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Motivated Emotion Regulation: Impacts on Effort, Affect, and Strategy Selection

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Abstract

Affective science literature has begun to acknowledge emotion regulation as a motivated process, and recognize that motivations to regulate our emotions might have important implications for emotional outcomes. Despite this acknowledgement, as well as evidence that emotion regulation depends on fundamental cognitive control processes that can be modulated by motivation, there is little research that experimentally manipulates motivation in the context of emotion regulation. To address this, we investigated emotion regulation task performance under baseline, extrinsic motivation, and intrinsic motivation conditions. Across two experiments, 149 participants completed an emotion regulation task under both baseline and motivation (extrinsic or intrinsic) conditions. During this task, participants were shown either negative or neutral images and asked to either regulate their emotions or attend and respond naturally. Self-report measures of negative affect, difficulty/effort, and regulation strategy choice were obtained after each trial. Under both extrinsic and intrinsic motivation, participants reported decreased negative affect and task difficulty relative to baseline. The presence of a motivator also significantly increased the reported use of regulation strategies such as reappraisal, identified as a high-effort cognitive strategy. Taken together, these results suggest that experimental manipulations of motivation may enhance emotion regulation performance (in terms of decreased negative affect) and effort (in terms of increased use of regulation strategies), consistent with previously observed effects of motivation on performance and effort in classic cognitive control tasks. These results further demonstrate that motivation has important implications for emotion regulation outcomes and call for further research into differential effects of distinct motivators.

Introduction

Emotion regulation (ER), the process by which individuals exert control over the emotions they experience, is adaptive, goal-oriented, and informed by motivational factors. The ability to effectively regulate our emotions has downstream consequences on our mental and physical health as well as on our social relationships (Aldao & Nolen-Hoeksema, 2012; Hu et al., 2014; Saxena, Dubey, & Pandey, 2011). Individuals who regulate their emotions effectively have been shown to have healthier social relationships and are at decreased risk for psychopathology diagnoses (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Cloitre et al., 2019; Gross & John, 2003; Haviland-Jones, 2018). Despite the recognition of ER as a goal-oriented process central to adaptive behavior, the role of motivation in ER and the mechanisms by which it can modulate ER have only begun to be characterized. In one such study, individuals who have been diagnosed with clinical depression and bipolar disorder reported feeling more motivated to feel negative emotions and emotional instability, respectively (Hay et al., 2014; Millgram, Gruber, Villanueva, Rapoport, & Tamir, 2021). In the political domain, Porat and colleagues reported that more liberal political leanings were associated with increased motivation to feel angst under existential threat (Porat et al., 2019). In addition to these characterizations, a recent theoretical account highlights the central importance of motivation in ER more broadly and argues that motivated ER requires directed action to shift current emotions toward desired emotional states (Tamir, Vishkin, & Gutentag, 2020).

Prior literature has also distinguished between different potential motives for emotion regulation. While sometimes the goal of regulation is emotional change itself (such goals are known as *hedonic* motives), the regulation of emotions can also be driven by higher-order motives (known as *instrumental* motives) that offer benefits beyond the desired emotional state,

such as facilitating social relationships (Niedenthal & Brauer, 2012), improving game performance (Tamir, Mitchell, & Gross, 2008), or influencing cognition (Levenson, 1999). While emotion regulation has historically been characterized in terms of striving towards increasing pleasant emotions and decreasing unpleasant emotions (Larsen, 2000), subsequent evidence has illustrated that desired end-states may vary across individuals and contexts (Hasan-Aslih et al., 2019; Hoffman, 1990; Kyriazi, Bogaerts, Tamir, Denissen, & Garofalo, 2021; Tamir, 2009; Tamir, Mitchell, & Gross, 2008) and that this variability in goal endpoints may reflect both hedonic and instrumental motives. ER driven by instrumental motives can be further characterized in terms of the functional benefits pursued: for example, motivated ER might be in pursuit of either intrinsic emotional outcomes (i.e. reducing stress to increase well-being), or an extrinsic goal (i.e. getting a job promotion). Given both contextual and individual-level variation in motivation, characterizing emotion regulation strategies and their outcomes under different motivational states is critical to understanding why and how people choose to regulate their emotions, as well as characterizing their regulation success.

Despite this, to our knowledge, studies that have focused on characterizing motivated ER in the pursuit of instrumental goals have been relatively limited in number. Further characterization is important, given the many real-life instances in which one may regulate their emotions in the service of an instrumental goal, instead of pursuing a given emotion as endpoint itself: for example, regulating emotion to act in a socially acceptable manner, or to attain personal goals such as receiving a job promotion (English, Lee, John, & Gross, 2017; Kalokerinos, Tamir, & Kuppens, 2017; Tamir, 2009). In such situations, regulation might be implemented to alter one's emotional state or expression, but that change in emotion itself might serve an instrumental purpose. Instead of emotion change itself as the goal of regulation, the

focus in such contexts is the outcome contingent upon the process of successfully regulating one's emotions. Additionally, despite the important distinction between hedonically- and instrumentally-motivated emotion regulation, the impact of instrumental motivation on ER strategy and success has yet to be fully explored.

