Scheier, M. F., Buss, A. H., & Buss, D. M. (1978). Self-consciousness, self-report of aggressiveness, and aggression. *Journal of Research in Personality*, *12*, 133-140. doi:10.1016/0092-6566(78)90089-2

Scheier, M. F., & Carver, C. (1977). Self-focused attention and the experience of emotion: Attraction, repulsion, elation, and depression. *Journal of Personality and Social Psychology*, *35*, 625-636. doi:10.1037/0022-3514.35.9.625

Scherer, K. R., & Wallbott, H. G. (1994). Evidence for universality and cultural variation of differential emotion response patterning. *Journal of Personality and Social Psychology*, *66*, 310-328. doi:10.1037/0022-3514.66.2.310

Serbun, S. J., Shih, J. Y., & Gutchess, A. H. (2011). Memory for details with self-referencing. *Memory*, *19*, 1004-1014. doi:10.1080/09658211.2011.626429

Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory: Mood and the false memory effect. *Psychological Science*, *16*, 785-791. doi:10.1111/j.1467-9280.2005.01615.x

Storbeck, J., Clore, G. L. (2011). Affect influences false memories at encoding: Evidence from recognition data. *Emotion*, *11*, 981-989. doi:10.1037/a0022754

Suengas, A. G., & Johnson, M. K. (1988). Qualitative effects of rehearsal on memories for perceived and imagined complex events. *Journal of Experimental Psychology: General*, *117*, 377-389. doi:10.1037/0096-3445.117.4.377

Sylvia, P. J., Kelly, C. S., Zibaie, A., Nardello, J. L., & Moore, L. C. (2013). Trait self-focused attention increases sensitivity to nonconscious primes: Evidence from effort-related cardiovascular reactivity. *International Journal of Psychophysiology*, *88*, 143-148. doi:10.1016/j.ijpsycho.2013.03.007

Tangney, J. P., & Dearing, R. L. (2002). *Shame and guilt*. New York, NY: Guilford.

Tangney, J. P., Miller, R. S., Flicker, L., & Barlow, D. H. (1996). Are shame, guilt, and embarrassment distinct emotions? *Journal of Personality and Social Psychology*, *70*, 1256-1269. doi:doi.org/10.1037/0022-3514.70.6.1256

Threadgill, A. H., & Gable, P. (2019). Negative affect varying in motivational intensity influences scope of memory. *Cognition and Emotion*, *33*, 332-345. doi:10.1080/02699931.2018.1451306

Tracy, J. L., & Robins, R. W. (2007). The self in self-conscious emotions: A cognitive appraisal approach. In J. L. Tracy, R. W. Robins, & J. P. Tangney (Eds.), *The self-conscious emotions: Theory and research* (pp. 3-20). New York, NY: Guilford.

Troyer, A. K., Winocur, G., Craik, F. I. M., & Moscovitch, M. (1999). Source memory and divided attention: Reciprocal costs to primary and secondary tasks. *Neuropsychology*, *13*, 467-474. doi:10.1037/0894-4105.13.4.467

Vallacher, R. R. (1978). Objective self-awareness and the perception of others. *Personality and Social Psychology Bulletin*, *4*, 63-67. doi:10.1177/014616727800400113

Van Damme, I. (2013). Mood and the DRM paradigm: An investigation of the effects of valence and arousal on false memory. *The Quarterly Journal of Experimental Psychology*, *66*, 1060-1081. doi:10.1080/17470218.2012.727837.

Wang, B. (2015). Negative emotion elicited in high school students enhances consolidation of item memory, but not source memory. *Consciousness and Cognition*, *33*, 185-195. doi:10.1016/j.concog.2014.12.015

Wang, B., & Sun, B. (2015). Timing matters: Negative emotion elicited 5 min but not 30 min or 45 min after leaning enhances consolidation of internal-monitoring source memory. *Acta Psychologica*, *157*, 56-64. doi:10.1016/j.actpsy.2015.02.006

Watkins, E., & Brown, R. G. (2002). Rumination and executive function in depression: An experimental study. *Journal of Neurology, Neurosurgery, & Psychiatry*, *72*, 400-402. doi:10.1136/jnnp.72.3.400

Wells, G. L., Hoffman, C., & Enzle, M. E. (1984). Self- versus other-referent processing at encoding and retrieval. *Personality and Social Psychology Bulletin*, *10*, 574-584. doi:10.1177/0146167284104010

Wood, J. V., Saltzberg, J. A., & Goldsamt, L. A. (1990). Does affect induce self-focused attention? *Journal of Personality and Social Psychology*, *58*, 899-908. doi:10.1037/0022-3514.58.5.899

Appendix A

The structure of the MCQ composite variables, Cronbach's Alphas, and corresponding items

