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Behavioral effects of longitudinal training in cognitive reappraisal

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Abstract

While recent emotion regulation research has identified effective regulatory strategies that participants can employ during single experimental sessions, a critical but unresolved question is whether one can increase the efficacy with which one can deploy these strategies through repeated practice. To address this issue we focused on one strategy, reappraisal, which involves cognitively reframing affective events in ways that modulate one's emotional response to them. With a commonly used reappraisal task, we assessed the behavioral correlates of four laboratory sessions of guided practice in down-regulating responses to aversive photos. Two groups received practice in one of two different types of reappraisal tactics: psychological distancing and reinterpretation. A third no-regulation control group viewed images in each session without instructions to regulate. Three key findings were observed. First, both distancing and reinterpretation training resulted in reductions over time in self-reported negative affect. Second, distancing participants also showed a reduction over time in negative affect on baseline trials where they responded naturally. Only distancing group participants showed such a reduction over and above the reduction observed in the no-regulation control group, indicating that it was not attributable to habituation. Third, only participants who distanced reported less perceived stress in their daily lives. The present results provide the first evidence for the longitudinal trainability of reappraisal in healthy adults using short courses of reappraisal practice, particularly using psychological distancing.

Keywords

emotion; reappraisal; training; longitudinal; perceived stress

Introduction

Whether it is the sadness and grief over the death of a loved one or the anxiety accompanying financial uncertainty or risk of failure, there is no shortage of challenges to our emotional equilibrium and no end to the need to adaptively regulate our responses to them. While we all possess some degree of emotion regulatory skill needed to cope with these trying times, many of us could stand to get better.

This need to improve our regulatory abilities is, of course, felt most acutely by those with clinical disorders of emotion, who seek out treatments that purport to improve their emotion regulation abilities and thereby improve the emotional quality of their daily lives. For example, studies demonstrating the clinical efficacy of cognitive behavioral therapies (CBTs) suggest that some individuals can get better at regulating (Butler, Chapman, Forman, & Beck, 2006; Dobson, 2010; Hollon & Beck, 1994). One problem with such studies, however, is that clinical treatments typically incorporate various cognitive strategies all at once, and as such, it can be hard to evaluate which specific strategies are most effective and why. Although one study on the efficacy of CBT and some of its component processes in major depressive disorder found that CBT was no more effective than behavioral activation or automatic thought modification alone in treating depression (Jacobson et al., 1996), the CBT condition still contained the full complement of cognitive and behavioral therapies that comprise CBT, rather than just cognitive therapies in isolation, and it is therefore possible that focused training using individual cognitive strategies may be particularly effective in modifying emotional experience over time. Thus, basic experimental work on how practice with specific cognitive strategies can improve regulatory abilities is needed to address this gap in knowledge (Berking, Ebert, Cuijpers, & Hofmann, 2013; Berking et al., 2008). Despite the importance of this issue, few studies have targeted this gap.

Here we address this issue experimentally by asking how the ability to deploy one of the most powerful and flexible emotion regulatory strategies can improve over the course of four practice sessions. This strategy is known as reappraisal, and involves cognitively transforming one's construal of an emotion-eliciting stimulus in a way that alters its emotional impact (Gross, 1998b; Ochsner & Gross, 2005, 2008). One prior study has examined longitudinal training in both reappraisal and compassion meditation in healthy adults but did not find any significant effect of reappraisal training on reductions in self-reported negative emotion over time (Weng et al., 2013). Another recent daily diary study has reported that thinking about daily negative events with the instruction to reappraise over the course of a week (but without repeated training in reappraisal inside the laboratory) is effective in reducing self-reported negative emotion relative to a control condition where no reappraisal occurred, but no longitudinal reductions in self-reported negative emotion were observed over the course of the study (Ng & Diener, 2013). No other published reports have examined whether reappraisal efficacy can improve over time through longitudinal training. While the absence of reappraisal training effects in the two studies above may be due to several factors, three lines of work suggest that reappraisal is a particularly promising strategy to probe in terms of its trainability.

First, numerous laboratory studies have shown that when used to diminish negative emotion, reappraisal is effective at down-regulating experiential, physiological, and neural measures of affective response (Denny, Silvers, & Ochsner, 2009; Jackson, Malmstadt, Larson, & Davidson, 2000; Ochsner & Gross, 2005, 2007, 2008; Ochsner, Silvers, & Buhle, 2012; Urry, 2010) without the negative consequences for memory and autonomic response attendant to some other strategies, like expressive suppression (Gross, 1998a; Gross & John, 2003; Gross & Levenson, 1993; Richards & Gross, 2000). Second, additional studies suggest that individuals who self-report greater use of reappraisal in their daily lives may

experience more adaptive emotional and social outcomes (Gross & John, 2003; Troy, Wilhelm, Shallcross, & Mauss, 2010), although it isn't known whether and how this may be related to repeated practice with – and consequently improving performance in – reappraisal. Third, clinical studies show that cognitive therapies containing elements of reappraisal, in addition to other regulation techniques, are effective for reducing reports of negative affect and clinical symptomology in unipolar depression, generalized anxiety disorder, panic disorder, social phobia, and posttraumatic stress disorder (Berking et al., 2013; Butler et al., 2006; Dobson, 2010). Berking and colleagues (2013), in particular, have recently provided evidence for the added benefit of receiving additional training in various emotion regulation skills (including reappraisal) as part of a CBT intervention. However, in all of these studies, any unique benefits arising from specific training in reappraisal have remained unclear. Thus, laboratory, field and clinical studies indicate that reappraisal is a very effective emotion regulation strategy that can be trained during single experimental sessions in the laboratory, has been associated with positive overall well-being, and may contain some of the cognitive “ingredients” of clinical therapies.