Emotion regulation and cognitive effort

Individuals tend to vary in their emotion regulation, either by using different strategies or implementing the same strategy in different ways (Gross & John, 2003). Given that ER is thought to rely on fundamental cognitive control processes (Goldin, McRae, Ramel, & Gross, 2008; Herwig et al., 2007; Martins-Klein, Alves, & Chiew, 2020), a key factor potentially accounting for variation in ER processes is the amount of cognitive effort demanded by the strategy use being implemented, relative to the motivation to regulate. Given fundamental limits on cognitive resources and the cost of exerting cognitive effort, people tend to avoid cognitive effort where possible (Kool, McGuire, Rosen, & Botvinick, 2010) and, when confronted with a cognitive problem, use strategies that are easier to implement over more difficult strategies (Crocker, Fiske, & Taylor, 1984). However, research on motivation and cognitive control suggests that introducing a motivator can increase the amount of cognitive effort (i.e., level of engagement in a given task; Westbrook & Braver, 2016) that individuals are willing to exert in a task. Further, both intrinsic and extrinsic motivation have been demonstrated to modulate exerted cognitive effort (Braver et al., 2014; Kramer, Duijvenvoorde, Krabbendam, & Huizenga, 2021; Sandra & Otto, 2018). Therefore, one potential way that ER might vary as a function of motivation is in the amount of cognitive effort implemented towards regulation. Differing levels of motivation to regulate may potentially influence the overall cognitive effort exerted during

regulation, or they may influence whether people choose to implement high- or low-effort regulation strategies. Examining the deployment of cognitive effort and effort avoidance may inform consideration of how and why specific emotion regulation strategies are employed and how these might vary by context.

Much ER literature has focused on *cognitive reappraisal* (reframing an emotional stimulus in a way that changes its emotional meaning; (McRae, 2016) as a regulation strategy of primary interest both experimentally and clinically (reviewed in Mcrae, Jacobs, Ray, John, & Gross, 2012; Opitz, Lee, Gross, & Urry, 2014) . Cognitive reappraisal has been found to be one of the most successful ER strategies across a range of situational contexts (Webb et. al., 2012) and associated with improved emotional outcomes. However, in requiring both the construal and the reinterpretation of an emotional situation or stimulus, cognitive reappraisal can be considered a complex process dependent on working memory and cognitive control resources (McRae, Jacobs, et al., 2012; Ochsner & Gross, 2005; Opitz et al., 2014); potentially more cognitively demanding than other emotion regulation strategies such as distraction (Sheppes, Catran, & Meiran, 2009). Consistent with the idea that reappraisal may be more cognitively effortful than distraction as an ER strategy, Martins and colleagues demonstrated that use of reappraisal was associated with greater pupil dilation (a physiological metric of cognitive effort) than distraction during emotion regulation in an older adult sample (Martins, Florjanczyk, Jackson, Gatz, & Mather, 2018). Additionally, instructed use of cognitive reappraisal as an ER strategy engages brain regions associated with cognitive control and implementation of mental effort, such as the dorsolateral prefrontal cortex (DLPFC; (Ochsner, Bunge, Gross, & Gabrieli, 2002), and increased activity in such prefrontal regions during appraisal has been shown to predict lower overall levels of negative emotion (i.e., greater emotion regulation success; Silvers, Weber,

Wager, & Ochsner, 2014), suggesting that greater cognitive effort during reappraisal can be associated with regulatory success. Additionally, adults tend to be more successful at reappraisal than children or adolescents, suggesting that the ability to successfully reappraise may correlate with maturation of cognitive control and related brain regions, such as the PFC (McRae, Gross, et al., 2012). While both distraction and reappraisal engage DLPFC regions implicated in the cognitive control of emotion, reappraisal recruits these regions to a greater extent than distraction, as well as recruiting medial PFC and anterior temporal regions implicated in processing affective meaning (McRae et al., 2010). These findings suggest that reappraisal, while often a highly effective regulation strategy, might require greater cognitive effort than distraction and recruit cognitive control processes and related brain regions to a greater extent. Together with evidence that motivation may increase willingness to exert cognitive effort during controlled performance (Chiew & Braver, 2016; Chiew & Braver, 2013; Ennis, Hess, & Smith, 2013), one's ability and motivation to implement effort during regulation could thus potentially impact ER both in terms of influencing strategy selection (i.e., with higher motivation leading to increased use of reappraisal versus distraction), as well as modulating willingness to exert more effort in implementing that regulation strategy.

In line with this prediction, several recent studies have demonstrated that emotion regulation strategy selection can vary as a function of task demand and contextual factors. For example, Sheppes and colleagues (2011) observed that in high-intensity (i.e., more demanding) emotional situations, individuals instructed to regulate their emotions were more likely to choose to engage in distraction over reappraisal; in contrast, in low-intensity emotional situations, the same individuals were more likely to engage in reappraisal than distraction. Sheppes et al. interpreted this finding as indicating that when cognitive resources are limited, strategy choice

may be constrained; thus, people may not always use the most successful strategy (i.e., reappraisal) to regulate their emotions if it is also effortful and resource-demanding. Additionally, Thiruchselvam and colleagues (2011) found that distraction led people to attenuate their emotional responses to negative stimuli more *rapidly* compared to reappraisal, while Sheppes and Meiran (2007) found that distraction also led people to attenuate their responses more *effectively* than reappraisal when time to regulate was limited. Reappraisal has been also observed to be less effective in attenuating negative emotion for individuals in low-control situations (i.e., low versus high socioeconomic status), leading to the suggestion that reappraisal, while globally linked to regulatory success, should not be considered to have a “one size fits all” effectiveness (Troy, Shallcross, & Mauss, 2013).

Taken together, these observations suggest that regulation strategy selection might vary with contextual factors. Given studies in the classic cognitive control literature demonstrating that task strategy selection can be modulated both by context and by motivation (Braver et al., 2014; Bugg, Jacoby, & Toth, 2008; Hertzog & Dunlosky, 2004) the use of one task strategy versus another in the emotion regulation domain may likewise be impacted by motivation. It is possible that, under varying levels of motivation, ER strategies may be chosen primarily based on the effort (or perceived effort) necessary for successful strategy implementation, instead of the regulation success associated with that strategy (e.g., using distraction instead of reappraisal, given its lower effort demands). Understanding the role of strategy choice and effort in ER, and how both strategy choice and effort may vary in the context of different motivational states, could potentially impact how and when we encourage individuals to engage in different regulation strategies that lead to optimal emotional outcomes.

