Enhancing Reappraisal by Linking Cognitive Control and Emotion

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Abstract
In the current study we explored whether training individuals to recruit cognitive control prior to exposure to negative pictures can facilitate the propensity to use reappraisal and reappraisal success. Participants were randomly assigned to one of two groups. In the training group, negative pictures were typically preceded by a stimulus that recruits cognitive control, whereas in the control group, negative pictures were typically preceded by a stimulus that does not recruit cognitive control. Participants were subsequently asked to reflect on a negative personal event and to later reappraise the event. As predicted, compared to participants in the control group, those in the training group were more likely to use reappraisal spontaneously, and when instructed to reappraise, were more successful in doing so. We argue that the ability to employ cognitive control has a causal role in reappraisal use and success.

Keywords
reappraisal, cognitive control, training, flanker, emotion, open data, open materials

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People use different strategies to cope with negative events. An often helpful strategy is to reappraise the event and thus reinterpret it in a way that reduces negative emotions. The propensity to use reappraisal and the success in doing so when instructed have both been associated with improved quality of life (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Gross & John, 2003).

Recent views suggest that cognitive control, the ability to pursue goal-directed behavior and resist distraction, may be a core process in reappraisal (Cohen, Daches, Mor, & Henik, 2014; McRae, Jacobs, Ray, John, & Gross, 2012). In support of this notion are correlational findings showing that cognitive control is associated with reappraisal success (McRae et al., 2012; Salas, Gross, & Tornbull, 2014) and that the use of cognitive control when processing emotional information is associated with increased propensity to use reappraisal (Cohen, Henik, & Moyal, 2012). In addition, neuroimaging findings indicate that during reappraisal, there is an increase in brain activity in regions related to cognitive control and a reduction in brain activity in regions related to emotional processing (for a meta-analytic review, see Buhle et al., 2014).

Although theory suggests that cognitive control (particularly over emotional information) causally affects reappraisal, studies to date have been correlational. In fact, some studies have reported the opposite causal direction, that reappraisal modulates the effect of emotion on attention (Adam, Schönfelder, Forneck, & Wessa, 2014) and on cognitive control (Moser, Most, & Simons, 2010). To date, no studies have manipulated cognitive control to examine its effect on people’s tendency to use reappraisal and on their success in doing so. One way to examine this effect is to repeatedly train people to use cognitive control when processing emotional content and assess training effects on reappraisal. While there are studies in which reappraisal was directly trained (Denny, Inhoff, Zerubavel, Davachi, & Ochsner, 2015; Denny & Ochsner, 2014; Kivity & Huppert, 2016; Ng & Diener, 2013), no studies have examined whether training people to recruit cognitive control when facing distracting emotional information can affect the

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tendency to use reappraisal or the success in doing so. Such an investigation can elucidate the mechanisms that are involved in reappraisal as well as provide an avenue for intervention. Moreover, a cognitive control training may have significant clinical utility, as cognitive training procedures were effective in reducing depressive symptoms as well as rumination, a maladaptive tendency to focus repeatedly on one’s distress and on its possible causes and consequences (Cohen, Mor, & Henik, 2015; Siegle, Ghinassi, & Thase, 2007).

In the current study, we explore whether training individuals to recruit cognitive control prior to exposure to emotional stimuli enhances reappraisal success and the propensity to use reappraisal. We employed a new version of a training procedure we developed in Cohen, Mor, et al. (2015), following a line of studies that showed that the behavioral and physiological effects of negative stimuli are attenuated when these stimuli are preceded by a task that recruits cognitive control (Cohen et al., 2012; Cohen, Henik, & Mor, 2011; Cohen, Moyal, & Henik, 2015; Cohen, Moyal, Lichtenstein-Vidne, & Henik, 2016). In Cohen, Mor, et al. (2015), we examined the effect of cognitive control training on rumination. Participants were presented with a cognitive control task (arrow-flanker task; Eriksen & Eriksen, 1974), followed by negative or neutral pictures. They were assigned to either an experimental condition, in which 90% of the negative pictures were preceded by incongruent flanker stimuli, known to recruit cognitive control (Fan, McCandliss, Sommer, Raz, & Posner, 2002), or to a control condition, in which only 10% of the negative pictures were preceded by incongruent flanker stimuli. Subsequently, participants recalled a negative personal event. Participants in the experimental group ruminated less about the event than did those in the control group.