One issue that arises in studying reappraisal training is that “reappraisal” is an umbrella term referring to the myriad cognitive means that can be used to mentally transform the meaning of an emotionally evocative stimulus. With this in mind, we sought to compare the effects of training using the two most commonly studied variants of reappraisal, or reappraisal tactics as they sometimes are called (McRae, Ciesielski, & Gross, 2012).

The first reappraisal tactic of interest is *distancing*, which involves mentally changing one's construal of an emotional event by increasing or decreasing one's psychological distance from it (Ochsner et al., 2012; Trope & Liberman, 2010). This goal could be realized in multiple, non-competing ways. For example, in line with construal-level theory (Trope & Liberman, 2003, 2010), one could change psychological distance by varying the perceived physical or temporal closeness of an emotional event or by viewing it from the perspective of a third person observer (Ayduk & Kross, 2008; Davis, Gross, & Ochsner, 2011; Liberman, Sagristano, & Trope, 2002). In addition, in perceiving the event one may adopt the mindset of an objective, impartial observer (Gross, 1998a; Koenigsberg et al., 2009; Kross, Davidson, Weber, & Ochsner, 2009; Ochsner et al., 2004).

The second reappraisal tactic of interest in the present work is *reinterpretation*, which involves mentally changing the meaning of the actions, context, and/or outcomes depicted in a stimulus (e.g. imagining that a pictured event is not as bad as it first seemed or that hurt individuals will be fine and help is on the way; Ochsner, Bunge, Gross, & Gabrieli, 2002; Ochsner et al., 2004; Urry, 2010).

Critically, while both of these reappraisal tactics have been shown to be effective in the moment, they may differentially benefit from training. To understand why this might be the case, consider that distancing involves the maintenance of a mindset that remains more or less consistent across varying emotionally evocative events. For example, if you are presented with images of a plane crash, burned body, and dirty bathroom in the laboratory and are instructed to distance, you could diminish negative responses to these images by maintaining a consistently detached, third-person observer mindset. By contrast,

reinterpretation involves generating stimulus-specific “stories” that change the meaning of each individual stimulus in particular ways. Thus, for the above named example images, one might generate three different reinterpretations involving plane crash survivors, Hollywood make-up to fake a burn, and a work crew soon cleansing a soiled bathroom.

These considerations predict both common and distinct effects of distancing and reinterpretation training. We would expect that training in each tactic would improve the ability to deploy that tactic when instructed to do so in response to specific images in the laboratory. But the extent to which the effects of training generalize may be different. Whereas repeated practice with distancing may foster the ability to adopt a distant mindset that is generally applicable to a wide variety of situations – including everyday life events – the effects of repeated practice with reinterpretation may be more limited to the specific kinds of stimuli one has trained upon in the laboratory.

To address these alternative hypotheses, we designed a procedure to test the effects of reappraisal training that had three separate groups: one that received training only in distancing (Distancing group), one that received training only in reinterpretation (Reinterpretation group), and, to control for simple habituation effects, a third group that was asked simply to respond naturally to stimuli across sessions but was not trained in any form of reappraisal (No Regulation control group). Across each of four sessions separated by 2-5 days each (spanning approximately two weeks in total), the Distancing and Reinterpretation groups completed a reappraisal task used in numerous prior studies (Denny, Ochsner, Weber, & Wager, in press; Ochsner et al., 2002; Ochsner et al., 2004). In each session, participants first received instruction in the specific reappraisal tactic they were to employ, and then completed a series of computerized task trials with negative and neutral images. Unique images were presented for the first three sessions, and on the fourth session participants were re-exposed to the images they had seen at the first session. On each trial an instruction word indicated whether participants were to reappraise a subsequently presented image or whether (on a baseline Look trial) they were to let themselves respond naturally. The control No Regulation group completed only baseline Look trials in each session for an equivalent number of images.

To measure changes in emotional responding across time, at the end of each trial we collected measures of self-reported emotion, which have been shown to reliably index both the magnitude of affective response and changes in that response due to effective reappraisal (Ray, McRae, Ochsner, & Gross, 2010). In addition, we collected a commonly used questionnaire-based measure of perceived stress that was completed by participants at each training session and was included to measure the generalized effects of reappraisal training outside the laboratory. This measure has been shown to have high short-term test-retest reliability ($\alpha=0.85$) as well as strong concurrent and predictive validity, reliably predicting the impact of stressful life events on well-being as well as depressive symptomatology in ways not strongly affected by age or gender (S. Cohen, Kamarck, & Mermelstein, 1983).