Composite Variable	Cronbach's α	Items
Clarity	.835	*My memory for the event was dim vs. sharp/clear.* *My memory for the event involved visual details.* *My memory for the event was sketchy vs. very detailed.* *The order of events in my memory was confusing vs. comprehensible.* *Overall, my memory for the event was vague vs. very vivid.* *Overall, I remembered the event hardly vs. very well.*
Sensory	.605	*My memory for the event involved sound.* *My memory for the event involved smell.* *My memory for the event involved taste.* *My memory for the event involved touch.*
Contextual	.630	*My memory for the location where the event took place was vague vs. clear/distinct.* *In my memory, relative spatial arrangement of objects was vague vs. clear/distinct.* *In my memory, relative spatial arrangement of people was vague vs. clear/distinct.*
Time	.729	*My memory for the time when the event took place was vague vs. clear/distinct.* *My memory for the year when the event took place was vague vs. clear/distinct.* *My memory for the season when the event took place was vague vs. clear/distinct.* *My memory for the day when the event took place was vague vs. clear/distinct.* *My memory for the hour when the event took place was vague vs. clear/distinct.*
Thoughts and Feelings	.645	*I remembered what I thought at the time when the event took place: Not at all vs. clearly.* *I remembered how I felt at the time when the event took place: not at all vs. clearly.*
Valence of Feelings*		*My feelings at the time when the event took place were negative vs. positive.*
Intensity of Feelings*		*My feelings at the time when the event took place were not intense vs. very intense.*

Note: * The Intensity of Feelings and the Valence of Feelings were assessed using single items.

Appendix B

Statistical results of item memory using d-prime as a measure of performance

The proportion of missing responses (Shame: $M = .004$, $SD = .007$; Anger: $M = .004$, $SD = .009$; Control: $M = .004$, $SD = .007$) did not significantly differ across the emotion conditions, $F(2, 237) = 0.122$, $p = .885$. Missing responses were counted as incorrect responses. For each participant, d-prime score was calculated by subtracting z-score-transformed false-alarm rates (the proportion of "new" words incorrectly identified as old) from z-score-transformed hit rates (i.e., the proportion of "old" words correctly recognised as old). One-sample t-tests showed that d-prime scores were significantly above chance performance level of zero across all Emotion conditions, all $t(79)$s > 15.472, all ps < .05. A one-way ANOVA conducted on d-prime scores with Emotion (shame, anger, control) as the between-subjects factor revealed a significant effect of Emotion, $F(2, 237) = 5.317$, $p = .006$, $\eta_p^2 = .043$. Bonferroni-corrected post-hoc tests revealed that item memory was significantly impaired in the Shame condition ($M = .770$, $SD = .445$) compared to both the Anger ($M = .973$, $SD = .372$), $p = .010$, and Control conditions ($M = .950$, $SD = .472$), $p = .026$. Item memory did not significantly differ between the Anger and Control conditions, $p = .999$.

To examine whether self-focused attention mediated the effect of Emotion condition on item memory performance, we ran two mediation analyses with PROCESS macro for SPSS (model 4; Hayes, 2018) using bootstrapping procedures with 10,000 samples. In the first analysis, we dummy-coded the Emotion condition to examine the relative direct effect, indirect effect, and total effect (i.e., the sum of the direct and indirect effects) of the Shame condition and Anger condition, respectively, relative to the Control condition (i.e., reference group). In the second analysis, we used two orthogonal contrasts to examine relative direct, indirect, and total effects of (a) Shame and Anger conditions collectively (i.e., Emotions) relative to the Control condition (contrast coded as Shame = 1/3, Anger = 1/3, Control = –2/3) and (b) the Shame condition relative to the Anger condition (contrast coded as Shame = 1/2, Anger = –1/2, Control = 0), respectively.

As shown in Table A1, relative to the Control condition, the Shame condition had a significant negative indirect effect on item memory accuracy via self-focused attention as well as a significant negative total effect, but a nonsignificant direct effect. Relative to the Control condition, the Anger condition had a significant negative indirect effect on item memory via self-focused attention but a nonsignificant total effect, suggesting that the nonsignificant yet positive direct effect counteracted the negative indirect effect. Relative to the Control condition, the two emotion conditions (Shame and Anger) collectively had a significant negative indirect effect on item memory accuracy via self-focused attention, but nonsignificant direct and total effects. Relative to the Anger condition, the Shame condition had a significant indirect effect on item memory accuracy via self-focused attention as well as significant direct and total effects, all of which were in a negative direction.

Table A1

Regression coefficients for mediation analyses examining the effect of Emotion condition on item memory accuracy (as calculated as d-prime score) via self-focused attention.