In the current study, we made four modifications to the tasks used in Cohen, Mor, et al. (2015). First, we changed the proportion of incongruent stimuli paired with negative pictures in the training and the control groups (from 90% and 10% to 80% and 20%, respectively). This modification allows the examination of training effects on emotional interference, which was not possible due to the low proportion of incongruent trials paired with negative stimuli in the control condition. Second, to rule out alternative explanations for training effects, participants rated the negativity and significance of the event they recalled. Third, the propensity to use reappraisal was assessed by adding a state reappraisal questionnaire following the ruminative thinking measure. Fourth, we added a second phase to the recall task in which participants were instructed to reappraise the event. Reappraisal propensity and success were assessed twice, following the recall and following the instructed reappraisal. Reappraisal success was indexed by a sad mood assessment.

We predicted lower emotional interference in the training compared to the control group. We further predicted a higher propensity to use reappraisal and lower ruminative thinking in the training compared to the control group. Finally, we expected the training group to report reduced sad mood, compared to the control group, following the recall as well as following instructed reappraisal of the event.

Method

Participants

A total of 95 students at the Hebrew University of Jerusalem participated in the study. Data from 4 participants were removed due to a high error rate in the training (above 3 SD from the mean error rate in either the flanker or the discrimination tasks). Thus, the analyses of the training task included 91 participants ($n_{\text{control}} = 48$, $n_{\text{training}} = 43$; 58 females; age $M = 24$ years, $SD = 3.36$). Four additional participants were excluded from the analyses of reappraisal due to data loss. Thus, these analyses included 87 participants ($n_{\text{control}} = 45$, $n_{\text{training}} = 42$; 55 females; age $M = 24$ years, $SD = 3.37$). All participants had normal or corrected-to-normal vision, were native Hebrew speakers, and reported no history of attention deficit disorder. Participants in the two training groups did not differ in demographic characteristics, habitual rumination or reappraisal, and severity of depressive and anxiety symptoms.

Apparatus

The experiment was run on an AMD SM-SR 1600 computer with a 17-inch color monitor. The training task was programmed using E-Prime (E-Prime 2 Professional, Psychology Software Tools, Inc., Pittsburgh, PA, USA). The reappraisal assessment task was programmed using Visual Basic.

Procedure

Participants were randomly assigned to one of the two training conditions. They subsequently completed a reappraisal assessment procedure that included a recall of a negative autobiographical memory, followed by an instructed reappraisal phase. Participants completed self-report measures of reappraisal, state rumination and sad mood following the recall as well as the instructed reappraisal. Finally, participants completed self-report questionnaires assessing trait anxiety (the trait scale of the State-Trait Anxiety Inventory;
Spielberger, 1970), depressive symptoms (the Beck Depression Inventory–II; Beck, Steer, & Brown, 1996), trait rumination (the Ruminative Responses Scale; RRS; Nolen-Hoeksema & Morrow, 1991), and trait reappraisal (Emotion Regulation Questionnaire; ERQ; Gross & John, 2003).1

Training

Participants were instructed to respond as quickly and as accurately as possible to two tasks on each trial: a flanker task and a discrimination task (see Cohen, Mor, et al., 2015). Each trial (see Fig. 1) commenced with a fixation cross, presented for 1,000 ms, followed by a flanker stimulus (a target arrow appearing with two flanking arrows on each side, congruent or incongruent with the direction of the target arrow), presented for 1,000 ms or until response. Following an interval of (1,000 – RT) ms, a picture (neutral or negative) was presented for 100 ms. Next, a blank screen was presented for 50 ms, followed by the discrimination target (a blue or a green square) that remained on the screen for 2,000 ms or until response. Participants were asked to respond to the flanker stimulus by indicating the direction of the target arrow and to respond to the discrimination target by indicating whether it was blue or green.

