Attentional bias towards angry faces in trait-reappraisal

Jody E. Arndt *, Esther Fujiwara

Department of Psychiatry, 1E1 WC Mackenzie Health Sciences Centre, University of Alberta, Edmonton, AB, Canada T6G 2R7

ARTICLE INFO

Article history:
Received 31 May 2011
Received in revised form 26 August 2011
Accepted 31 August 2011
Available online 2 October 2011

Keywords:
Trait emotion regulation
Reappraisal
Attention
Individual differences
Dot-probe

ABSTRACT

Emotion regulation (ER) strategies differ in when and how they influence emotion experience, expression, and concomitant cognition. However, no study to date has directly compared cognition in individuals who have a clear disposition for either cognitive or behavioural ER strategies. The present study compared selective attention to angry faces in groups of high trait-suppressors (people who are hiding emotional reactions in response to emotional challenge) and high trait-reappraisers (people who cognitively reinterpret emotional events). Since reappraisers are also low trait-anxious and suppressors are high trait-anxious, high and low anxious control groups, both being low in trait-ER, were also included. Attention to angry faces was assessed using an emotional dot-probe task. Trait-reappraisers and high-anxious individuals both showed attentional biases towards angry faces. Trait-reappraisers’ vigilance for angry faces was significantly more pronounced compared to both trait-suppressors and low anxious controls. We suggest that threat prioritization in high trait-reappraisal may allow deeper cognitive processing of threat information without being associated with psychological maladjustment.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

An extensive literature suggests that cognition is influenced by the emotional connotation of to-be-processed information. Emotional events, especially negative emotional events, orient, attract and/or capture attention more so than neutral events. Evidence comes from studies using the emotional dot-probe paradigm (MacLeod & Mathews, 1988). This task measures selective attention biases towards or away from emotional relative to neutral stimuli (see Methods for details). Several person variables influence such biases. For example, high trait anxious individuals are more likely than low trait anxious individuals to show an attentional bias towards threatening stimuli (Frewen, Dozois, Joanisse, & Neufeld, 2008). Interestingly, trait anxiety seems to modify the ability to disengage attentional resources from the location of a threatening stimulus more so than the speed of orienting attention toward the stimulus location. For example, Fox, Russo, Bowles, and Dutton (2001) found that high anxious, but not low anxious individuals responded slower to a dot-probe when an angry face, as opposed to a happy or a neutral face, appeared in a different screen location just prior. However, high anxious participants were not faster to respond to the dot-probe when it followed in the same location as the angry faces compared to happy or neutral faces (attentional orienting). Hence, trait anxiety seems associated with a tendency to dwell on (i.e., difficulty in disengaging attention), rather than to quickly orient toward, threatening stimuli such as angry facial expressions.

Although it is relatively well-established that individual differences in trait emotionality (i.e., high versus low trait anxiety) influence attentional processing of emotional information, little is known about how attentional biases may interact with a person’s attempt to modulate their emotional responses. Recent findings in emotion regulation (ER) suggest that emotion regulative strategies differ in their consequences for the emotional response and concomitant cognition. To date, most studies of ER have compared cognitive and behavioural forms of ER, with the two most commonly studied ER strategies being cognitive reappraisal and expressive suppression (Gross, 1998; Richards & Gross, 2000). According to Gross (1998), reappraisal involves cognitively changing our appraisal of the emotional meaning of a stimulus in order to render it less emotional, and in so doing, down-regulating our own emotional response. In contrast, suppression involves the behavioural inhibition of overt reactions to emotional experiences (e.g., frowning) without changing the evaluation of the emotional stimulus itself.

1.1. Instructed emotion regulation

To examine the consequences of ER, researchers have traditionally exposed participants to an emotion-eliciting stimulus with an instruction to use a specific ER strategy to down-regulate (or more rarely, up-regulate) the resulting emotion. Because participants are
instructed by the researcher to employ a specific ER strategy, we refer to this type of ER as instructed ER. Instructed reappraisal and suppression have divergent effects on the experience and expression of emotion (Gross & Levenson, 1997; Lazarus & Alfert, 1964). Instructed reappraisal decreases negative emotional responding, as evidenced by decreased physical displays of emotion, self-reported negative affect (Gross, 1998), and peripheral physiological responding (Ohira et al., 2006). Conversely, instructed suppression reduces the behavioural expression of negative emotion, but does not result in parallel decreases in negative emotion experience (Richards & Gross, 2000). Thus, while instructed reappraisal results in genuine reductions to the emotional experience, instructed suppression does not.