This design allowed us to make two key predictions. First, self-report measures may show reappraisal-related drops in negative affect across time for both the Distancing and Reinterpretation groups over and above any habituation-related diminishment of emotional

responding shown by the No Regulation group. Second, we predicted that the generalized nature of distancing as compared to reinterpretation training might lead distancing participants to show larger changes in perceived stress in their everyday life.

Methods

Participants

103 healthy participants gave informed consent according to the regulations of the Columbia University Institutional Review Board and were randomly assigned to either the Distancing, Reinterpretation, or No Regulation group (as described below). Sample sizes were determined in order to provide sufficient power to detect between-group differences in self-reports of negative affect at $\alpha = 0.05$ and moderate to large effect sizes (i.e. 25-30; J. Cohen, 1992). Two participants' data were not analyzed due to too much elapsed time between sessions, 1 participant's data were not analyzed due to an inaccurate session number being entered into the computer program controlling the counterbalanced image display, and 1 participant's data were not analyzed due to being a behavioral outlier of more than 3.5 standard deviations from the mean, with additional comments from the experimenter that the participant was not properly attending to the task. Thus, the current self-reported negative affect results reflect data from 99 participants (N=33 in the Distancing group [mean age = 23.9 years, 22 female], N=33 in the Reinterpretation group [mean age = 23.9 years, 26 female], and N=33 in the No Regulation group [mean age = 22.4 years, 19 female]). Questionnaire reports from 3 Distancing participants were not available due to technical difficulties with questionnaire data collection at Session 1. Participants reported no psychiatric history, no chronic pain or autoimmune disorders, no substance abuse, and no psychoactive medication use within the past 6 months.

Although not the focus of the present study, a subset of the 103 participants also underwent concurrent psychophysiological recording during performance of the image-based reappraisal task at all sessions (with measurement of heart rate and galvanic skin response measurement; N=52), with all other procedures being identical. A linear mixed model analysis was performed using the procedures detailed below and incorporating fixed effect predictors for group assignment, testing session, and trial type, as well as a binary predictor of whether or not participants underwent psychophysiological recording. There was no main effect of receiving psychophysiological recording on negative affect reports, nor was there any interaction with any other factor in the design. Therefore, the behavioral results reported here are pooled across participants who did and did not receive psychophysiological recording.

Materials

99 aversive images were selected from the International Affective Picture System (IAPS; Lang, Greenwald, Bradley, & Hamm, 1993; mean normative valence = 2.39, mean normative arousal = 6.02), along with 9 additional negative images that have been used in prior reappraisal studies (Ochsner et al., 2002; Ochsner et al., 2004), for a total of 108 negative task images. 54 neutral images from the IAPS were also shown (mean normative valence = 5.33; mean normative arousal = 3.15). An additional set of 18 similarly valenced

and arousing images and 6 similarly valenced and arousing neutral images were used during task instruction and pre-task practice (and described below).

Procedure

During each of 4 sessions, each spaced 2-5 days apart, participants (1) completed questionnaires, (2) received training in either reappraisal (Distancing or Reinterpretation) or the control instructions (No Regulation), and then (3) completed an image-based regulation task. Each of these 3 components is explained in more detail below.

Here, it is worth noting four considerations that led us to select four sessions of training spaced 2-3 days apart. First, given the paucity of data on the effects of longitudinal training on *specific* emotion regulation strategies, we believed it would be of great potential benefit if a relatively short course of regulation training could be shown to have positive effects. Second, studies of memory consolidation show that learning and memory performance benefits after a day or more to consolidate long-term memories (McGaugh, 2000). Third, in studies of cognitive skill learning, large improvements in performance are often seen over as few as two to four sessions (Squire, Knowlton, & Musen, 1993). And fourth, individuals who respond to a typical three month course of CBT have been observed to show changes within the first two weeks (Dobson, 2010; Feske & Chambless, 1995).

I. Questionnaires—Participants completed questionnaires at the beginning of every session. The Perceived Stress Scale (PSS; S. Cohen et al., 1983) was given at all four sessions. At Session 1, these questionnaire items were framed in terms of their perceptions of stress “in general,” and at Sessions 2, 3, and 4, they were framed in terms of their perceived stress “in the past few days.” All PSS items assessed subjective stress reports. For example, at Session 1, a representative item was “In general, how often do you feel nervous and ‘stressed’?” (assessed via a 5-point rating scale from 0=never to 4=very often). At subsequent sessions, that item was framed as “In the past few days, how often have you felt nervous and ‘stressed’?” (assessed via the same rating scale).

During Session 1, participants also completed the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991) to assess any group differences in baseline rumination tendencies.