In the classic cognitive control literature, motivation to exert cognitive effort has

primarily been manipulated using extrinsic incentives, such as monetary rewards (although note that other external motivators such as primary rewards and punishments, social incentives, and threat of shock have also been utilized; (Braver et al., 2014; Chiew & Braver, 2014; Chiew & Bowen, in press; Crawford et al., 2020)). While extrinsic incentives are frequently used in laboratory settings and generally appear to enhance momentary performance on cognitive tasks, there is limited evidence for their potential impact on longer-term, more complex metrics of performance, such as personal growth and achievement (Klaßen, Baskerville, & Bonner, 2000; Murayama, Pekrun, Lichtenfeld, & Vom Hofe, 2013). Conversely, intrinsic motivation has been linked to both short-term positive outcomes, such as increased task engagement (Braver et al., 2014), as well as longer-term positive outcomes, such as increased creativity in the workplace (Zhang & Bartol, 2010) and greater emotional well-being (Ryan & Deci, 2000; Schwartz & Wrzesniewski, 2016).

It is reasonable to think of both intrinsic and extrinsic motivation as potentially impacting ER choice and outcomes in daily life (Tamir & Millgram, 2017). For example, if one were to be insulted by a superior at work, she may be extrinsically motivated to regulate her emotional response in order to keep her job and maintain her professional demeanor. On the other hand, one could also be intrinsically motivated to regulate her emotional response in the same situation because she knows that too much stress has negative consequences on one's physical and mental health (in which case, the alteration in emotion is itself the goal motivating emotion regulation). Given that ER can be thought of as driven by both extrinsic and intrinsic motivators, and has been characterized both momentarily in laboratory tasks as well as on longer timescales in real-life settings (Heij & Cheavens, 2014; Seeley, Garcia, & Mennin, 2015), characterizing and comparing the role of intrinsic versus extrinsic motives in ER could contribute to an improved

understanding of ER outcomes both inside and outside the laboratory. However, to our knowledge, these distinctions have not been systematically manipulated and compared.

To address these open questions, the current study investigates whether systematic manipulation of extrinsic and intrinsic motivation lead to strategy and effort differences in ER, as well as differences in downstream emotional outcomes. We manipulated motivational orientation by presenting participants with either an extrinsic (monetary) or intrinsic (well-being-focused) motivational framing statement prior to a standardized emotion regulation paradigm (adapted from McRae et al. 2012, etc.) and examined effects on reported regulation strategy choice, performance demand, and emotional outcomes on a trial-by-trial basis, relative to a baseline condition. We hypothesized that relative to baseline, in the motivation condition participants would report choosing a high-effort ER strategy (i.e., appraisal) more often, and report both greater effort and regulation success. Further, evidence that extrinsic and intrinsic motivators might have differential effects on long-term well-being and performance, with greater benefits potentially observed with intrinsic motivation (Ryan & Deci, 2000), we hypothesized that this benefit of motivation to emotion regulation performance might be greater in intrinsically- versus extrinsically-motivated participants. These hypotheses were examined across two experiments, with Experiment 1 using a sample of undergraduate students, and Experiment 2 serving as a replication in a larger sample of online community participants recruited from the Prolific platform (www.prolific.co).

Experiment 1

Methods

Transparency and Openness

Sample size determinations are reported below. All data, analysis code, and research materials will become available on the Open Science Framework (www.osf.io) upon publication. Data were analyzed using R, version 4.0.0 (R Core Team, 2020) and the packages ez version 4.4-0 (Lawrence & Lawrence, 2016), ggplot, version 3.2.1 (Wickham, Chang, & Wickham, 2016), lme4, version 1.1-27.1 (Bates et al., 2018), and mlogit, version 3.0 (Croissant, 2012). This study's design and its analysis were not pre-registered. These specifications apply to both Experiment 1 and Experiment 2.

Sample Size Determination

An *a priori* power analysis for repeated-measures ANOVA with two groups and three measurements, including a within-between subjects interaction (in G*Power version 3.1; Faul, Erdfelder, Lang, & Buchner, 2007), revealed that running 38 participants per between-subjects Motivation condition (Intrinsic vs. Extrinsic) would give sufficient power ($1 - \beta = 80\%$) to detect differences in effects of motivation manipulations on ER success with an effect size of $d = 0.519$ (considered a medium effect size; J. Cohen, 1992) and $\alpha = .05$. This effect size estimate was informed by observations from a previous study (Walsh, Carmel, & Grimshaw, 2018) examining the effect of reward on emotional distraction: specifically, the observed effect size of monetary reward on a behavioral measure of emotion distraction (reaction time differences). The effect size from this contrast was chosen as, to our knowledge, no published effect sizes are available regarding the effect of extrinsic monetary incentives on emotion regulation. Further, a recent study examining the effect of motivation for happiness or sadness in depression noted a medium-to-large effect size (between $d = .66$ and $d = .71$; (Millgram, Joormann, Huppert, Lampert, &

Tamir, 2019). Given the magnitude of these effects, we used the effect size from the Walsh paper as a conservative estimate when calculating our proposed sample size.

Experiment 1, which utilized an undergraduate student sample, fell short of our sample size goal according to this power analysis due to participant recruitment difficulty related to the onset of the COVID-19 pandemic in Spring 2020. Because of this, we conducted a fully-powered replication in a separate, online community sample (Experiment 2) which is subsequently described below.

Participants

81 University of Denver undergraduates between the ages of 18-35 years (age $M = 20.06$ years, $SD = .33$; 51 females) were recruited through the University of Denver's SONA participant pool and participated in exchange for course credit. Fluency in English was required for participation. Fifteen participants were excluded for completing fewer than half of all trials in both the baseline and motivation block, one participant was excluded due to a failure to demonstrate comprehension of task instructions, and eight participants were excluded due to high scores on depression and anxiety scales. Twenty-four participants in total were excluded, resulting in a final sample size of $N = 57$ (Extrinsic $N = 29$, Intrinsic $N = 28$; 36 females). Demographic information for the final sample is presented in Appendix I. This study was approved by University of Denver's Institutional Review Board (IRB #1501215).