Instructed reappraisal and suppression also influence cognition in different ways: While reappraisal has been shown to increase explicit memory for reappraised stimuli (Dillon, Ritchey, Johnson, & LaBar, 2007; Hayes et al., 2010; Richards, Butler, & Gross, 2003), suppression decreases memory (Bonanno, Papa, O’Neill, Westphal, & Coifman, 2004; Dillon et al., 2007; Richards & Gross, 2000, studies 1–2). Dillon and colleagues (2007) proposed that the memory advantage caused by instructed reappraisal is related to extensive cognitive analysis of a negative stimulus, promoting deep and elaborative semantic encoding. Conversely, during instructed suppression, actively trying to inhibit emotional expression may direct attention away from stimulus elaboration, resulting in poorer memory performance. Indeed, Bebko, Franco-neri, Ochsner, and Chiao (2011) used eye-tracking to examine the influence of instructed reappraisal and suppression on attention to negative pictures. Compared to instructed suppression, instructed reappraisal increased attentional deployment to negative pictures. Thus, instructed reappraisal, but not instructed suppression, seems to increase attention to and memory for emotional information.

1.2. Trait emotion regulation

It is rare that in our daily lives other people instruct us to regulate our emotions using a specific ER strategy. Rather, if we aim to change our emotions, we normally regulate them of our own accord and relatively automatically (i.e., trait-ER; Williams, Bargh, Nocera, & Gray, 2009). Studies of trait-ER have considered individual differences in the habitual use of reappraisal and suppression measured by the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). With a 3-month test-retest reliability of $r = 0.69$ for ERQ reappraisal and suppression subscales, both constructs represent reasonably stable personality differences. Similar to findings in instructed ER, research using the ERQ has shown that trait-reappraisal is associated with lower levels of negative emotion, better social functioning, and greater physical and mental well-being compared to trait-suppression (Gross & John, 2003).

Research on cognitive consequences of emotion regulation using an individual differences approach however, is rather limited. Richards and Gross (2000; study 3) examined the influence of trait-reappraisal and trait-suppression (measured with the ERQ) on memory. Memory was assessed by asking participants to recall episodes during which they regulated their emotions over a 2-week period that had been recorded daily in diary form. A self-report measure of general memory abilities was also administered. Findings showed that individuals scoring higher on suppression recalled fewer episodes and also self-reported worse memory than low suppression scorers. In contrast, trait-reappraisal had no impact on either self-reported or objective memory. These findings are generally in line with instructed ER findings and suggest that while suppression is cognitively costly and impacts memory, reappraisal may result in less cognitive cost.

1.3. The current study

Based on these two lines of evidence an interesting discrepancy emerges: Instructed reappraisal effectively reduces negative emotions while instructed suppression does not. Similarly, trait-reappraisers have lower levels of negative emotion than trait-suppressors. Since low levels of emotionality (e.g., low state and/or trait anxiety) are associated with decreased attention and vigilance to negative information (Fox et al., 2001; Frewen et al., 2008), one may predict a reduced sensitivity of trait-reappraisers to detect, attend, and process negative information compared to trait-suppressors. This prediction conflicts with known effects of ER on cognition: Whereas instructed reappraisal increases attention to emotion and does not impair emotional memory, suppression reduces memory for emotional materials presented under suppression instruction. Similarly, trait-suppression, but not trait-reappraisal is linked to memory reductions. Better memory for emotional information in instructed or trait-reappraisal compared to suppression then could be mediated by increases rather than decreases in selective attention to emotional information in trait-reappraisal (i.e., one likely has better memory for attended than unattended events). Our study tested these two alternative hypotheses: (1) Since trait-reappraisers experience less negative emotions on a daily basis than trait-suppressors, they may have decreased attention to emotional information compared to suppressors. (2) Alternatively, since instructed reappraisal increases attention and memory, trait-suppressors may also show increased attention to emotional information compared to suppressors. Our dependent measure was selective attention in an emotional dot-probe task (MacLeod & Mathews, 1988) measuring selective attention biases toward or away from emotional stimuli. Given that in Western societies, we are more frequently required to down-regulate negative emotions (e.g., anger) compared to positive emotions (e.g., happiness), we chose angry faces as emotional stimuli.

The following additional hypotheses were tested: To isolate known influences of anxiety on the emotional dot-probe task from trait-ER influences (Frewen et al., 2008), we compared reappraisers to a low-ER low-anxious control group and suppressors to a low-ER high-anxious control group. If trait-ER indeed modulates anxiety influences on attention we should see disparate biases in high trait-ER groups compared to their low-ER controls (reappraisers > low-anxious; suppressors < high-anxious). If trait-ER does not change anxiety influences on attention, high trait-ER groups should behave similarly to their low-ER controls, matched in anxiety (reappraisers = low anxious; suppressors = high-anxious). Finally, the two low-ER control groups were compared as a manipulation check assuming low-anxious individuals will show a smaller attentional bias than high-anxious individuals (Frewen et al., 2008).

