

Individual differences in cognitive reappraisal: Experiential and physiological responses to an anger provocation

Iris B. Mauss^{a,*}, Crystal L. Cook^b, Jennifer Y.J. Cheng^c, James J. Gross^b

^a Department of Psychology, University of Denver, 2155 South Race Street, Denver, CO 80208, United States

^b Stanford University, United States

^c San Jose State University, United States

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Abstract

Effective emotion regulation is widely seen as vital for healthy adaptation. There remains considerable uncertainty, however, as to what constitutes effective emotion regulation. One promising emotion regulation strategy is *cognitive reappraisal*, which involves reframing emotional events so as to decrease their emotional impact. This strategy is useful because it seems to enable individuals to down-regulate negative feelings without the physiological costs that are associated with other forms of emotion regulation. It remains unknown, however, whether individual differences in the use of reappraisal are associated with experiential and physiological responses to anger-inducing situations. To examine this question, individuals either high or low in reappraisal were made angry in the laboratory while emotion experience and cardiovascular responses were assessed. Results indicated that compared to low reappraisers, high reappraisers had a more adaptive profile of emotion experience and cardiovascular responding. Specifically, across baseline and provocation periods, high reappraisers reported less anger, less negative emotion, and more positive emotion, showed greater cardiac output and ventricular contractility, and lesser total peripheral resistance. These findings suggest that reappraisers are successful at down-regulating negative emotions, even in the context of a potent negative emotion such as anger.

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“Anger, I say, has this great fault — it refuses to be ruled.” —
Seneca

Successful control of emotional impulses, especially potentially destructive ones such as anger, is a task of fundamental importance for an individual’s well-being, health, and social functioning (e.g., Davidson et al., 2000a,b; Gross, 2001; Mayer and Salovey, 1995). However, as the Stoic philosopher Seneca observed, such control is often difficult to achieve, particularly for potent negative emotions such as anger (e.g., Gross et al., 2006; Stearns and Stearns, 1986). Moreover, even if some level of regulation is achieved, that control is often obtained at a substantial cost to the individual (e.g., Muraven et al., 1998; Polivy, 1998), including maladaptive physiological responding (e.g., Davidson et al., 2000a,b; Dembroski et al., 1985; Gross

and Levenson, 1997) and disrupted social interactions (e.g., Butler et al., 2003). These considerations present something of a dilemma: Should we incur the costs of not regulating emotions such as anger, or incur the costs of emotion control?

One response to this dilemma is suggested by the observation that different emotion regulation strategies have different profiles of consequences (Gross, 2001). If one could identify effective (and cost-free) forms of regulation, one could avoid paying a price either for expressing anger or for regulating it. But how can one distinguish between more adaptive strategies and less adaptive strategies? We have suggested that one way to predict the adaptiveness of different emotion regulation strategies is to use a process model of emotion regulation (Gross, 2001; John and Gross, 2004) that considers emotions to be a sequence of events and individual responses unfolding over time. At the broadest level, this model distinguishes between *response-focused* and *antecedent-focused* emotion regulation strategies.

This distinction is useful because it helps us distinguish between more and less adaptive regulatory strategies. Altering

* Corresponding author.

E-mail address: imauss@psy.du.edu (I.B. Mauss).

only some components of the emotional response *after* it has come under way (response-focused regulation) would seem to have adverse effects because other components of the emotional response continue to be active. In contrast, antecedent-focused regulation strategies alter the whole emotional response *before* it arises. Such strategies would seem to have beneficial effects without much cost at all, as they alter all downstream components of the reaction before the emotional response has become activated. One particularly intriguing example of antecedent-focused strategies is one in which an individual cognitively transforms, or *reappraises*, an emotional situation by changing the way he or she thinks about it. For example, upon hearing an annoying comment from an acquaintance, we might cognitively re-evaluate the comment (e.g., as a sign of their insecurity rather than malevolence) and thereby alter the entire emotion trajectory, feeling compassion for the acquaintance rather than anger.

Cognitive reappraisal exemplifies a particularly effective and flexible tool to down-regulate even intense negative emotion (Gross, 2001; Ochsner et al., 2004), and it is a strategy that is frequently used by individuals in everyday life (e.g., Gross et al., 2006). It thus presents a promising candidate for addressing the dilemma of how to control negative emotion. The core idea that motivates the present research is that cognitive reappraisal of an anger-evoking situation might allow one to successfully down-regulate anger, without the costs that are associated with other regulatory strategies.