The proportion of incongruent and congruent trials, as well as the proportion of negative and neutral pictures, was equal across groups. However, in the experimental group, negative pictures were predominately (i.e., 80% of negative pictures) preceded by incongruent stimuli, and only seldom by congruent stimuli (i.e., 20% of negative pictures). In the control group the reverse was true (i.e., 20% of negative pictures were preceded by congruent stimuli). The task consisted of 320 randomly presented trials, preceded by 16 practice trials.

Picture stimuli

A total of 12 negative and 12 neutral pictures from the International Affective Pictures System (Lang, Bradley, & Cuthbert, 2008) were used (for more details, see Cohen, Mor, et al., 2015).

Reappraisal assessment procedure

The reappraisal assessment included two stages: a recall of a negative autobiographical memory and instructed reappraisal.
Autobiographical memory recall. As in Cohen, Mor, et al. (2015), participants were given 4 min to recall a recent upsetting personal event (that made them feel bad about themselves) and write about it. Then they rated the event negativity (“How negative is this event for you?”) and personal significance (“How significant is this event for you?”). Subsequently, they sat quietly for 2 min to allow self-reflection to occur.

Instructed reappraisal. Based on prior work (e.g., McKae et al., 2012), participants were asked to reinterpret the event to make it seem less negative. They were allotted 4 min to describe the reappraisal of the event. Then, they rated the event negativity and personal significance again, and sat quietly for another 2 min.

Self-report state measures (reappraisal, rumination and mood). The propensity to use reappraisal was assessed using five statements modified from the ERQ (Gross & John, 2003; e.g., “right now, I want to feel less negative emotion (sadness or anger), and therefore I am changing the way I think about the situation”). As in Cohen, Mor, et al. (2015), rumination was assessed using statements modified from the RRS (Nolen-Hoeksema & Morrow, 1991). Cronbach’s alpha reliabilities were good for both measures (.898 and .838, respectively). The assessment of sad mood included four items (e.g., “right now, I feel sad”). In all three measures, participants answered by marking with a mouse cursor a location on a visual analogue scale that ranged from highly agree (0) to highly disagree (100).

Results

Training task

Data reduction. Trials with incorrect responses (4.39% and 4.42% of responses in the flanker and discrimination tasks, respectively) and trials involving extreme RTs that were 2.5 SD below or above the participant’s mean RT (2.4% and 2.50% of responses in the flanker and discrimination tasks, respectively) were eliminated.

Flanker task. RTs in the flanker task were subjected to a two-way mixed analysis of variance (ANOVA) with congruity (congruent vs. incongruent) as a within-subjects factor and group as a between-subjects factor. The typical main effect of congruity was found, \( F(1, 89) = 6.89, p < .001 \), partial \( \eta^2 = .08 \), reflecting faster RTs on congruent trials (\( M = 483 \) ms, SD = 50) compared to incongruent ones (\( M = 545 \) ms, SD = 49). As expected, the interaction between congruity and training group was not significant \( F(1, 89) = 1.06, p = .31 \), partial \( \eta^2 = .01 \), indicating that the training groups did not differ in the degree of cognitive control they exhibited on the flanker task.