Overview of Experimental Procedure

The study was programmed in Qualtrics and conducted online through the University of Denver's SONA research participation portal. After providing informed consent, participants

were trained on reappraisal and distraction emotion regulation strategies (following a training procedure utilized in McRae et al., 2012) and then completed a block of an emotion regulation task under baseline motivation conditions. Participants then were presented with one of two motivational framing manipulations (Intrinsic or Extrinsic, counterbalanced between participants; see *Motivation Manipulation* below) before completing a second block of the emotion regulation task under the motivation condition. Following completion of this task block, participants completed several questionnaires indexing individual differences in emotion, motivation, and personality (see *Individual Difference Measures* below), received debriefing, and exited the study (experiment paradigm structure presented in Figure 1). Study tasks and measures are outlined in more detail below.

Figure 1. Overview of experiment procedure. ER = emotion regulation; PANAS = Positive and Negative Affect Scales.

Emotion Regulation Task

ER task performance was evaluated using a structured emotion regulation task adapted from a paradigm used in many prior ER studies (McRae, Ochsner, Mauss, & Gross, 2008; Ochsner et al., 2004). On each trial of this paradigm, participants were first cued to either regulate (“Regulate”) or respond naturally (“Look”) to an upcoming emotional (negatively-valenced) or neutral stimulus and then immediately reported information about strategy use and emotional outcomes on that trial. Regulation success on this task was characterized by reduced reported negative affect experienced in response to negative emotional stimuli when regulating, relative to responding naturally. Negative and neutral emotional target stimuli were selected from the International Affective Picture Set (IAPS; Lang, Bradley, & Cuthbert, 1997), which norms emotional stimuli on valence (using a 7-point Likert scale, where 1 = most negative and 7 = most positive) and arousal (again using a 7-point Likert scale, where 1 = least arousing and 7 = most arousing). 80 negative images (normed valence: $M = 2.52$, $SD = 0.50$; normed arousal: $M = 5.71$, $SD = 0.78$) and 40 neutral images (normed valence: $M = 4.84$, $SD = 0.15$; normed arousal: $M = 2.91$, $SD = 0.56$) were used in the experiment. Specific image stimuli and their IAPS norms are provided in Appendix II.

Before commencing the task, participants were trained on the use of two emotion regulation strategies: cognitive reappraisal (i.e., changing their perspective on the image and depicted content in a way that made them feel less negative) and distraction (i.e., focusing on a non-emotional part of the image, such as the background) using instructions detailed in McRae et al. (2012). Exact instructions for this training are presented in the experimenter script (Appendix III). After the participant completed this training, they completed a task practice and a comprehension check to verify understanding prior to the start of the emotion regulation task.

At the start of each task trial, participants viewed a scrambled version of the target image for 4 seconds¹. Then, participants were presented with a 2 second cue instructing them to either “Regulate” or “Look” before the presentation of the target image (either emotionally Neutral or Negative). The task block included equal numbers of Look-Neutral, Look-Negative, and Regulate-Negative trials. Within each motivation group, we further counterbalanced target stimuli so that each negative image was presented with either Look and Regulate instructions, balanced across participants, within each group. Trial order was also pseudo-randomized so that a given task instruction was presented for no more than 3 consecutive trials. Following the cue, a negative or neutral image was presented for 6 seconds, during which time participants were to engage with the image as instructed by the cue. Participants then immediately rated 1) how negative they felt (using a 5-point Likert scale), 2) which regulation strategy, if any, they implemented (on Regulate trials only; i.e., reappraisal, distraction, other, or did not regulate), and 3) how difficult the strategy was to implement (using a 5-point Likert scale). A prompt for each post-image rating was presented for 2 seconds; rating order was counterbalanced across trials to encourage task engagement and deliberate responding. The Baseline and Motivation task blocks consisted of 60 trials each. Motivation manipulations employed prior to the Motivation task block in both the Extrinsic and Intrinsic motivation conditions are described below in *Motivation Manipulation* and task trial structure is detailed in Figure 2.

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¹ Given that this paradigm was originally intended to be run in conjunction with pupillometry data collection, the scrambled image was meant to provide a luminance-matched baseline to measure changes in pupil dilation against. This was retained in the online version of this paradigm to enable future comparison against a replication with physiological measures.

Regulate Trials

(Experiment 1 Only)

Experiment 1

Experiment 2

4 sec.

2 sec.

6 sec.

Exp. 1 - 2 sec.
Exp. 2 - Self-pacedExp. 1 - 2 sec.
Exp. 2 - Self-pacedExp. 1 - 2 sec.
Exp. 2 - Self-paced**Look Trials**

(Experiment 1 Only)

Experiment 1

Experiment 2

4 sec.

2 sec.

6 sec.

Exp. 1 - 2 sec.
Exp. 2 - Self-pacedExp. 1 - 2 sec.
Exp. 2 - Self-paced**Extrinsic Cue** **Intrinsic Cue**

Figure 2. Task trial structure. Trial events and timing were consistent across Baseline and Motivation Blocks, with the only difference being that extrinsic and intrinsic cues were presented together with the regulation instruction in the Motivation Block to remind participants of the motivational manipulation.

Motivational Manipulation

Following the baseline task block and prior to the motivated task block, participants underwent a motivation manipulation in the form of a text statement that framed the emotion regulation task in terms of either monetary incentives (Extrinsic Motivation) or intrinsic benefits (Intrinsic Motivation) for regulation performance on the subsequent task block. Motivation condition was counterbalanced across participants. The external and internal motivational framings are detailed below, with exact instructions included in the experimenter script (Appendix III).