II. Training—Participants were randomly assigned to receive training in either Distancing, Reinterpretation, or No Regulation across all four experimental sessions. Each session began with instruction and task training, which consisted of an approximately 6-10 minute interaction with an experimenter in which a standardized set of instructions were given. The instruction and training methods are essentially identical to that used to train participants in reappraisal in numerous prior single-session reappraisal studies (Denny et al., in press; McRae et al., 2010; Ochsner et al., 2002; Ochsner et al., 2004; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008). The difference here is that they were repeated across four separate experimental sessions. Demand characteristics were minimized for all groups by ensuring that the term “training” was never mentioned to participants at any time or in any form during their participation in the experiment. Instead, participants were simply told that

they would be asked to complete four separate sessions involving the completion of questionnaires and an image-based task.

In the course of the pre-task instructions, participants in the Distancing and Reinterpretation groups were first told about the two types of instruction cues that they would see on a trial by trial basis: LOOK and DECREASE. For images preceded by a LOOK cue, participants were instructed to simply look at and respond naturally to the image. For images preceded by the DECREASE cue, participants were given standardized instructions in the appropriate strategy. In particular, on DECREASE trials, participants in the Distancing group were instructed to view the image with a “detached, objective, impartial, and scientific mindset” (Ochsner & Gross, 2008; Ochsner et al., 2012), “and/or imagine that the pictured events happened far away or a long time ago” (Trope & Liberman, 2010). Participants in the Reinterpretation group were instructed to tell themselves a contextually-appropriate story about the outcome, “so that whatever is going on will soon be resolved, or that help is on the way.” These participants were also told: “You could also focus on a detail or aspect of the situation that isn't quite as bad as it first seemed” (Ochsner & Gross, 2008; Ochsner et al., 2012). For participants in the No Regulation group, only instruction in LOOK trials was provided.

Then, three “walk-through” images were presented. The first of these was a negative image to which participants were instructed to respond naturally. Then, two additional negative “walk-through” images were presented in which participants were asked to vocalize appropriate reappraisals (in the case of the Distancing and Reinterpretation groups) or to just look and respond naturally to the images (No Regulation group). Participants were guided in their responses by the experimenter to focus on the appropriate strategy and were given examples following their self-generation in order to increase clarity. In the Distancing and Reinterpretation groups, experimenters were trained to spend more time explaining a strategy if participants could not self-generate an appropriate reappraisal. Walk-through images were unique for every session, and were counterbalanced across sessions. At Session 1 only, participants also completed 9 fixed-pace practice trials that demonstrated the timing of the actual image-based task, described below.

III. Reappraisal Task—The reappraisal task used was very similar to one that has been described previously and used in numerous prior studies (e.g. Denny et al., in press; McRae et al., 2010; Ochsner et al., 2002; Ochsner et al., 2004; Wager et al., 2008). The trial structure for the task is shown in Figure 1. For each trial, a cue (either LOOK or DECREASE) was presented for 2 s, followed by a neutral or negative IAPS image for 8 s, followed by a fixation interval of either 2 or 4 s, then a rating period in which participants rated their current strength of negative affect on a scale of 1 (least) to 5 (most) for 4 s, and finally an inter-trial fixation interval of either 2 or 4 s.

Three different trial types were presented at each session: “Look Neutral” (i.e. LOOK instruction paired with a neutral image), “Look Negative” (i.e. LOOK instruction paired with a negative image), and “Reapp Negative” (i.e. DECREASE instruction paired with a negative image). No other trial types or conditions were administered on this task. 54 trials were presented per session with 18 trials each per trial type. These were presented across 3

task runs (with short breaks in between) comprised of 6 trials per run per trial type. Unique stimuli were presented on each trial in Sessions 1, 2, and 3. At Session 4, the task images from Session 1 were shown again (with trial types maintained) for test-retest purposes. Image sets were counterbalanced across sessions and trial types. Within runs, trials were presented in a randomized order. After Sessions 1-3, participants were reminded of their next session time. After Session 4, participants were debriefed, thanked, and paid \$20 per hour for their participation.

Data Acquisition and Analysis

Behavioral data were acquired using E-Prime software (Psychology Software Tools, Inc.) and questionnaire responses were recorded using Limesurvey software (www.limesurvey.org) on a laboratory computer.

Behavioral and questionnaire data were analyzed using SPSS software (Version 20, IBM Corp.). The data were analyzed using linear mixed models of the following form: $Y_i = X_i B + Z_i b_i + e_i$, where Y_i represents a vector of values of the dependent measure of interest for the i^{th} participant, X_i represents a matrix of p predictors (independent variables) for the i^{th} participant, B represents a vector of p fixed effect beta weight estimates for each predictor in X_i , Z_i represents a matrix of q random effect predictors, b_i represents a vector of q random effect estimates, and e_i represents a vector of the model fit error, representing the discrepancy between the model prediction for each observation from the i^{th} participant and the actual value of that observation.

For the behavioral data, there were three categorical predictors (group assignment, testing session, and trial type) along with their interactions, including the three-way interaction. For the questionnaire data, there were two categorical predictors (group assignment and testing session) along with their interaction. Further, in all mixed model analyses, each participant was treated as a random variable; matrix Z contained 1 column for each participant pertaining to that participant's random effect estimate b .

Planned paired and independent-sample t-tests were subsequently performed to further investigate the effects. All t-test results are two-tailed, and Cohen's d effect sizes are reported for each (J. Cohen, 1992).