Previous studies have shown that reappraisal, relative to no emotion regulation and relative to response-focused emotion regulation, is accompanied by an adaptive profile of affective responding. Across disgust, sadness, and distress contexts, reappraisal effectively decreases emotion experience in negative emotion eliciting contexts, and does so without appreciable physiological costs (for a review, see Gross, 2001). These studies suggest that when reappraisal is experimentally manipulated, it is associated with an adaptive profile of responses. Further, individuals who report they make frequent use of reappraisal generally experience greater positive emotion and lesser negative emotion. Moreover, they show enhanced functioning in interpersonal and well-being domains, as assessed by self-reports as well as peer-reports (Gross and John, 2003).

Together, experimental and correlational studies suggest that reappraisal is associated with lesser experience of negative emotion and greater experience of positive emotion, without maladaptive physiological responding. Given that reappraisers are successful at down-regulating a range of negative emotions, they might be very adept at down-regulating anger as well. Research suggesting that anger has a strong cognitive component (e.g., Ayduk et al., 2002; Rusting and Nolen-Hoeksema, 1998) makes it plausible that this cognitive strategy would be successful in the context of anger. This would be an important conclusion, because anger is both a negative emotion that has to be regulated in everyday life with particular urgency (e.g., Tavris, 1984), and an emotion that may be particularly difficult to regulate (as the quotation from Seneca attests). This fact, together with the fact that dysregulation of anger has been implicated in major areas of social functioning (e.g., violence:

Davidson et al., 2000a,b) and health (e.g., cardiovascular disease: Friedman and Booth-Kewley, 1987; Kubzansky et al., 2005) makes anger a particularly important emotion to investigate.

Unfortunately, three key limitations of the existing literature suggest that we cannot yet place full confidence in this hopeful conclusion. (1) To date no studies have examined reappraisal in the context of anger. (2) Many of the existing studies have assessed the effects of reappraisal in the context of passive slide or film viewing contexts (e.g., Gross and Levenson, 1997; Ochsner et al., 2004). Few studies have assessed the effects of reappraisal in intense, ecologically valid emotional situations, while measuring key affective responses (including experience and physiological responding). (3) Studies that have assessed individual differences in reappraisal have assessed their affective consequences using questionnaires only. It is crucial that their effects also be assessed in standardized laboratory situations using physiological measures in order to avoid the limitations posed by biases in questionnaire data. Together, these limitations make it difficult to derive firm conclusions about the effects of individual differences in reappraisal on individuals' affective responses in the context of anger.

In the present study, we sought to address the question whether individual differences in reappraisal are associated with an adaptive profile of responding to a laboratory anger provocation. Participants were made angry in a laboratory context, while their anger experience was assessed with self-reports and their cardiovascular responses were recorded. Because cardiovascular responding is multi-dimensional, and maladaptive cardiovascular responding cannot be characterized by one measure alone (e.g., Lacey, 1967; Stern and Sison, 1990), particular care was taken to assess multiple measures of cardiovascular responding, including heart rate (HR), ventricular contractility (VC), cardiac output (CO), total peripheral resistance (TPR), and mean arterial blood pressure (MAP). Greater cardiac activation (ventricular contractility and cardiac output) is indicative of a *maladaptive threat* response in the context of greater vascular responding (especially total peripheral resistance) but indicative of an *adaptive challenge* response in the context of lower vascular responding (Mendes et al., 2003; Tomaka et al., 1993). In a separate session, participants' tendency to use reappraisal was assessed with the Emotion Regulation Questionnaire (ERQ; Gross and John, 2003).

Based on previous studies of anger (e.g., Herrald and Tomaka, 2002; Stemmler, 2004) we expected that the anger provocation relative to the baseline would lead to greater anger and negative emotion experience, lesser positive emotion experience, and greater HR, BP, CO, and VC, with no changes in TPR in all participants. Based on our analysis of the literature on reappraisal (e.g., Gross and Levenson, 1997), we hypothesized that relative to individuals low on reappraisal, individuals high on reappraisal would self-report lesser anger and negative emotion experience and greater positive emotion experience, and show greater adaptive responding of the cardiovascular system (challenge versus threat responses, characterized by greater CO and VC and lower TPR) during the relatively neutral baseline film as well as during the anger provocation.