Emotional interference. To examine the hypothesis that compared to participants in the control group, those in the training group would demonstrate reduced emotional interference following incongruent stimuli, RTs to discrimination targets were subjected to a three-way mixed ANOVA. Flanker congruity (congruent vs. incongruent) and picture valence (negative vs. neutral) served as within-subjects factors and group (training vs. control) as a between-subjects factor. As predicted, the interaction among congruity, valence, and group was significant, \( F(1, 89) = 4.39, p < .05 \), partial \( \eta^2 = .05 \). Post hoc analyses revealed that the interaction between congruity and valence was nonsignificant in the control group \( F(1, 89) = 1.18, p = .28 \), partial \( \eta^2 = .03 \), wherein a main effect for valence was observed, \( F(1, 89) = 6.63, p < .05 \), partial \( \eta^2 = .10 \), with an overall slower response following negative compared to neutral pictures. In contrast, the congruity–valence interaction was marginally significant in the training group, \( F(1, 89) = 3.45, p = .07 \), partial \( \eta^2 = .07 \). In this group, the response to discrimination targets was delayed following negative compared to neutral stimuli when the picture was preceded by a congruent stimulus, \( F(1, 89) = 11.17, p < .01 \), partial \( \eta^2 = .25 \), but not when it was preceded by an incongruent stimulus \( (F > 1) \). Thus, attenuation of emotional interference following the recruitment of cognitive control occurred in the training group, but not in the control group.

Reappraisal assessment task

Training effect on the propensity to use reappraisal. As predicted, following the autobiographical recall, participants in the training group reported a higher propensity to use reappraisal than did those in the control group, \( t(85) = -2.29, p < .05 \), Cohen’s \( d = 0.49 \) (see Fig. 2). To examine reappraisal propensity following the instructed reappraisal, we conducted a hierarchical multiple regression analysis, predicting reappraisal propensity at Time 2 (following instructed reappraisal) from reappraisal propensity at Time 1 (prior to instructed reappraisal) and group (training vs. control). Reappraisal propensity at Time 1 was entered first and group was entered at the second step. The first model was significant, demonstrating that reappraisal propensity at Time 1 predicted reappraisal propensity at Time 2 (\( p = .76, t = 10.71, p < .0001 \)), and accounted for 57.4% of reappraisal propensity following the instructed reappraisal, \( R^2 = .57, p < .0001 \). Training group, entered in the second step, did not predict reappraisal propensity at Time 2 (\( p = .31, t = .31 \)). Thus, the group effect on reappraisal propensity was observed following the recall, but not following instructed reappraisal.

Training effect on reappraisal success. Sad mood was used as an index of reappraisal success. Contrary to
our prediction, the training and control groups did not differ in sad mood following the recall, $t(85) = 0.57, p = .57$, Cohen’s $d = 0.12$. To examine reappraisal success following instructed reappraisal, we conducted a hierarchical multiple regression analysis, predicting sad mood at Time 2 (following instructed reappraisal) from sad mood at Time 1 (prior to instructed reappraisal) and group (training vs. control). Sad mood at Time 1 was entered first and group was entered in the second step. The first model was significant, demonstrating that sad mood at Time 1 predicted sad mood at Time 2 ($\beta = .83, t = 13.72, p < .0001$), and accounted for 68.9% of sad mood following instructed reappraisal, $F(1, 86) = 188, p < .0001$. Training group, entered in the second step, significantly predicted sad mood at Time 2 ($\beta = -.13, t = -2.10, p < .05$). The second model was significant, $F(2, 86) = 100, p < .0001$, and accounted for an additional 1.6% of the variance in sad mood at Time 2, $F$ change(1, 84) = 4.42, $p < .05$. Thus, instructed reappraisal was more effective in reducing sad mood in the training, compared to the control group.