Regression	*B*	*SE*	*t*	*p*	LLCI	ULCI
			Relative total effects			
Shame (vs. Control)	–0.180	0.068	–2.642	.009	–0.315	–0.046
Anger (vs. Control)	0.023	0.068	0.335	.738	–0.112	0.157
Emotions (vs. Control)	–0.079	0.059	–1.332	.184	–0.195	0.038
Shame (vs. Anger)	–0.203	0.068	–2.977	.003	–0.338	–0.069
			Relative direct effects			
Shame (vs. Control)	–0.080	0.079	–1.015	.311	–0.234	0.075
Anger (vs. Control)	0.071	0.070	1.011	.313	–0.067	0.209
Emotions (vs. Control)	–0.004	0.066	–0.067	.947	–0.133	0.125
Shame (vs. Anger)	–0.151	0.071	–2.131	.034	–0.290	–0.011

	Relative indirect effects			
	Estimate	Boot *SE*	Boot LLCI	Boot ULCI
Shame (vs. Control)	–0.101	0.048	–.0199	–0.011
Anger (vs. Control)	–0.048	0.025	–0.105	–0.005
Emotions (vs. Control)	–0.074	0.036	–0.150	–0.008
Shame (vs. Anger)	–0.053	0.026	–0.107	–0.005

Note: *B* = unstandardized regression coefficient; *SE* = unstandardized standard error; LLCI = lower-limit confidence interval; ULCI = upper-limit confidence interval; Boot = bootstrap.

Appendix C

Statistical results of source memory accuracy conditionalised on correct item recognition

Source memory accuracy was calculated as the proportion of correctly recognized old words that were attributed to the correct source, P(source correct | hit). The overall proportion of missing responses (Shame: M = .004, SD = .009; Anger: M = .005, SD = .010; Control: M = .004, SD = .009) did not significantly differ across the emotion conditions, $F(2, 237) = 0.246$, p = .782. Missing responses were counted as incorrect responses, conditionalised on correct item recognition. One-sample t-tests showed that source memory accuracy was significantly above chance performance level of .50 across all Emotion conditions, all $t(79)$s > 2.884, all ps < .05. A one-way ANOVA with Emotion (shame, anger, control) as the between-subjects factor revealed no significant effect of Emotion, $F(2, 237) = 0.132$, p = .877 (Shame: M = .533, SD = .093; Anger: M = .531, SD = .097; Control: M = .539, SD = .104).

To examine whether self-focused attention mediated the effect of Emotion condition on source memory performance, we ran two mediation analyses using PROCESS macro for SPSS (model 4; Hayes, 2018) using bootstrapping procedures with 10,000 samples. In the first analysis, we dummy-coded the Emotion condition to examine the relative direct effect, indirect effect, and total effect (i.e., the sum of the direct and indirect effects) of the Shame condition and Anger condition, respectively, relative to the Control condition (i.e., reference group). In the second analysis, we used orthogonal contrasts to examine relative direct, indirect, and total effects of (a) Shame and Anger conditions collectively (i.e., Emotions) relative to the Control condition (contrast coded as Shame = 1/3, Anger = 1/3, Control = –2/3) and (b) the Shame condition relative to the Anger condition (contrast coded as Shame = 1/2, Anger = –1/2, Control = 0), respectively. As shown in Table A2, the results of these analyses revealed that none of the direct, indirect, or total effects was statistically significant.

Table A2
Regression coefficients for mediation analyses examining the effect of Emotion condition on source memory accuracy (conditionalised on correct item recognition) via self-focused attention.

Regression	*B*	*SE*	*t*	*p*	LLCI	ULCI
			Relative total effects			
Shame (vs. Control)	–0.006	0.016	–0.393	.695	–0.037	0.025
Anger (vs. Control)	–0.008	0.016	–0.483	.630	–0.038	0.023
Emotions (vs. Control)	–0.007	0.013	–0.505	.614	–0.033	0.020
Shame (vs. Anger)	0.001	0.016	0.090	.928	–0.029	0.032
			Relative direct effects			
Shame (vs. Control)	0.007	0.018	0.363	.717	–0.029	0.042
Anger (vs. Control)	–0.002	0.016	–0.091	.928	–0.033	0.030
Emotions (vs. Control)	0.003	0.015	0.169	.866	–0.027	0.032
Shame (vs. Anger)	0.008	0.016	0.493	.622	–0.024	0.040

	Relative indirect effects			
	Estimate	Boot *SE*	Boot LLCI	Boot ULCI
Shame (vs. Control)	–0.013	0.010	–0.032	.006
Anger (vs. Control)	–0.006	0.005	–0.017	.003
Emotions (vs. Control)	–0.009	0.007	–0.024	.005
Shame (vs. Anger)	–0.007	0.005	–0.018	.004

Note: *B* = unstandardized regression coefficient; *SE* = unstandardized standard error; LLCI = lower-limit confidence interval; ULCI = upper-limit confidence interval; Boot = bootstrap.