1. Method

1.1. Participants

One hundred and eleven female students participated in a laboratory anger provocation. In order to eliminate variance due to gender differences in anger regulation (e.g., Timmers et al., 1998), only female participants were used. One week later, participants returned to the laboratory for a session during which their reappraisal scores were assessed. In order to maximize variability in reappraisal in the specific laboratory situation, high and low reappraisal groups were selected from the top and bottom tertile, respectively, of the distribution of scores on the Reappraisal subscale of the ERQ (rather than the top and bottom 50%). Five of the participants were excluded from analyses because of technical malfunctions that affected at least one channel of the physiological recording. This left 67 participants for analysis, 33 of them high reappraisers (average age = 20.8 years, $SD=3.2$; average reappraisal score = 6.1, $SD=0.45$) and 33 of them low reappraisers (average age = 20.3 years, $SD=3.0$; average reappraisal score = 3.8, $SD=0.72$).¹ The ethnic composition of the sample was mixed: 3% African American, 22% Asian American, 53% European American, 15% Hispanic American, 6% of multiple ethnic backgrounds, with 1% choosing not to identify their ethnic background. High and low reappraisal groups did not differ from each other in terms of ethnicity, $\chi^2=5.13$, $p=.40$, and age, $F(1, 66)=.50$, $p=.43$.

1.2. Procedure

Participants were recruited for a 1-h study on mood and cognitive performance. Upon arrival at the lab, physiological sensors were attached by a female research assistant. The participant then viewed an emotionally neutral 5-min nature film, which served as a baseline period. At the end of the film, the participant rated her current emotion experience. Once she was finished, the experimenter (a second, female research assistant) entered the room to introduce herself. The experimenter was brisk with all participants, and spoke to them in a condescending manner. She informed the participant that she would be participating in a cognitive performance task, and that the two of them would be communicating through an intercom system. The experimenter then left the room for the remainder of the experiment.

At this point, the anger provocation began, which was adapted from Stemmler (1997). In order to standardize the procedure, all questions and directions played over the intercom to the participant were pre-recorded in the experimenter's voice. Participants were asked to count backwards quickly in increments of 7 or 13 from a very high number (e.g., "Count

backwards in steps of 7 from 18,652") for 1 min. This task was repeated three times. In between each counting task, participants were told that they were moving too often, producing physiological artifacts and rendering the data useless, and that they were not speaking sufficiently loudly. These comments were given in an increasingly annoyed (and annoying) tone of voice. After three tasks, the experimenter informed the participant that she would have to return to the task later on, implying that the attempts had been useless. Then, participants provided emotion ratings. This procedure was followed by two other tasks not relevant to the present research.

After this, sensors were removed and a funneled debriefing procedure was used to assess the extent to which participants were aware of the true nature of the "cognitive performance task" (the anger provocation) (Bargh and Chartrand, 2000). Of the 38 participants used for final analyses, 28 did not report any suspicion at all and ten reported some suspicion. Secondary analyses were performed using only participants who reported no suspicion, and yielded results identical to the analyses that included participants with some suspicion. After the funneled debriefing, participants were thanked and fully debriefed.

Approximately 1 week after the first session (average time between the two sessions was 9.1 days, $SD=3.4$), participants returned to fill out the Emotion Regulation Questionnaire (ERQ). We obtained these ratings after the anger provocation rather than before to minimize the likelihood that participants would become aware of the purpose of the anger provocation.

1.3. Measures

1.3.1. Emotion experience

Emotion experience was assessed after the baseline and again after the anger provocation with ratings on 11-point Likert scales, ranging from 0 (*none at all*) to 10 (*extremely*). An anger experience composite was formed using the terms frustrated, annoyed, and angry ($\alpha=.83$ for baseline; $.79$ for provocation). A negative emotion experience composite was formed using the terms sad, anxious, guilty, ashamed, worried, afraid, and nervous ($\alpha=.82$ for baseline; $.87$ for provocation). A positive emotion experience composite was formed using the terms joyful, pleased, and happy ($\alpha=.84$ for baseline; $.91$ for provocation).

1.3.2. Physiological responding

During the session, physiological channels were sampled at 400 Hz. Five measures of cardiovascular responding were obtained: heart rate (HR), mean arterial blood pressure (MAP), cardiac output (CO), ventricular contractility (VC), and total peripheral resistance (TPR). Three of these measures were of particular interest: CO, VC, and TPR, because (a) they are involved in anger responding and emotion regulation (Gross and Levenson, 1997) and (b) they are important for differentiating (more maladaptive) threat from (more adaptive) challenge patterns within overall activation (Mendes et al., 2003; Tomaka et al., 1993). In addition, somatic activity was assessed through the use of a piezo-electric device attached to the participant's chair which generates an electrical signal proportional to the participant's overall body movement in any

¹ When using a median split to compare high and low reappraisal groups, the pattern of results remained the same, with high reappraisers as compared to low reappraisers reporting significantly lesser anger and negative emotion experience, significantly greater positive emotion experience, and exhibiting greater CO and lower TPR. Results for VC failed to reach significance when using median splits ($p=.08$) but means were in the same direction as when using tertiles, with high reappraisers exhibiting greater VC than low reappraisers during the baseline and the anger provocation.

direction. This measure of activity was then used to control for the effects of body movement on cardiovascular activation.