External Motivation. Using mild deception, we instructed participants that their ability to regulate their emotions successfully in the next task block would be monitored online using movements from their computer mouse (citing findings reported by Yamauchi & Xiao, 2018) that online mouse movements can index subjective emotional experience during computerized task performance) and that they would receive a payout for successful ER performance (up to \$10). To remind participants of this motivational induction, the instructional cue (“Look” or “Regulate”) was accompanied by dollar signs on each trial of the subsequent task block.

Internal Motivation. Participants were presented with a statement describing putative benefits of successful emotion regulation to well-being, including physical, psychological, and financial benefits (Gyurak & Levenson, 2010), and suggested to participants that others who have engaged in the task found the practice of regulating their emotions to be engaging, helpful,

and rewarding. To remind participants of this motivational induction, the instructional cue (“Look” or “Regulate”) was accompanied by an image of a lotus flower (alluding to well-being) on each trial of the subsequent task block.

Individual Differences Measures

Following the completion of the ER task, participants completed a post-task questionnaire reporting on their task experience, as well as individual differences measures of emotion, motivation, and personality: the Behavioral Avoidance/Inhibition Scales (Carver & White, 1994), Emotion Regulation Questionnaire (Gross & John, 2003), Post-experimental Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989), Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996), Perceived Stress Scale (Cohen, 1994), State Trait Anxiety Inventory (*STAI*; Spielberger, 2010), and a COVID-19 questionnaire (given that we conducted this experiment in Spring 2020). The post-task questionnaire included open-ended questions regarding the different reappraisals that participants recalled generating on Regulate-Negative trials, as well as participants’ perceptions about how effectively they were able to regulate their emotions. The PANAS was collected multiple times during the experiment session: before the Baseline Block, between the Baseline and Motivation Block, and after the Motivation Block, as a complementary measure of positive and negative affect over the course of the study. All other individual differences measures were examined to confirm that our External and Internal Motivation Groups did not significantly differ on these measures but were not analyzed further relative to task performance in the current study. Group averages on these measures are available in the supplement in Appendix IV.

Results

Negative Affect: effects of task manipulations

To examine the effects of task demands on self-reported negative affect, a 3 (Trial Type) x 2 (Block) x 2 (Motivation Group) repeated-measures ANOVA was conducted. Block (Baseline, Motivation) and Trial type (Look-Negative, Look-Neutral, Regulate-Negative) were included as within-subjects factors, while Motivation Group (Intrinsic, Extrinsic) was included as a between-subjects factor. Mean values for negative affect as a function of these factors are visualized in Figure 3. The ANOVA revealed a significant main effect of Trial Type ($F_{(2,110)} = 302.64, p < .001, \eta^2 = .85$) in which self-reported negative affect was highest for Look-Negative trials ($M = 3.09, SD = 1.35$), followed by Regulate-Negative trials ($M = 2.82, SD = 1.31$), with the lowest negative affect being reported in the Look-Neutral trials ($M = 1.34, SD = .70$). All pairwise comparisons were significant (Reg-Neg vs. Look-Neg: $t_{(56)} = -5.62, p < .001$, Reg-Neg vs. Look-Neu: $t_{(56)} = 16.53, p < .001$, Look-Neg vs. Look-Neu: $t_{(56)} = -19.41, p < .001$). The significant decrease in negative affect from Look-Negative to Regulate-Negative trials suggests successful ER induction and replicates typical findings for regulation tasks in the ER literature. We also found a significant main effect of Block ($F_{(1,55)} = 84.70, p < .001, \eta^2 = .60$), in which negative affect was higher in the Baseline Block than the Motivation Block ($t_{(56)} = 9.48, p < .001$). Additionally, the ANOVA revealed a significant Trial Type by Block interaction ($F_{(2,110)} = 23.76, p < .001, \eta^2 = .30$) wherein negative affect was lower in the Motivation Block than the Baseline Block for all three trial types (Baseline vs. Motivation: Reg-Neg: $t_{(56)} = 8.00, p < .001$, Look-Neg: $t_{(56)} = 8.18, p < .001$, Look-Neu: $t_{(56)} = 6.28, p < .001$) but decreased more for Look-Negative and Regulate-Negative trials than Look-Neutral trials. Finally, we also found a

significant Trial Type by Motivation Group interaction ($F_{(2,110)} = 3.51, p = .03, \eta^2 = .06$) in which participants in the Intrinsic Group reported higher negative affect than participants in the Extrinsic Group for Look Negative and Regulate-Negative trials, but lower negative affect in the Look-Neutral trials. Neither the main effect of Motivation Group ($F_{(1,55)} = 1.33, p = .25, \eta^2 = .02$) nor the main Trial Type by Block by Motivation Group interaction ($F_{(2,110)} = 2.35, p = .10, \eta^2 = .04$) reached significance.

Figure 3. Self-reported negative affect means by Block, Trial Type and Motivation Group. Mean negative affect was higher for the Baseline block for all three trial types. Mean negative affect was also higher for the Intrinsic Motivation Group for Look-Neg and Reg-Neg trials, but higher for the Extrinsic Motivation Group for Look-Neu trials.