**Training effect on ruminative thinking.** Contrary to our prediction, the two groups did not differ in rumination following event recall, $t(85) = -0.075, p = .94$, Cohen’s $d = 0.02$. To assess ruminative thinking following the instructed reappraisal, we conducted hierarchical multiple regression analysis predicting state rumination at Time 2 (following instructed reappraisal) from state rumination at Time 1 (prior to instructed reappraisal) and group (training vs. control). State rumination at Time 1, entered first, significantly predicted state rumination at Time 2 ($\beta = .81, t = 12.60, p < .0001$). The model accounted for 65.1% of state rumination following the instructed reappraisal, $F(1, 86) = 159, p < .0001$. Training group, entered in the second step, did not predict state rumination at Time 2 ($\beta = .02, t = 0.03, p = .98$). We suspected that overall low levels of ruminative thinking, resulting from the inclusion of the negativity and the significance questions, as well as from sample characteristics, might account for the null effect of the training on rumination. Our concerns were confirmed in a follow-up study as potential sources of the replication failure.

**Discussion**

In this study, we investigated whether training to recruit cognitive control when processing negative stimuli increases the propensity to use reappraisal and its success. We demonstrated that in the training group, responding to incongruent flanker stimuli prior to the presentation of negative pictures led to reduced interference by these stimuli on a subsequent discrimination task. Thus, the training reduced emotional interference. It is noteworthy that participants in the training group reported using more reappraisal of a personal negative event than did those in the control group. In addition,
after being instructed to reappraise the event, participants in the training group reported lower levels of sad mood and rated the event as less personally significant than did participants in the control group. These findings provide evidence for a causal link between the use of cognitive control to reduce emotional interference and reappraisal, and are the first to show that cognitive control training can enhance both the propensity to use reappraisal and reappraisal success.

Our findings are novel in several ways. First, prior research on the link between cognitive control and reappraisal success was mostly correlational. Reappraisal success has been associated with cognitive control abilities such as working memory (Schmeichel & Volokhov, 2008), set shifting (McRae et al., 2012), inhibitory control (Salas et al., 2014), and task switching (Malooly, Genet, & Siemer, 2013). In the current study, we directly manipulated participants’ employment of control over emotional information. Therefore, we were able to show that employing control over emotional information causally affects the ability to use reappraisal to reduce sad mood. To date, only one other study has examined the effect of a cognitive control training procedure on reappraisal success (Sanchez, Everaert, & Koster, 2016). Whereas Sanchez and colleagues (2016) instructed participants explicitly to shift their attention to task-relevant positive stimuli and provided feedback for this shift, in the current research the training was implicit and participants were unaware of it. Moreover, the current study used autobiographical memories (rather than pictorial stimuli) as objects of reappraisal, providing a close simulation of real-life reappraisal processes.

Second, our findings show that the propensity to use reappraisal, and not only reappraisal success, can be increased by training. To our knowledge, only two studies have examined training effects on the propensity to use reappraisal. Both demonstrated the efficacy of a web platform in which participants reappraise unpleasant situations posted by other participants, in increasing the propensity to reappraise (Doré, Morris, Burr, Picard, & Ochsner, 2017; Morris, Schueller, & Picard, 2015). Our work points to the utility of implicit cognitive training that does not involve direct experience in reappraisal as a means for increasing reappraisal use.

Third, this research relates to a prior debate over the role of cognitive control in reappraisal success versus reappraisal propensity. McRae et al. (2012) reported that reappraisal success, but not reappraisal propensity, correlated with cognitive control processes (working memory and set shifting) that do not involve emotional stimuli. In contrast, the propensity to use reappraisal did correlate with cognitive control of emotional information (e.g., Cohen et al., 2012). Our current findings suggest that reappraisal success may be linked to cognitive control whether one exerts control over emotional or non-emotional stimuli, but the propensity to use reappraisal may be specifically linked to cognitive control of emotional content.

It is noteworthy that in the current study, reappraisal propensity was altered by the training only when participants engaged in spontaneous reappraisal (following the recall), but not when they were instructed to do so. In contrast, the training affected reappraisal success (i.e., reduced sad mood and significance ratings) following instructed reappraisal, but not after the initial recall. Our findings add to an emerging body of research that distinguishes between these two forms of reappraisal (e.g., Ehring, Tuschen-Caffier, Schnülle, Fischer, & Gross, 2010; Quigley & Dobson, 2014). Future research should explore potential explanations for the differential training effects on spontaneous versus instructed reappraisal.