(a) *HR* was calculated from R–R intervals in the electrocardiogram obtained with a standard configuration of three sensors on the participants left and right rib cage and a ground on the participant's abdomen; (b) *MAP* was obtained from the third finger of the non-dominant hand by means of the Finapres™ 2300 (Ohmeda, Madison, WI) system. From this signal, beat-to-beat stroke volume was measured using Wesseling's pulse-contour analysis method (BEATFAST, TNO-Biomedical Instrumentation, Amsterdam); (c) *CO* was calculated as stroke volume \times heart rate; (d) *TPR* was calculated as $(MAP \times 80) / CO$; (e) *VC*, as indexed by pre-ejection period (with smaller values of pre-ejection period indexing greater VC), was derived from the ECG and the ZCG waves. The ZCG signal was obtained with an HIC-2000 Bio-Impedance Cardiograph (Bio-Impedance Technology, Inc.) using a set of four spot electrodes, applied at the front of the neck above the collar bone, the nape of the neck, the xiphisternal junction, and the lower back. A 4-mA AC 400-kHz current was sent through the two back sensors and transthoracic impedance as well as the first derivative of basal impedance, or the change of impedance over time, was obtained from the two front sensors. Pre-ejection period is identified as the time elapsed between the Q point on the ECG wave (the left ventricle contracting) and the B inflection on the ZCG wave (the opening of the aortic valve). Later, customized analysis software (Wilhelm et al., 1999) was applied to physiological data reduction, artifact control, and computation of average physiological scores for each participant for the baseline and the anger provocation (across the three 1-min counting tasks).

1.3.3. Individual differences in reappraisal

Individual differences in reappraisal were assessed with the 7-item Reappraisal subscale from the ERQ (Gross and John, 2003) (e.g., "I control my emotions by changing the way I think about the situation I'm in."; $\alpha = .96$). Participants were divided into high reappraisers and low reappraisers by selecting the lowest and the highest tertile of the distribution.

1.4. Data Analysis

We first used groupwise *t* tests in order to assess whether the high versus low reappraisers differed at baseline with respect to their emotion experience or their physiological activation. These tests indicated group differences in anger experience, $p = .05$, negative emotion experience, $p = .007$, positive emotion experience, $p = .009$, *CO*, $p = .03$, *VC*, $p = .04$, and *TPR*, $p = .04$, at baseline rendering change scores from baseline or analyses of covariance inappropriate (cf. Miller and Chapman, 2001). We thus used analyses of variance (ANOVA) for each dependent variable, with period (baseline versus anger provocation) as a repeated measure and reappraisal group as a between-participants factor, to assess the effects of the anger provocation and the effects of reappraisal group on emotion experience and physiological responding. Because none of the reappraisal group by period interactions reached significance (all $ps > .10$), only main effects are presented in the following section. Main effects of period test

whether the anger provocation was successful in inducing increased anger experience, increased negative emotion experience, decreased positive emotion experience, as well as increased cardiovascular activation (Effects of the anger provocation). Main effects of reappraisal group test the hypothesis that high as compared to low reappraisal participants would exhibit lesser anger and negative emotion experience, greater positive emotion experience, and a cardiovascular challenge pattern during the baseline and the anger provocation (Effects of reappraisal).

2. Results

2.1. Effects of the anger provocation

2.1.1. Emotion experience

As predicted, three 2 (reappraisal group) \times 2 (period) ANOVAs revealed a significant main effect of period for anger experience, $F(1, 65) = 173.18$, $p < .001$, $\eta^2 = .73$, negative emotion experience, $F(1, 65) = 54.97$, $p < .001$, $\eta^2 = .46$, and positive emotion experience, $F(1, 65) = 166.15$, $p < .001$, $\eta^2 = .72$, indicating that high as well as low reappraisers reported greater anger (Fig. 1, Panel a), greater negative emotion (Fig. 1, Panel b), and lesser positive emotion (Fig. 1, Panel c) during the anger provocation than during the baseline (see also Table 1).