Results

Self-Reported Negative Affect

Figure 2 shows average negative affect reports by trial type and session for the three groups (No Regulation, Reinterpretation, and Distancing). Error bars reflect standard error of the mean. Robust downregulation of negative affect was observed during reappraisal of negative images relative to responding naturally at all sessions in both the Reinterpretation and Distancing groups (all $p < 0.001$), and affect ratings for neutral trials were universally lower still, reflected in a large main effect of trial type overall, $F(2,928) = 2301.65$, $p < 0.001$.

Self-reports of affect as a function of group, testing session and trial type—

The Distancing group reported lower negative affect overall relative to the other two groups,

$F(2,97)=4.24$, $p<0.02$, and negative affect ratings tended to decrease over the course of the testing sessions overall, $F(3,928)=9.33$, $p<0.001$. In addition, there was a significant group X trial type interaction, $F(3,928)=9.96$, $p<0.001$, which motivated an analysis of each trial type separately to unpack this result. Thus, what follows are the results of separate analyses examining effects of group and testing session for Reapp Negative, Look Negative, and Look Neutral trials.

I. Effects of group and testing session for Reapp Negative trials—Figure 2A shows negative affect reports for Reapp Negative trials. Relevant to our first question regarding the overall efficacy of reappraisal training on behavior, a main effect of testing session was present, $F(3,192)=9.45$, $p<0.001$, indicating downward movement in ratings over time for Reapp Negative trials. Planned paired t-tests further showed that there was a significant decrease in negative affect over time (i.e. Session 1 vs. Session 4) for Reapp Negative trials for both the Distancing group, $t(32)=2.92$, $p<0.01$, $d=0.38$, and the Reinterpretation group, $t(32)=3.45$, $p<0.01$, $d=0.55$. However, the Distancing group reported lower negative affect overall, $F(1,64)=5.00$, $p<0.03$.

II. Effects of group and testing session for Look Negative trials—An ANOVA examining affect ratings on Look Negative trials showed a pattern more typical of a group \times session interaction, though this was not significant, $F(6,288)=1.66$, $p=0.131$, n.s (Figure 2B). There was, however, a main effect of group, $F(2,96)=3.67$, $p<0.03$, with the Distancing group again showing lower ratings overall, and a main effect of testing session, $F(3,288)=17.50$, $p<0.001$, indicating a general downward trend in ratings over time.

Planned t-tests revealed that Distancing group self-reports for Look Negative trials were not significantly different from the other groups at Session 1, but they were significantly lower than No Regulation group ratings at Session 2, $t(64)=2.08$, $p<0.05$, $d=0.51$, Session 3, $t(64)=2.53$, $p<0.02$, $d=0.62$, and Session 4, $t(64)=2.75$, $p<0.01$, $d=0.68$. Distancing ratings were also significantly lower than Reinterpretation ratings at Session 2, $t(64)=2.59$, $p<0.02$, $d=0.64$, and Session 4, $t(64)=2.09$, $p<0.05$, $d=0.51$, and marginally lower at Session 3, $t(64)=1.78$, $p<0.08$, $d=0.44$. Further, all groups showed longitudinal reductions in negative affect reports for Look Negative trials ($t(32)=3.96$, $p<0.01$, $d=0.56$ for the Distancing group; $t(32)=3.39$, $p<0.01$, $d=0.46$ for the Reinterpretation group; and $t(32)=3.36$, $p<0.01$, $d=0.24$ for the No Regulation group).

To determine whether these results were attributable to habituation, or rather an effect of being in the Distancing group *per se*, Session 1 versus Session 4 within-participant negative affect reductions were compared across groups. Critically, the Distancing group showed a significantly larger drop in negative affect over time than the No Regulation group (i.e. Session 1 vs. Session 4 within-subject change compared across groups; $t(64)=2.10$, $p<0.04$, $d=0.52$), whereas this comparison was not significant between the Reinterpretation and No Regulation groups, suggesting that these results are not attributable to habituation.

III. Effects of group and testing session for Look Neutral trials—While Look Neutral trial ratings did decline overall over time, $F(3,288)=3.27$, $p<0.03$, they did not significantly differ between any groups at any session (all $p>0.15$; Figure 2C). The

Distancing and Reinterpretation groups did show longitudinal reductions in negative affect for Look Neutral trials, ($t(32)=3.10$, $p<0.01$, $d=0.13$; and $t(32)=2.36$, $p<0.03$, $d=0.28$, respectively), though there was no significant change over time in the No Regulation group for Look Neutral trials.

Questionnaire Data

There were no baseline (Session 1) differences between groups in PANAS reports of positive and negative affect (all $p>0.25$). In addition, ruminative responses scores (RRS) did not differ between groups at Session 1 (all $p>0.50$), nor were there any baseline differences in perceived stress (PSS) (all $p>0.41$). Thus, the three experimental groups showed comparable baseline levels of positive and negative affect as well as tendencies to ruminate and magnitude of perceived stress. There were, however, interesting longitudinal changes in perceived stress.