2. Methods

2.1. Participants

Participants were recruited according to their scores on the ERQ (Gross & John, 2003), the trait version of the Spielberger State-Trait Anxiety Inventory (STAI-T; Spielberger, 1983), and the Balanced Inventory of Desirable Responding (BIDR; Paulhus, 1991), from a database of 3573 students who participated in online testing sessions in the Department of Psychology at the University of Alberta. Individuals with ERQ-reappraisal scores greater than 4 and ERQ-suppression scores less than 4 and at least 2 points lower than their ERQ-reappraisal score comprised the reappraisal group (‘R-group’: N = 27). Participants with ERQ-suppression scores greater than 4 and ERQ-reappraisal scores less than 4 and at least 2 points lower than their ERQ-suppression scores were assigned to the
suppression group ('S-group'; N = 23; similar to the procedure used by Abler, Hofer, & Viviani, 2008). Individuals with low scores on the STA-I (less than the median of 42) and low scores on both ER scales (reappraisal and suppression scores less than 4, with less than a 2-point difference between the two) were assigned to the low-anxiety group ('LA-group'; N = 23). The high-anxiety group consisted of individuals with high STA-I scores (greater than 42) and low scores on both ER scales ('HA-group'; N = 22). There were 51 females and 44 males (mean age: 19.93 ± 2.2 years). Participants provided written informed consent and received partial course credit for their participation.

2.2. Stimuli

We drew 72 face photographs from three standardized databases ( NimStim Database1; Ekman & Friesen, 1975; Lyons, Akamatsu, Kamachi, & Gyoba, 1998). Faces were presented in neutral–neutral pairs or angry–neutral pairs. The 72 faces were selected on the basis of 10 judges’ ratings of how angry and how emotional each expression was (rated on two 7-point Likert scales). The 54 photos with the lowest scores on both scales were selected as neutral faces; the 18 photos with the highest scores were selected as angry faces. Photographs were presented side-by-side in pairs. All photographs were 198 pixels in height by 140 pixels in width. Faces measured 45 by 30 mm (subtending a visual angle of 1.9° horizontally and 2.9° vertically) on screen; the distance between the inner edges of a pair of faces was 64 mm (subtending a visual angle of 2.0°). The dot-probe stimulus was a 1 mm diameter grey dot (subtending a visual angle of 0.1°) displayed on a dark screen. Ten neutral–neutral face pairs were used as practice items.

2.3. Procedure

The task consisted of 20 practice trials and 864 experimental trials (432 angry–neutral face pairs and 432 neutral–neutral face pairs) presented in a new random order for each participant. On angry–neutral trials, half of the angry faces were presented on the right side of the screen and half on the left. In equal number of trials, the dot-probe appeared in the location of the neutral face and in the location of the angry face (i.e., no predictive relationship between angry face position and dot-probe position). In total, there were six experimental conditions (ARPR, ARPL, ALPR, ALPL, ARNP, ALNP; A = angry, P = probe, N = No probe, R = right, L = left) with 72 trials each. Neutral–neutral face pair trials were included to determine whether attentional biases resulted from heightened orientation towards angry faces, difficulty in disengaging attention from angry faces, or both (Salemink, van den Hout, & Kindt, 2007).

Participants completed the task individually in a quiet, moderately-lit room, seated approximately 90 cm from a computer monitor. The task was programmed using Inquisit 2.0.61004.7 [Computer software] (2007). Each trial began with the presentation of a central fixation mark for 500 ms, followed by a pair of faces for 250 ms, one shown to the right of the fixation mark and one to the left. On 67% of trials, a dot-probe stimulus then appeared in the location of one of the faces. The dot-probe remained on the screen until the participant indicated its location (left/right) with a key press. Participants were instructed to respond as quickly and as accurately as possible. The remaining 33% of trials (N = 288; 50% angry–neutral, 50% neutral–neutral face pairs) were catch trials in which no dot-probe appeared, automatically ending after 1000 ms. Participants were instructed to make no response on the catch trials. Catch trials discourage participants from attending to only one side of the display and responding to mere presence or absence of the dot-probe. The intertrial–interval was 1000 ms.

3. Results

3.1. Participant characteristics

Descriptive statistics of the experimental and control groups are presented in Table 1.