2.1.2. Physiological responding

As predicted, five 2 (reappraisal group) \times 2 (period) ANOVAs revealed a significant main effect of period for HR, $F(1, 65) = 83.01$, $p < .001$, $\eta^2 = .58$, MAP, $F(1, 65) = 170.95$, $p < .001$, $\eta^2 = .74$, CO, $F(1, 65) = 48.68$, $p < .001$, $\eta^2 = .45$, and VC, $F(1, 65) = 17.78$, $p < .001$, $\eta^2 = .23$, but no main effect of period for TPR, $p = .63$, indicating that during the anger provocation both high and low reappraisers exhibited increased HR, MAP, CO (Fig. 1, Panel d), increased VC (Fig. 1, Panel e), and no change in TPR (Fig. 1, Panel f) as compared to their baseline cardiovascular activation (see also Table 1). These effects held when controlling for somatic activity by entering it as a moving covariate in the analyses, which suggests that findings are not due to changes in gross motor activity.

2.2. Effects of reappraisal

2.2.1. Emotion experience

As predicted, three 2 (reappraisal group) \times 2 (period) ANOVAs revealed a significant main effect of reappraisal group for anger experience, $F(1, 65) = 10.06$, $p = .002$, $\eta^2 = .13$, negative emotion experience, $F(1, 65) = 9.52$, $p = .003$, $\eta^2 = .13$, and positive emotion experience, $F(1, 65) = 3.92$, $p = .05$, $\eta^2 = .05$, indicating that high reappraisers as compared to low reappraisers reported lesser anger (Fig. 1, Panel a), lesser negative emotion (Fig. 1, Panel b), and greater positive emotion (Fig. 1, Panel c) during the baseline as well as during the anger induction.

2.2.2. Physiological responding

As predicted, five 2 (reappraisal group) \times 2 (period) ANOVAs revealed a significant main effect of reappraisal group for CO, $F(1, 65) = 5.59$, $p = .02$, $\eta^2 = .09$, VC, $F(1, 65) = 3.87$, $p = .05$, $\eta^2 = .06$,