Perceived Stress: Comparisons of longitudinal change in perceived stress reports across groups

Figure 3 shows perceived stress reports in each group over time. A mixed model ANOVA shows that there was no main effect of group, but there was a main effect of session, $F(3,279)=2.88$, $p<0.04$, with lower reports over time overall. While the interaction between group and session was not significant, planned comparisons examining within-group changes over time in perceived stress were performed given our *a priori* hypothesis that longitudinal training in reappraisal (particularly using distancing) in the laboratory may exert effects that carry over to reports of perceived stress in daily life. We found that the Distancing group showed a significant drop over time in perceived stress, $t(29)=2.45$, $p<0.03$, $d=0.36$, whereas the other two groups did not. Figure 3 indicates that the reduction in perceived stress in the Distancing group occurs relatively quickly—between the first and second session—and is then maintained in subsequent sessions, in contrast to the other two groups. Independent-sample t-tests show that the change in perceived stress between Sessions 1 and 2 is significantly larger for the Distancing group relative to the No Regulation group, $t(61)=2.66$, $p<0.01$, $d=0.67$.

Discussion

The present results represent the first evidence for the longitudinal trainability of reappraisal in healthy adults. Two primary questions were addressed: first, we examined whether reappraisal training improved the ability to down-regulate negative emotion that could not be attributed to habituation as measured by self-reports of negative affect. Second, we asked whether two reappraisal tactics – distancing and reinterpretation – differed in the extent to which they showed beneficial effects of training, including showing effects that generalized beyond the laboratory to perceptions of stress in daily life.

With respect to the first question, we found that both distancing and reinterpretation led to drops in self-reported negative affect over the course of four experimental sessions. With respect to the second question, overall negative affect responses were lower during reappraisal when using the distancing as opposed to the reinterpretation tactic. More importantly, however, participants in the Distancing group also showed longitudinal drops in negative affect for baseline negative image trials where participants were not instructed to

regulate. This is not attributable to habituation, as evidenced by the fact that this drop was greater than any diminishment of negative affect shown on baseline trials in the No Regulation group. This suggests that the effects of distancing training may generalize in the laboratory beyond trials in which participants are explicitly instructed to regulate by, in effect, “bleeding over” to baseline “Look” trials where negative affect also becomes diminished. In keeping with this interpretation, the Distancing group – but not the Reinterpretation or No Regulation groups – showed longitudinal drops in perceived stress in daily life. This suggests that the salutary effects of distancing may generalize beyond the laboratory and into the field. Taken together, these results argue for the potential benefits of reappraisal training in general and of distancing training in particular.

Implications for understanding the effects of emotion regulation training

These results provide the first experimental laboratory evidence that longitudinal training in reappraisal has adaptive consequences. We found that self-reported negative affect for images that participants were instructed to reappraise decreased for both groups trained in reappraisal (i.e. using either distancing or reinterpretation) over the course of four experimental sessions. Comparing these results to those of prior work may help clarify what aspects of training are important for observing significant effects on emotional responding.

For example, one of the two prior experimental studies to examine reappraisal training used an internet-based procedure to train participants and assess reappraisal ability. Each day for two weeks participants received 30 minutes of pre-recorded audio instructions in how to reappraise personal life events (Weng et al., 2013). On any given day, they could recall the same or different events, reappraise them using reinterpretation, distancing or another reappraisal tactic, and recorded their resulting negative affect. This procedure resulted in only a trend towards lower levels of self-reported negative affect over time. Similarly, the only other study to examine the potential for longitudinal reductions in self-reported negative affect via repeated use of reappraisal used a daily diary approach, which did not involve multiple instances of focused instruction in the strategy in the laboratory but rather a concise written instruction to reinterpret negative events more positively (Ng & Diener, 2013). Compared to the present results, the lack of significant effects of training in these two studies could be attributable to a number of factors, including our use of in-person guided practice with an experimenter, the use of standardized images rather than personal memories, completion of the task under controlled conditions in the laboratory and the fact that participants received training in a singular reappraisal tactic (which may have afforded greater practice time for that tactic, specifically). Some or all of these factors may be essential for ensuring compliance with training instructions and accurate assessments of affect change over time.

One other difference is that we randomly assigned participants to reappraisal and no regulation control groups, which together with the above procedures, allowed us to approximate a randomized control trial in the clinical literature. This is relevant because there is ample support from clinical trials for the effectiveness of training modalities like CBT, which incorporate multiple cognitive and behavioral change strategies over a typical period of a few months (Butler et al., 2006; Dobson, 2010; Feske & Chambless, 1995;

Jacobson et al., 1996; Sheldon, 2011). Here, we have shown that significant training effects can emerge in as few as two weeks with training solely in reappraisal. These results are commensurate with those from a meta-analysis of 12 CBT studies that examined the “dose-response” question: length of CBT treatment was not associated with better emotional outcomes (Feske & Chambless, 1995). Thus, the present results suggest that, for healthy adult participants, even a short course of training with a single cognitive change strategy can yield adaptive outcomes, and these effects must be understood with respect to the specific tactics used to implement the strategies.