Effort: effect of task manipulations

A 3x2x2 ANOVA parallel to the one run for Affect (described above) was conducted with self-reported Effort as the dependent variable. Mean values of effort are visualized in Figure 4. Again, we observed a main effect of Trial Type ($F_{(2,110)} = 1.39, p < .001, \eta^2 = .72$) Driving this effect, self-reported effort was highest for the Regulate-Negative trials ($M = 2.65, SD = 1.35$), followed by Look-Negative trials ($M = 2.34, SD = 1.37$), with Look-Negative trials having the

lowest reported effort ($M = 1.24$, $SD = .64$). All pairwise comparisons were significant (Reg-Neg vs. Look-Neg: $t_{(56)} = 4.22$, $p < .001$, Reg-Neg vs. Look-Neu: $t_{(56)} = 15.87$, $p < .001$, Look-Neg vs. Look-Neu: $t_{(56)} = 10.97$, $p < .001$). We also observed a main effect of Block ($F_{(1,55)} = 4.56$, $p < .001$, $\eta^2 = .45$) with higher reported effort for the Baseline Block than the Motivation Block ($t_{(56)} = 9.48$, $p < .001$). Also parallel to the Affect results, we observed a significant Trial Type by Block interaction ($F_{(2,110)} = 1.25$, $p < .001$, $\eta^2 = .18$) in which self-reported effort was higher in the Baseline Block than Motivation Block for all three trial types (Baseline vs. Motivation: Reg-Neg: $t_{(56)} = 6.99$, $p < .001$, Look-Neg: $t_{(56)} = 4.66$, $p < .001$, Look-Neu: $t_{(56)} = 2.25$, $p = .02$), but decreased more for Look-Negative and Regulate-Negative than for Look-Neutral trials. Again, neither the main effect of Motivation Group ($F_{(1,55)} = 5.13$, $p = .98$, $\eta^2 < .001$) nor the Trial Type by Block by Motivation Group interaction ($F_{(2,110)} = 2.56$, $p = .25$, $\eta^2 = .02$) reached significance.

Figure 4. Self-reported effort means by Block, Trial Type and Motivation Group. Effort was highest for the Baseline Block for all three trial types, but decreased more for Look-Negative and Regulate-Negative trials in the Motivation Block.

Modulation of regulation strategy choice by motivation

We next conducted analyses to examine whether the motivation manipulation was associated with significant differences in strategy choice on task trials requiring emotion regulation. Reported strategy use as a function of Block and Motivation Group are visualized in Figure 5. Analyses of Regulate-Negative trials, examining reported regulation outcome (Reappraisal, Distraction, Other, or No Regulation Strategy as categorical outcomes), were conducted using a multinomial logistic regression (using the *mlogit* function in the *mlogit* package in R version 4.0.1) with Block (Baseline, Motivation) and Motivation Group (Intrinsic, Extrinsic) as fixed effects and with participant modeled as a random effect. This approach allowed us to examine whether the choice of regulation strategy varied as a function of Block and Motivation Group, while accounting for the non-independence of strategy proportions and individual variability and avoiding data aggregation. Binomial contrasts between the four strategy outcome categories, resulting in six separate contrasts, were computed (Reappraisal vs. Distraction; Reappraisal vs. Other; Reappraisal vs. None; Distraction vs. Other; Distraction vs. None; Other vs. None).

Globally, across blocks and motivation conditions, participants indicated using reappraisal approximately 46% of the time, distraction approximately 39% of the time, no strategy (“None”) approximately 9% of the time, and a different strategy (“Other”) approximately 6% of the time. These global means suggest that participants complied with task instructions to regulate, and further, reported using the emotion regulation strategies that they were instructed on prior to the task (reappraisal and distraction) on the majority of task trials.

Effects of Block on Strategy Choice. The contrasts of Reappraisal vs. None and Distraction vs. None both revealed a significant effect of Block, with participants reporting greater use of Reappraisal and Distraction versus None in the Motivation vs. Baseline Block

(Reappraisal vs None: $\beta = -0.66$, $SE = 0.18$, $z = -3.57$, $p < .001$, 95% CI [-1.01, -0.30];

Distraction vs. None: $\beta = -0.53$, $SE = 0.17$, $z = -2.86$, $p = .004$, 95% CI [-0.90, -0.17]).

Effects of Motivation Group on Strategy Choice. Motivation Group was significant for all contrasts except for Reappraisal vs. Distraction ($\beta = 0.07$, $SE = 0.10$, $z = .70$, $p = .49$, 95% CI [-0.13, .27]). Participants in the Intrinsic Group reported relatively *more* use of Other strategies versus to both Reappraisal and Distraction than participants in the Extrinsic Group (Reappraisal vs. Other: $\beta = 0.97$, $SE = 0.21$, $z = 4.66$, $p < .001$, 95% CI [0.57, 1.39], Distraction vs. Other: $\beta = 0.91$, $SE = 0.21$, $z = 4.28$, $p < .001$, 95% CI [0.49, 1.32]). Participants in the Intrinsic Group also reported using no strategy (None) vs. Reappraisal and Distraction relatively *less* than participants in the Extrinsic Group (Reappraisal vs. None: $\beta = -0.58$, $SE = 0.19$, $z = -3.08$, $p = .002$, 95% CI [-0.94, -0.21], Distraction vs. None: $\beta = -0.65$, $SE = 0.19$, $z = -3.41$, $p < .001$, 95% CI [-1.02, -0.27]). In the Other vs. None contrast Intrinsic Motivation participants reporting relatively more use of Other strategies versus None compared to the Extrinsic Motivation Group ($\beta = -1.55$, $SE = 0.27$, $z = -5.89$, $p < .001$, 95% CI [-2.07, -1.04]).

Taken together, these findings indicate that while people generally used the instructed regulation strategies, their relative use of reappraisal and distraction, relative to other or no strategies, increased in the Motivation block vs. Baseline block. Additionally, participants reported using “Other” regulation strategies to a greater extent in the Intrinsic vs. Extrinsic Motivation Group. Implications of these findings are discussed further below.

Figure 5. Mean proportion of choice counts by Block and Motivation. Participants used Reappraisal (RA) and Distraction (distract) more often in the Motivation Block than in the Baseline Block. Participants in the Intrinsic motivation group reported more overall use of the Other strategy than participants in the Extrinsic group.