The current study suggests several mechanistic accounts for the enhancing effect of cognitive control training on reappraisal. First, it is possible that recruiting cognitive control when processing emotional stimuli reduces emotional reactivity, which in turn manifests itself in reappraisal propensity and success. Indeed, prior research found a reduction in amygdala activation following cognitive control training (Cohen, Margulies, et al., 2016). However, our findings, that participants in the two groups did not differ in their rating of the event's negativity or in their sad mood following event recollection, do not support this possibility. Therefore, we argue that training individuals to employ control over emotional information does not flatten emotional reactions, but increases the tendency to employ reappraisal as a strategy to alleviate negative mood. As we have noted (Cohen et al., 2014; Cohen, Mor, et al., 2015), this enhancement in reappraisal may be mediated by increased ability to filter out irrelevant emotional information. Similar brain regions are involved in cognitive control and reappraisal (Kalisch, 2009; Ochsner & Gross, 2005), strengthening the idea that enhancing the ability to employ control over emotional information can increase the tendency to use reappraisal and the success in doing so.

A related mechanistic account refers to conflict adaptation (Botvinick, Braver, Barch, Carter, & Cohen, 2001; also called Gratton effect; Gratton, Coles, & Donchin, 1992). Conflict adaptation refers to the phenomenon by which recruitment of cognitive control on a specific trial modulates the response on a subsequent trial. Specifically, responding to an incongruent stimulus is faster when the previous trial was incongruent. Although this effect was attributed to priming by some researchers (e.g., Mayr & Awh, 2009; Mayr, Awh, & Laurey, 2003),
it is usually interpreted as a lingering effect of cognitive control (e.g., Braem, Abrahamse, Duthoo, & Notebaert, 2014). Our finding of reduced emotional interference following incongruent stimuli (see also Cohen et al., 2011; Cohen, Moyal, et al., 2016) may be explained by this lingering effect. Indeed, recent findings propose a link between conflict adaptation and affective responses (e.g., Hengstler, Holland, van Steenbergen, & van Knippenberg, 2014). It is possible, thus, that frequent activation of control processes when in a negative affective state (picture viewing) facilitated participants' ability to employ control over the negative emotions elicited by the autobiographical recall. This ability was evidenced in elevated levels of spontaneous reappraisal and in an enhanced ability to benefit from instructed reappraisal.

A third mechanistic account may involve priming processes. It is possible that in the current study we primed participants to ignore irrelevant information and then exposed them to unpleasant content. This priming manipulation may have created an association between ignoring irrelevant content and the experience of negative feelings. As a result, participants learned to employ control when experiencing negative emotions during the autobiographical recall.

It is noteworthy that the control condition in this study can be seen as a form of training, because in this condition negative pictures were consistently primed by congruent stimuli. This design was chosen to equate the number of negative pictures and trials that recruit cognitive control in the two conditions (i.e., in both groups 50% of the pictures were negative and 50% of the flanker stimuli were incongruent). Although it may be argued that the group differences in reappraisal were carried by the control group, we believe that this is unlikely. In the current as well as in our previous studies (e.g., Cohen, Mor, et al., 2015; Cohen, Margulies, et al., 2016), attenuation of emotional interference following the recruitment of cognitive control occurred in the training group, but not in the control group. Thus, pairing of incongruent stimuli (but not congruent stimuli) with negative information reduces emotional responses. Furthermore, the groups did not differ in mood ratings before or following the training, suggesting that pairing congruent stimuli with negative pictures did not result in higher levels of negative mood than the reverse pairing.