Implications for differential effects of reappraisal training tactics

In the present study, while there was evidence for the adaptiveness of training in both the distancing and reinterpretation tactics, there were additional benefits of training in psychological distancing. While the only prior study to directly examine behavioral differences in reappraisal efficacy between distancing and reinterpretation at a single time point did not show significant effects (Ochsner et al., 2004), potentially due to being underpowered given that study's particularly small sample size per group (N=12), in the current study the effects of distancing generalized both within the laboratory and into the field.

Within the laboratory, distancing – but not reinterpretation – resulted in diminished negative affect on baseline trials where participants responded naturally. This effect was not attributable to habituation. Together, these data suggest that distancing may in some sense become more “habitual” over time. This may have happened because distancing invokes a flexible global mindset of detached and objective appraisal, applicable to a variety of situations regardless of whether reappraisal is instructed. In contrast, the effects of reinterpretation may be more specific to individual affective instances in which a context-appropriate, event-specific, re-assessment of meaning must be generated. Further evidence that distancing became more automatic, being engaged even when participants weren't explicitly told to do so, came from the fact that only distancing training generalized from the lab into the field, resulting in decreases in participants' reports of perceived stress in their daily lives. These reductions in perceived stress emerged relatively quickly (within 2-5 days) after training began and were maintained throughout the course of training. This finding supports the notion that distancing training may involve an adaptive change in a global mindset whereby stressful situations are appraised more objectively in daily life.

Limitations

A few limitations of the present work should be noted. First, it is important to acknowledge that reinterpretation and distancing can themselves be realized in multiple ways. For example, as used here, our distancing tactic allowed for manipulation of both the perceived spatial and temporal distance to a negative event as well as viewing a negative event as an objective, impartial observer. Although we did this so as to broaden and deepen participants understanding of the reappraisal tactic and to give them some flexibility in terms of how they might best implement the strategy on a trial-by-trial basis, it raises the question as to whether different means of distancing may have different effects. This highlights how a reappraisal tactic such as distancing may further be divided into sub-variants that permit

multiple ways that the tactic may be operationalized by experimenters and implemented by participants. Future research may directly compare these operationalizations to determine their potential differential impacts on affective experience.

In addition, the direct relevance of the present work to clinical treatment modalities remains to be seen given the exclusive focus here on healthy adult participants who completed a particular form of image-based reappraisal task. While distancing has been shown to be effective in attenuating negative affective experience relating to the recall of negative autobiographical memories in major depressive disorder within individual sessions (Kross, Gard, Deldin, Clifton, & Ayduk, 2012), future longitudinal research involving clinical populations and ecologically-valid stimulus presentations will be essential in extending the translational reach of this work, as noted below.

Conclusion and Future Directions

The present work represents the first laboratory evidence that a few laboratory sessions of reappraisal can result in significant changes in self-reported affect, and that training in distancing in particular leads to additional adaptive impacts on self-reported emotion that generalize both within the laboratory and into the field. Future work may continue to probe many additional questions about the effects of reappraisal training. For example, it will be important to know whether the effects of reinterpretation and/or distancing persist beyond the conclusion of the active training period. Addressing this issue will be essential for more closely mapping the efficacy of reappraisal training in clinical contexts where the durability of regulatory effects after training has ended is critically important.

It will also be important to determine when it is useful to receive training in different reappraisal tactics, and whether training in different tactics would yield differential trainability as a function of the nature of the content being regulated (e.g. emotional images versus autobiographical memories or other more personally-relevant stimuli). For instance, it will be important to ask whether the more general effects of distancing training always are beneficial. Indeed, as a result of training to use distancing to cope with negative events, one may not want to become habitually more distant in the face of subsequent positive events or sad events which require a compassionate and empathic response towards others. In such cases, reinterpretation may be more appropriate to the extent that its effects are restricted to the events that were the basis of training. Along these lines, it may be important to differentiate the benefits of using reinterpretation in the moment versus over the course of training. In the moment, one can use sub-variants of reinterpretation to flexibly pursue various emotion regulatory goals – e.g. one can look on the bright side to enhance positive responses to negative events, minimize negative interpretations to neutralize emotional responses, or even embellish negative appraisals to enhance negative emotions (McRae et al., 2012). Distancing, by contrast, is appropriate only if one wants to diminish emotional responses. Future work on the setting in which each tactic is more useful is essential here.

Further, future research may examine whether reappraisal training effects are modulated by age (in an age-diverse sample), gender, educational level, and individual differences in meaningful personality variables that prior research has shown may impact the ability to

employ reappraisal effectively, such as neuroticism (Ng & Diener, 2009) and trait rumination (Ray et al., 2005).

Finally, these results suggest future avenues of research examining whether and how various clinical populations may benefit from courses of different kinds of reappraisal training. Understanding whether courses of training in distancing or reinterpretation are effective in clinical populations could ultimately hold implications for understanding which patients may benefit from relatively short courses of focused reappraisal training – as well as which patients are likely to require longer, more variegated treatment modalities – across various populations that show particularly significant deficits in emotion regulation, including major depression, anxiety disorders, and borderline personality disorder, among others (Berking et al., 2013; Berking et al., 2008).