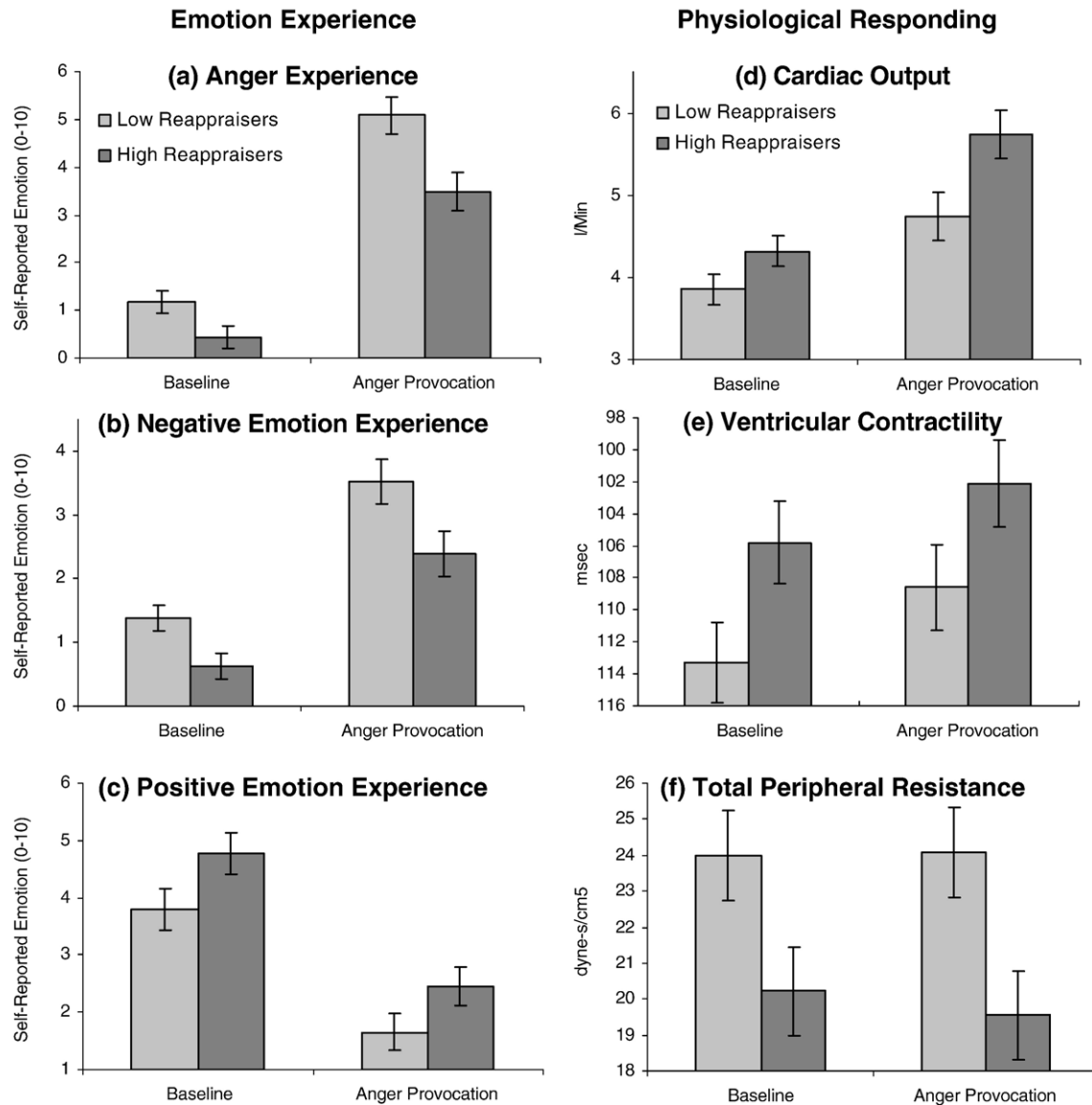


Fig. 1. Panels (a) through (f). Means (SEM) of (a) anger experience, (b) negative emotion experience, (c) positive emotion experience, (d) cardiac output, (e) ventricular contractility, and (f) total peripheral resistance for low versus high reappraisers for baseline and anger provocation periods.

and TPR, $F(1, 65) = 6.37, p = .01, \eta^2 = .10$, but no main effect of reappraisal group for HR or MAP, $ps > .14$, indicating that high reappraisers as compared to low reappraisers exhibited greater CO (Fig. 1, Panel d), greater VC (Fig. 1, Panel e), and lower TPR (Fig. 1, Panel f) during the baseline and during the anger provocation. These results held when controlling for somatic activity by entering it as a moving covariate in the analyses, which suggests that findings are not due to differences in gross motor activity.

3. Discussion

Anger control is of fundamental importance to many domains of life. However, how best to control anger has been a difficult question to answer. While some (rare) individuals appear to stay enviably calm even in taxing situations, others are sent into fits of rage when provoked, saying and doing things they later sorely regret. And even for those who do seem to achieve some measure

of anger control, this control too often seems to come at a steep price, such as maladaptive physiological responding (Davidson et al., 2000a,b; Dembroski et al., 1985; Pauls and Stemmler, 2003). The current research tested the hypothesis that reappraisal, or cognitively changing the way one sees an emotional situation, might present an answer to the problem of how one can control one's anger. It might present an effective means of down-regulating feelings of anger, while avoiding the physiological cost associated with other forms of emotion regulation. To address this hypothesis, we induced anger while assessing participants' emotion experience and physiological responding. In a separate session, we measured with a questionnaire the extent to which participants generally make use of cognitive reappraisal.

Results indicated that compared to low reappraisal participants, high reappraisal participants experienced significantly less anger, less negative emotion, and more positive emotion during the baseline as well as during the anger provocation.

Table 1
Mean (standard deviation) emotion experience and physiological responses for all participants for the resting baseline and the anger provocation

Measure		Period	
		Baseline	Anger provocation
Self-reported emotion experience	Anger (0–10)	0.83 (1.54)	3.83 (2.34) ^a
	Negative emotion (0–10)	1.07 (1.37)	2.66 (1.93) ^a
	Positive emotion (0–10)	4.10 (2.26)	2.01 (2.06) ^a
Physiological responding	Heart rate (beats/min)	74.9 (13.60)	85.4 (16.00) ^a
	Mean arterial blood pressure (mm Hg)	87.6 (15.96)	104.6 (17.77) ^a
	Cardiac output (l/min)	4.33 (1.05)	5.42 (1.47) ^a
	Ventricular contractility (ms)	108.02 (14.24)	103.21 (15.44) ^a
	Total peripheral resistance (dyne s/cm ⁵)	21.2 (6.70)	20.0 (4.59)

^a Pairwise comparisons between baseline and anger provocation are significant at $p < .001$, $N = 67$.

Physiologically, high reappraisers exhibited a relatively adaptive cardiovascular challenge response (greater CO and VC in combination with lower TPR), while low reappraisers exhibited a relatively maladaptive cardiovascular threat response (lower CO and VC in combination with greater TPR). These results allow for a number of conclusions about reappraisal, with implications that extend beyond the laboratory.