3.2. ER and dot-probe

Data analysis for the dot-probe task was based on reaction times (RTs) for correct responses. Error trials were discarded (0.9% of the data). Reaction times less than 200 ms, greater than 2000 ms, and greater than 3 SDs above a participant’s mean were considered outliers and excluded from all analyses (3.5% of the data).

Attentional bias scores were calculated by subtracting mean RTs to probes in the location of an angry face from mean RTs to probes in the location of a neutral face in angry–neutral face pairings (MacLeod & Mathews, 1988). Positive attentional bias scores reflect faster responses to probes replacing angry rather than neutral faces, consistent with vigilance for angry faces relative to neutral faces. Conversely, negative attentional bias scores reflect avoidance of angry faces. Attentional bias scores for each of the four groups are shown in Fig. 1A. One-sample t-tests comparing bias scores against zero indicated that only the R-group had a positive attentional bias, t(26) = 3.17, p < .005, Cohen’s d = 1.24; none of the other three groups had a bias that was significantly different from zero, S-group: t(22) = 0.60, p = .55; LA-group: t(22) = 0.26, p = .80; HA-group: t(22) = 1.51, p = .14.

A simple ANOVA with group as the between-subjects factor and attentional bias scores as the dependent variable showed marginally significantly differences in attentional bias, F(3,91) = 2.49, p = .07. To test the hypotheses of the current experiment, four planned comparisons were carried out to follow up this trend effect in the ANOVA. First, the R-group was significantly more vigilant for angry faces than the S-group, t(48) = 2.53, p < .05, d = 0.71, contrary to our first hypothesis, but consistent with our alternate hypothesis. Second, the R-group was significantly more vigilant for angry faces than the LA-group, t(47) = 2.53, p < .05, d = 0.74. Third, comparing the S-group to the HA-group revealed no significant difference in their mean attentional bias scores, t(36.2) = 1.61, p = .12, d = .47. Lastly, the HA-group and LA-group did not significantly differ in their attentional bias scores, t(29.6) = 1.50, p = .15, d = 0.44.

3.3. Attentional orienting versus disengagement

To determine whether attention biases mediated by trait-ER is due to attentional orientation or attentional disengagement, indices for both components of selective attention were calculated (Salemink et al., 2007). An orienting index was calculated by subtracting mean RTs to dots replacing angry faces in anger–neutral pairs from mean RTs to dots replacing neutral faces in neutral–neutral pairs. Positive scores reflect faster orienting to angry rather than neutral faces. T-tests against zero indicated none of the four groups had significant attentional orienting towards or away from angry faces (all ps > .10). Additionally, there were no significant between-group differences in orienting (all ps > .10). A disengagement index was calculated by subtracting mean RTs to dots replacing neutral faces in neutral–neutral pairs from mean RTs to dots replacing neutral faces in angry–neutral pairs. Positive scores...
HA-group, t(26) = 2.55, p < .05, d = 1.00, and t(22) = 2.18, p < .05, d = 0.93, respectively. In contrast, the S-group showed a trend to disengage from angry faces, compared to both the LA-group and the HA-group, t(26) = 2.55, p < .05, d = 1.00, and t(22) = 2.18, p < .05, d = 0.93, respectively. Consistent with previous studies (Salemink et al., 2007), the HA-group was significantly slower to disengage attention from angry faces than the LA-group, t(28.8) = 2.40, p < .05, d = 0.71.

Table 1
Characteristics of the participant groups. R-group: reappraisers, S-group: suppressors, LA-group: low-anxious control group; HA-group: high-anxious control group.

<table>
<thead>
<tr>
<th></th>
<th>R-group (N = 27)</th>
<th>S-group (N = 23)</th>
<th>LA-group (N = 23)</th>
<th>HA-group (N = 22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERQ reappraisal</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ERQ suppression</td>
<td>2.3</td>
<td>0.8</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>STAI-T</td>
<td>40.6</td>
<td>6.6</td>
<td>55.2</td>
<td>4.8</td>
</tr>
<tr>
<td>% Female</td>
<td>59</td>
<td>48</td>
<td>52</td>
<td>48</td>
</tr>
</tbody>
</table>

ERQ: Emotion Regulation Questionnaire. STAI-T: State-Trait Anxiety Inventory (trait-score). BIDR: Balanced Inventory of Desirable Responding (total score). Means with the same subscript are not significantly different at p < .05.