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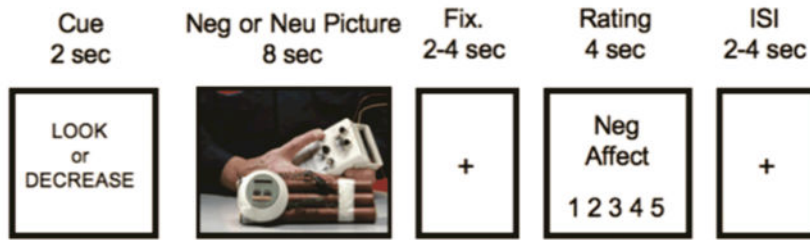


Figure 1.
Trial structure.

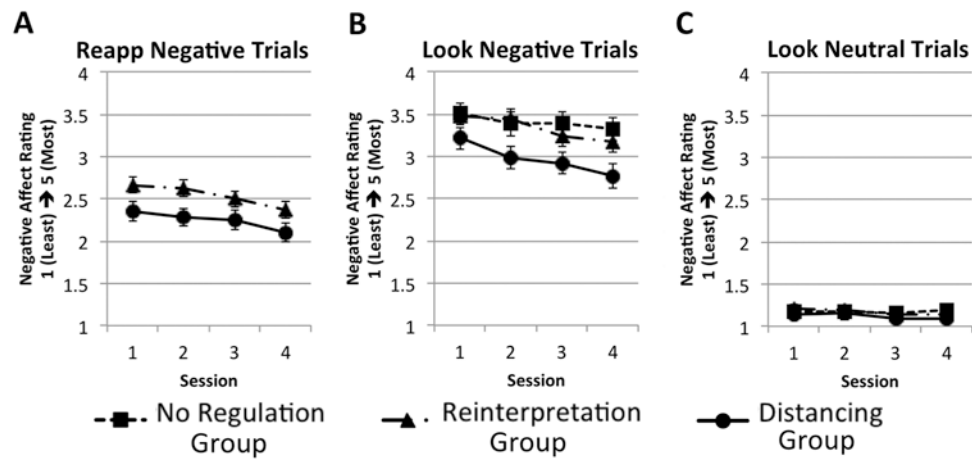


Figure 2.

Change over time in negative affect reports by group and trial type. Negative affect reports are shown over time for the No Regulation group (purple), Reinterpretation group (green), and Distancing group (orange) for (A) Reapp Negative trials, (B) Look Negative trials, and (C) Look Neutral trials.

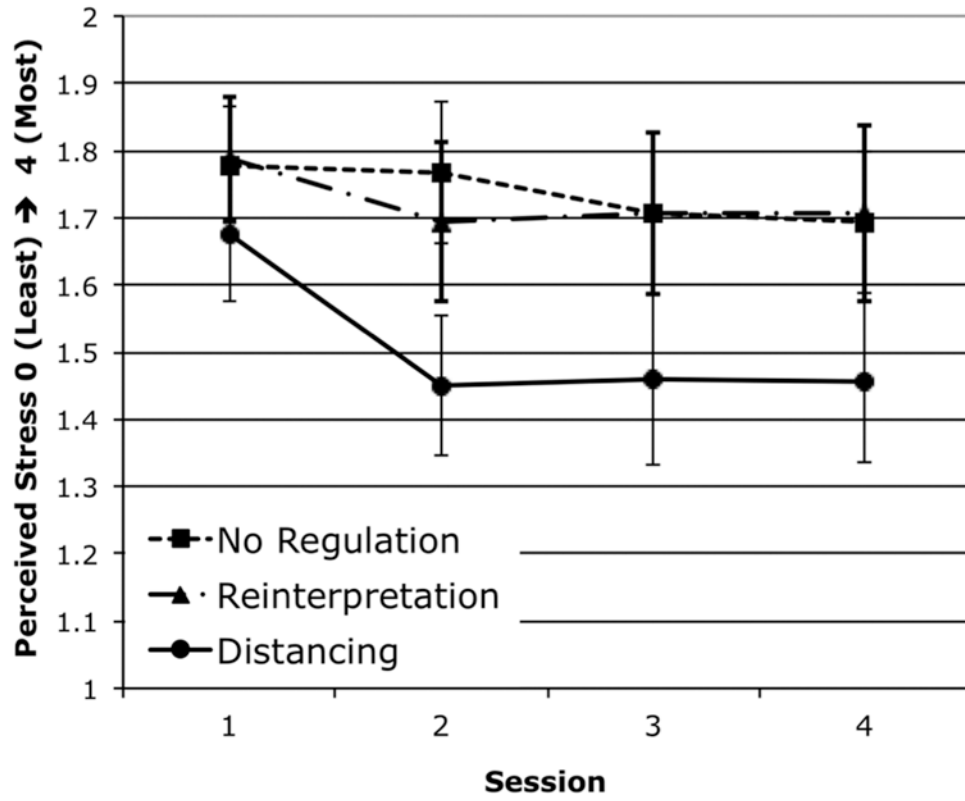


Figure 3. Perceived stress reports as a function of group and testing session.