3.1. Reappraisal and emotional responding

Despite the fact that the laboratory situation was standardized across participants, those with high reappraisal scores had a quite different experience from those with low reappraisal scores throughout the laboratory session. High reappraisers reported experiencing significantly less anger than low reappraisers during the relatively neutral baseline as well as during the anger provocation.

Why might even the relatively neutral baseline (a 5-min nature film) lead to such pronounced group differences? This might be due to the fact that the participation in experimental studies was part of a class requirement, leading low reappraisal participants to react with some measure of anger. It appears that even a relatively neutral context can function as a mild anger provocation for low reappraisers. This difference between reappraisal groups was maintained during the anger provocation. While all participants reacted to the anger provocation with some anger experience, high reappraisers did so to a much lesser extent than low reappraisers, rendering even a quite obnoxious event less toxic for them.

One question that this reduction of anger experience in the high reappraisal relative to the low reappraisal group raises is whether there might be an emotional cost. Would those who controlled their feelings of anger experience greater negative emotion such as guilt, sadness, or anxiety, as is suggested by psychoanalytically based notion of “anger turned inward” (Freud, 1917/1984; cf. Johnston et al., 1991)? Findings showed that the opposite was true: high reappraisers reported significantly less experience on a wide range of negative emotions, including guilt, sadness, and anxiety, as well as greater experience on a range of positive emotions,

including happiness and joy. Thus, far from “tuning anger inward,” high reappraisers exhibited enviably good cheer overall.

Another domain in which one might expect to see a cost of emotion control is cardiovascular responding. Other emotion regulation strategies, such as suppression or defensiveness, have been related to maladaptive forms of cardiovascular responding (e.g., Butler et al., 2003; Gross and Levenson 1997). However, this was not the case for reappraisal. High reappraisal, in contrast to low reappraisal, was associated with a cardiovascular challenge response pattern. This pattern is thought to indicate active coping and to be relatively adaptive (e.g., Mendes et al., 2003; Tomaka et al., 1993), a finding consistent with the notion that reappraisal involves active cognitive engagement with the emotional situation so as to render it less emotional (Gross and John, 2003). The differences in negative and positive emotion experience as well as in cardiovascular responding held during the more neutral baseline as well as during the anger provocation, suggesting that high reappraisers engage in adaptive emotion regulation strategies in a range of situations. Together, these results raise the intriguing possibility that reappraisal has all of the benefits but none of the costs associated with other forms of emotion regulation.

3.2. Implications for life outside the laboratory

Because thinking about emotional events is an activity that people engage in on a daily basis, we believe that the present results have implications beyond the laboratory to individuals’ well-being, social functioning, and health, to clinical contexts, and to contexts beyond the individual.

3.2.1. Implications for well-being, psychosocial functioning, and physical health

Given that reappraisal is a relatively stable trait (Gross and John, 2003), and that high reappraisers can thus be expected to engage in this adaptive type of emotion regulation in many different emotional contexts, the present findings might have far-reaching implications for individuals’ well-being, psychosocial functioning, and health. Anger regulation is of central importance for adaptive functioning in many domains of individuals’ lives, including daily tasks (e.g., driving), family relationships, friendships, romantic relationships, school, the workplace, and politics (e.g., Gross et al., 2006; Hochschild, 1983; Stearns and Stearns, 1986). Given the link between anger and aggressive behavior and even some forms of violence (Berkowitz, 1990; Howells, 2004; Zillmann, 1993), the ability to successfully control anger is of utmost importance to function in social contexts. In addition to functioning in various domains of everyday life, successful anger regulation has been related to positive psychological (e.g., Chemtob et al., 1997; Cole et al., 1994) as well as physical health outcomes (e.g., Dienstbier, 1989; Kubzansky et al., 2005). In sum, individuals’ ability to successfully regulate anger, without incurring a cost, might have beneficial cumulative effects in a wide range of domains.

3.2.2. Implications for clinical science

The present findings have implications for interventions used to reduce anger. A number of anger management interventions

are currently used (e.g., Fein, 1993; Gerzina and Drummond, 2000; Novaco, 1976; Zillmann, 1993), and while many seem to be quite successful, it is often unclear which components of treatments are effective, and why they are effective. Our findings support the use of cognitive strategies in such interventions, and suggest that changing the habitual way one thinks about anger-provoking events is an important mechanism of change in successful interventions.