4. Discussion

Our main finding was that trait-reappraisers were significantly more vigilant for angry faces compared to suppressors and also compared to similarly low-anxious but non-regulating individuals. This favours our alternate hypothesis: Trait-reappraisal is associated with heightened selective attention to threat. In addition, trait-suppressors had no significant attentional bias towards or away from negative information and did not differ statistically from similarly high-anxious, non-regulating individuals in their attention biases. Finally, high-anxious individuals were slower to disengage attention from angry faces than low-anxious individuals, confirming previous studies (Frewen et al., 2008) and providing a manipulation check.

Finding significant attentional biases towards and delayed disengagement from negative compared to neutral information in trait-reappraisers complements studies on ER-cognition interactions that suggest memory for emotional events is unaffected by instructed reappraisal (e.g., Dillon et al., 2007; Richards & Gross, 2000). Specifically, if high trait-reappraisal promotes attention to negative materials, trait-reappraisers may also have intact or superior encoding and retrieval of negative information. Our results are consistent with those of Bebko et al. (2011) who recently showed through eye-tracking (pupil size, fixation count) that instructed reappraisal enhances attentional deployment to negative scene pictures compared to instructed suppression.

Our reappraisers were significantly more vigilant for angry faces compared not only to suppressors, but also to low-anxious, low-regulating individuals. This vigilance was unrelated to faster orienting toward angry faces. Rather, reappraisers had greater difficulty disengaging attention from angry faces compared to suppressors and to low-anxious individuals. Thus, remarkably we observed similar attentional biases toward angry faces in two very different groups: Non-regulating, high-anxious individuals and low-anxious reappraisers—individuals with very different anxiety levels. We suspect that the causes of their attentional biases are different. Possibly, vigilance for and lack of disengagement from threat may be adaptive in some cases (trait-reappraisers) but maladaptive in others (high-anxiety). To speculate further, the attentional bias in reappraisers may indicate prolonged and more extensive analysis of emotional stimuli that may underlie their ability to efficiently and flexibly adjust their own emotional state accordingly. Conversely, a similar bias in high anxious individuals may be a sign of worry, failure to suppress task-irrelevant thoughts, and other maladaptive behaviours (Sadeh & Bredemeier, 2011; Verkuil, Brosschot, Putman, & Thayer, 2009).

To follow up on this speculation, we tested if attentional bias scores were correlated with anxiety and trait-reappraisal scores within each of the R-group and HA-group separately. For reappraisers, attentional bias was correlated with reappraisal (r = .48, p < .05) even when controlling for trait-anxiety (r<sub>partial</sub> = .47,
selective attention towards threat, we suggest that each ER trait emotion (1998) proposed attentional deployment as a separate high-anxious individuals’ attention biases are likely a maladaptive of situations in which reappraisal may be or become necessary, individuals. While reappraisers may focus attention more on neg-

ative information for reappraisers and high-anxious individuals, negative information. Thus, trait-suppression may involve diverting attention away from high-anxious group (see Fig. 1A) may have limited our ability to suppressors also did not differ from high-anxious non-regulating individuals in their biases. Note that the HA-group had the expected trend toward preferentially attending to angry faces (see Fig. 1A), along with a significant failure to disengage (see Fig. 1B). The high variability in attentional bias scores in the high-anxious group (see Fig. 1A) may have limited our ability to detect differences in attentional biases between the trait-suppres-
sor and high-anxious groups. Nevertheless, it appears safe to say that because suppressors showed no noteworthy attentional biases whereas the high-anxious group did, attentional biases to angry faces are reduced in trait-suppressors (who are also high-anxious). Thus, trait-suppression may involve diverting attention away from negative information.

5. Conclusions

In conclusion, we found similar attentional biases toward negative information for reappraisers and high-anxious individuals, groups of individuals who should have very dissimilar everyday experiences of emotions. Although these results should be replicated in future studies, we propose that the reasons for these attentional biases are different in reappraisers and high-anxious individuals. While reappraisers may focus attention more on negative than neutral stimuli to enable an in-depth cognitive analysis of situations in which reappraisal may be or become necessary, high-anxious individuals’ attention biases are likely a maladaptive expression of task-irrelevant thoughts. Gross’ process model of emotion (1998) proposed attentional deployment as a separate mechanism of ER. Based on our findings of trait-ER modulating selective attention towards threat, we suggest that each ER trait may in fact be associated with its own patterns of ER strategies, including attentional deployment. Future studies should test if and how Gross’ other ER-methods (situation selection, situation modification) may vary among ER-trait.

Acknowledgements

This work was supported by a studentship from the Canadian Institutes of Health Research. We would like to thank Dr. Patrick S. Davidson for providing laboratory space for this study.

References