Differences in Negative Affect as a function of Regulation Strategy, Motivation Group, and Block

Descriptives. Mean negative affect on regulation trials differed as a function of selected strategy choice. Negative affect for Regulate-Negative trials was lowest for trials in which Reappraisal was reported ($M = 2.41$, $SD = 1.17$), followed by Distraction ($M = 2.98$, $SD = 1.24$), then None (no regulation) ($M = 3.63$, $SD = 1.34$), with Other having the highest self-reported negative affect ($M = 3.68$, $SD = 1.45$).

Model comparison and selection. To test whether reported negative affect during regulation significantly differed on a trial-by-trial basis as a function of task manipulations and reported regulation strategy, we used a linear mixed-effects model (using *lmer* in the *lme4* package in R version 4.0.0). We first examined the model with random effect of subjects only, and then compared it to a model including fixed effects of Motivation Group (Intrinsic vs. Extrinsic), Block (Baseline vs. Motivation), and Regulation Strategy (Reappraisal, Distraction, Other, or None). Adding Motivation Group, Block, and Regulation Strategy as fixed effects in

the model predicting Affect significantly improved model fit over the model only including random effects ($LR = 365.13, p < .001$); thus, we describe these fixed effects below.

Model effects. Within the updated model with Motivation Group, Block, and Regulation Strategy as fixed effects, Motivation Group did not predict a significant difference in negative affect ($\beta = 0.25, SE = 0.19, t = 1.35, p = .18, 95\% CI [-0.11, 0.64]$). In contrast, Block predicted a significant difference in affect ($\beta = -0.61, SE = 0.05, t = -13.41, p < .001, 95\% CI [-0.70, -0.52]$), with lower negative affect reported in the Motivation vs. Baseline block. Affect also significantly differed between all pairwise contrasts of Regulation Strategy choices except the contrast between None and Other ($\beta = .08, SE = 0.13, t = .71, p = .48, 95\% CI [-0.16, 0.34]$). Specifically, negative affect was significantly lower in Reappraisal vs. Distraction ($\beta = 0.50, SE = 0.05, t = -9.55, p < .00, 95\% CI [0.40, 0.60]$), Reappraisal vs. Other ($\beta = 1.00, SE = 0.10, t = 9.81, p < .001, 95\% CI [0.80, 1.20]$), and Reappraisal vs. None ($\beta = 0.91, SE = 0.09, t = 9.61, p < .001, 95\% CI [0.72, 1.09]$), as well as in the Distraction vs. Other ($\beta = 0.50, SE = .10, t = 4.91, p < .001, 95\% CI [0.30, 0.70]$) and Distraction vs. None ($\beta = 0.41, SE = 0.10, t = 4.31, p < .001, 95\% CI [0.22, 0.60]$) contrasts.

Differences in Effort as a function of Regulation Strategy, Motivation Group, and Block

Descriptives. Similar to the pattern observed with negative affect, reported mean effort on regulation trials differed as a function of selected strategy choice. Effort on Regulate-Negative trials differed by strategy choice, with participants reporting the most effort for None ($M = 3.17, SD = 1.60$), followed by Other ($M = 3.05, SD = 1.64$), then Distraction ($M = 2.88, SD = 1.29$), and finally Reappraisal ($M = 2.32, SD = 1.22$).

Model comparison and selection. To characterize Effort, we used a linear mixed-effects model parallel in structure to that reported above to examine Affect as a function of Regulation

Strategy, Motivation Group, and Block. We first conducted a congruous model comparison examining the difference in model fit between a model with random effects of subject only and a model with Motivation Group, Block, and Regulation Strategy included as fixed effects and Effort as an outcome variable on a trial-by-trial basis. As in the model predicting reported negative affect, we found that the Effort model including fixed effects significantly improved model fit over the model with random effects alone ($LR = 190.85, p < .001$)

Model effects. Within the model including Motivation Group, Block, and Regulation Strategy as fixed effects, we observed that Motivation Group did not predict a significant difference in Effort ($\beta = 0.09, SE = 0.19, t = 0.52, p = .60, 95\% CI [-0.11, 0.64]$). In contrast, Block predicted a significant difference in effort ($\beta = -0.44, SE = 0.05, t = -8.65, p < .001, 95\% CI [-0.70, -0.52]$), with higher reported effort in the Baseline Block than the Motivation Block. When examining effort as a function of Regulation Strategy, we observed significantly lower reported effort in Reappraisal vs. Distraction ($\beta = 0.55, SE = 0.06, t = 9.53, p < .001, 95\% CI [0.44, 0.66]$), Reappraisal vs. Other ($\beta = 0.65, SE = 0.11, t = 5.80, p < .001, 95\% CI [0.43, 0.88]$), and Reappraisal vs. None ($\beta = 0.61, SE = 0.10, t = 5.80, p < .001, 95\% CI [0.40, 0.81]$). However, Effort did not significantly differ for the contrast of Distraction vs. None ($\beta = 0.06, SE = 0.11, t = .54, p = .59, 95\% CI [-0.15, 0.26]$), Distraction vs. Other ($\beta = .10, SE = 0.11, t = 0.91, p = .36, 95\% CI [-0.12, 0.32]$), or None vs. Other ($\beta = 0.05, SE = 0.14, t = 0.33, p = .74, 95\% CI [-0.23, 0.32]$). Taken together, these effects suggest that reported effort significantly differed between Reappraisal and other regulation strategies, but did not significantly differ between non-reappraisal strategies. This is in contrast to regulation strategy effects on reported negative affect, where all contrasts of different strategies yielded significant effects except for the None vs. Other contrast.