We did not replicate our prior finding that emotion control training reduces state rumination (Cohen, Mor, et al., 2015). As described earlier, the different results in the two studies may be attributed to the use of questions regarding the negativity and significance and to overall lower levels of trait rumination in the current sample.

The current study has several limitations. First, our measure of the propensity to use reappraisal was based on the ERQ (Gross & John, 2003), which assesses both the desire to reduce negative emotion and the use of reappraisal to do so. Therefore, it is possible that low ratings on the reappraisal propensity measure reflect a lack of desire to reduce negative emotions, rather than lower use of reappraisal. However, the sad mood ratings revealed that participants felt sad following the recall task, suggesting that the responses to the measure indeed reflected the use of reappraisal. Future research may benefit from questionnaires that are designed to assess state reappraisal (e.g., Ganor, Mor, & Huppert, 2017; Katz, Lustig, Assis, & Yovel, 2016), as well as multimodal assessment of reappraisal such as physiological indexes. Second, although we demonstrated that training reduced emotional interference in the training task itself, we did not examine the effects of the training on a near transfer task that would demonstrate that the training generalized to a novel task that assessed cognitive control. Third, although our reappraisal assessment closely mimics everyday recall of upsetting events, we assessed only immediate effects of the training on reappraisal. Thus, future research may examine the effect of multiple training sessions on reappraisal in everyday life. Such an assessment can assist in studying the long-lasting effects of the training.

To summarize, in this study we provide the first demonstration that training individuals to employ cognitive control over emotional information can increase the use of reappraisal and the success of instructed reappraisal. Thus, cognitive control enhances adaptive emotion regulation in two ways—increase the likelihood of use of adaptive strategies and make these strategies more effective. This work has the potential to assist in the development of interventions designed to promote emotional health and to expand the research on cognitive training to new domains of inquiry.

**Author Contributions**

N. Cohen and N. Mor developed the experimental design. Data collection was performed by N. Cohen and by five research assistants. Data analysis was performed by N. Cohen under the supervision of N. Mor. The manuscript was drafted by N. Cohen, and N. Mor provided critical revisions. All authors approved the final version of the manuscript for submission.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Open Practices
All data and materials have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/54y7r. The complete Open Practices Disclosure for this article can be found at http://journals.sagepub.com/doi/suppl/10.17772167702617731379. This article has received badges for Open Data and Open Materials. More information about the Open Practices badges can be found at https://www.psychologicalscience.org/publications/badges.

Notes
1. Participants also rated their mood before and after the training task and performed a lexical decision task. The training and control groups did not differ in these measures, and for brevity we do not discuss these measures in the current article.
2. The instructions were, “Now, you are being asked to reappraise the event in a less negative way—in a manner that will make you feel better about yourself and will elicit less feelings of sadness or regret. For example, you can focus on the positive aspects of the event and/or on what you have learned from it. You can also think about the event from a different perspective, such as an outside observer’s perspective. Please describe how you have reappraised the event. You have 4 minutes to do so.”
3. The design of the training task (80–20 pairing of congruent-negative/incongruent-negative) resulted in an imbalance in the number of trials in the two conditions. We changed the ratio from 90–10 in our previous article (Cohen, Mor, et al., 2015) to 80–20 to have enough trials for the analysis of the condition by group interaction. To examine whether trial number affected the findings, we conducted the same ANOVA after equating the number of trials in the different trial type combinations (by randomly choosing 30 trials for each of the following combinations: congruent-negative, congruent-neutral, incongruent-negative, incongruent-neutral). The interaction remained significant, suggesting that the different number of trials cannot account for the observed effect.
4. In a follow-up study, participants completed the recall task with (n = 20) or without (n = 25) answering the negativity and significance questions. Indeed, state rumination was lower among participants who reflected on event significance and negativity (M= 44.20, SD = 10.76). Cohen, Mor, et al., 2015: M = 45.87, SD = 13.11; follow-up study: M = 44.20, SD = 10.76).

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