3.2.3. *Implications for socio-cultural variation in anger*

How a person thinks about emotional events is not just a function of the individual itself but is strongly influenced by social and cultural contexts (Markus and Kitayama, 1992). Gender, ethnic background, and socioeconomic status, are but examples of social factors that systematically affect how a person will come to think of an emotional event (e.g., Krings, 2000; Mesquita, 2002). For example, someone socialized to empathize with others and de-emphasize personal goals would be more likely to use reappraisal in anger-provoking situations, and to respond in an affectively more adaptive manner. Understanding reappraisal can thus shed light on the complex mechanisms by which socio-cultural factors affect emotional responding.

3.3. *Limitations and future directions*

We have stressed the design features of our study that present important strengths. However, there are of course limitations to our study as well. In the following section, we describe four important limitations of our study and associated directions for future research.

One limitation of our study is that we used only female college students as participants. While some studies indicate that our core findings might generalize to other populations (e.g., Gross and John, 2003), there might also be important differences in anger regulation as a function of participants' age, sex, and culture (e.g., Timmers et al., 1998; Vrana and Rollock, 2002). While ethnic background did not moderate the current results, small sample sizes did not allow for formal tests of this finding and it will be important to systematically assess more diverse samples in future studies.

A second limitation that might limit our results' generalizability is that only one type of anger provocation was used. We suggest that in the present situation reappraisers' lessened anger experience is functional; however, this conclusion might not necessarily generalize to other situations. Awareness and expression of anger are seen by some researchers as evolutionarily adaptive (e.g., Darwin, 1872/1965; Panksepp, 1994), as important to psychological health (e.g., Roffman, 2004), or as motivators to achieve social change (e.g., Tiedens, 2000). Might the low anger levels of reappraisers thus be a downfall rather than an advantage in some situations? It is important in this context to emphasize that high reappraisal participants are not completely denying feelings of anger. Furthermore, they do not report increased negative or decreased positive emotion — one of the predictions made by proponents of the “psychological health” argument. Moreover, studies by Gross and John (2003) suggest that high reappraisers are highly socially functional, suggesting that agency can be achieved without experiencing high levels of anger. Together,

these findings are consistent with the interpretation that the level of anger control achieved by reappraisal is quite adaptive across a number of situations. However, future studies that systematically manipulate the anger-provoking context are needed to further test this conclusion.

A third limitation lies in the design we used. Reappraisal was varied by observing naturally occurring individual differences. While this approach maximizes external validity, it makes it impossible to derive a causal account about reappraisal from the present results alone, and it makes it difficult to specify which cognitive strategies individuals used in the laboratory situation. However, results obtained from studies that experimentally manipulated reappraisal in the context of other negative emotions such as sadness and disgust (e.g., Gross and Levenson, 1997) dovetail with the present results, thus giving our conclusions further weight. Nonetheless, further studies are needed that experimentally manipulate reappraisal in the context of laboratory anger provocation, and that assess the specific cognitive strategies that participants use (e.g., changing the narrative of the event versus distancing the self; Ochsner et al., 2004). Such studies would allow for causal conclusions and would lead to information about what specific cognitive mechanisms are most effective for anger reduction.

A fourth limitation lies in the fact that we focused on the affective correlates of reappraisal only. Other forms of emotion regulation, such as constructive anger expression (Davidson et al., 2000a,b), positive affective style (Davidson, 2000), a “cool” attentional focus (Ayduk et al., 2002), distraction (e.g., Rusting and Nolen-Hoeksema, 1998; Stemmler, 1997), or more automatic types of emotion regulation (e.g., Mauss et al., 2006), have been shown to be effective for reducing anger as well. Studies that simultaneously assess these processes and reappraisal are needed to assess how they might be interrelated. For example, reappraisal, a “cool” attentional focus, and constructive anger expression might be most successful and adaptive when they are used together. Studies that take into account several of these strategies might thus help us understand how they are interconnected in reducing anger, and which combination is the most successful.

4. **Concluding comment**

Much hinges on individuals' ability to control negative emotions, especially potentially destructive ones such as anger; regulation of anger is important in many domains of functioning, including well-being, social functioning, and physical health. However, effective anger control is difficult to achieve. Indeed, Seneca even went so far as to say that anger “refuses to be ruled.” Our results suggest that individuals who regularly employ reappraisal – cognitive reframing of emotional situations so as to feel less negative emotion – seem to have found an effective answer to the problem of anger regulation. Across different emotional contexts, they feel less anger, less negative emotion, and more positive emotion, and exhibit adaptive physiological responses. These strengths make them more likely to enjoy greater well-being, better social functioning, and better physical health.

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