Discussion

In Experiment 1, we examined effects of experimentally manipulating extrinsic and intrinsic motivation during emotion regulation on reported negative affect, regulation effort, and regulation strategy choice. Overall, we observed the expected task-related emotion regulation effect, wherein reported negative affect was lower for Regulate-Negative trials than for Look-Negative trials. While we did not observe a significant difference between intrinsic and extrinsic motivation conditions for either reported negative affect or effort, results suggested that introducing a motivational manipulation, relative to baseline, was associated with lower reported task difficulty and negative affect during regulation, potentially reflecting more effective regulation performance under motivation. Further, motivation impacted which regulation strategies participants reported spontaneously using; in particular, in the Motivation versus Baseline block, participants reported using Reappraisal significantly more often and using None (no regulation strategy) significantly less often. Previous work suggests that reappraisal might be an effective, but high-effort, emotion regulation strategy (Suri, Whittaker, & Gross, 2015; Troy, Brunner, & Shallcross, 2018) our observations suggest that people spontaneously use this strategy more often, find it easier, and find it more effective in terms of reducing negative affect, when they are in a motivated versus baseline state. Additionally, we observed a difference in reported regulation strategy use as a function of Extrinsic vs. Intrinsic motivation, whereby participants in the Intrinsic Motivation Group reported a significantly higher proportion of Regulation trials where an “Other” strategy was utilized. Intriguingly, this suggests that participants might spontaneously have generated their own regulation strategies (as opposed to Reappraisal and Distraction strategies, which they received training on prior to commencing the task) to a greater extent under our Intrinsic versus Extrinsic motivation condition. Given the

nature of the Intrinsic motivation manipulation (including an emphasis on stress reduction in the motivational framing statement read before the task as well as the lotus flower imagery used during task trials), we speculate that the elevated rate of reported “Other” strategy use might reflect spontaneous use of mindfulness or relaxation practices to promote emotion regulation in this condition.²

Overall, these results suggest that participants were generally able to successfully perform our emotion regulation task, consistent with instructions. Additionally, when motivated by either extrinsic or intrinsic motivators, participants reported both lower negative affect and lower task difficulty across trial types, suggesting that introducing a motivator led participants to complete the task more effectively. Intriguingly, reported use of regulation strategies significantly shifted in the Motivation condition relative to Baseline, with improved task compliance (in terms of fewer “None” (no strategy) outcomes reported on Regulation trials) and increased use of high-effort regulation strategies (specifically Reappraisal) reported in the Motivation block. Importantly, a time-on-task analysis indicated that these findings could not be fully explained by practice or fatigue effects (Appendix V). Overall, these findings suggest that introducing a motivator may improve emotion regulation success, possibly by making more effortful but effective regulation strategies (such as reappraisal, generally considered a cognitively demanding strategy) more adaptive to implement.

As a final note, due to subject recruitment challenges related to the advent of the COVID-19 pandemic in Spring 2020, we were unable to collect the estimated number of participants necessary from our undergraduate subject pool to fully explore our interaction of interest as

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² Note that while we employed a post-task questionnaire with open-ended questions regarding spontaneous use of different emotion strategies, participant responses were not informative enough to identify individual, alternative regulatory strategies associated with report of the “Other” strategy category.

described in our *a priori* power analysis reported above prior to the end of the academic year. Given this, we conducted a replication of Experiment 1 with a fully powered, community-based participant sample in Experiment 2 to confirm our results.

Experiment 2

Methods

Participants

133 adults between the ages of 18-35 years (age $M = 33$ years, $SD = 11.39$; 57 females) were recruited from the United States and United Kingdom through the Prolific online research platform (www.prolific.co) and compensated \$15 for their participation. Fluency in English was required for participation. 25 participants were excluded for completing fewer than half of all trials in both the baseline and motivation block, five participants were excluded due to a failure to demonstrate comprehension of task instructions, and eleven participants were excluded due to high scores on depression and anxiety scales. 41 participants total were excluded, resulting in a final sample size of 92 participants (Extrinsic = 49, Intrinsic = 43; 38 females). According to our power analysis outlined in Experiment 1 Methods, this sample was considered sufficient to detect our effects of interest. Demographic information for the final sample is presented in Appendix I.

Procedure

The procedure for Experiment 2 was nearly identical to Study 1 with a few minor adjustments. First, we removed the scrambled image from the beginning of each trial to reduce time demands on participants. Second, affect and effort ratings were self-paced as opposed to following the time limit (2 seconds) imposed in Experiment 1. Finally, to assess subjective task

effort more clearly, we changed the effort rating instructions to read “How much effort did you put into using this strategy?” instead of “How difficult was it to use this strategy?” All other ER task elements and individual difference measures remained identical to Experiment 1.

Results

Negative Affect: effects of task manipulations

To examine the effects of task manipulations on self-reported negative affect, we ran the same 3 (Trial Type) x 2 (Block) x 2 (Motivation Group) repeated-measures ANOVA as was run in Experiment 1. Mean values of negative affect as a function of these factors are visualized in Figure 6. We again observed a main effect of Trial Type ($F_{(2,180)} = 342.59, p < .001, \eta^2 = .79$) wherein self-reported negative affect was highest for Look-Negative trials ($M = 2.82, SD = 1.33$), followed by Regulate-Negative trials ($M = 2.55, SD = 1.26$), and lowest in Look-Neutral trials ($M = 1.36, SD = .76$). All pairwise comparisons were significant (Reg-Neg vs. Look-Neg: $t_{(91)} = 7.29, p < .001$, Reg-Neg vs. Look-Neu: $t_{(91)} = 17.95, p < .001$, Look-Neg vs. Look-Neu: $t_{(91)} = 20.71, p < .001$). We also found the same main effect of Block ($F_{(1,90)} = 166.35, p < .001, \eta^2 = .65$) with negative affect being higher in the Baseline Block than the Motivation Block ($t_{(91)} = 12.87, p < .001$). Additionally, we found the same Trial Type by Block interaction as in Experiment 1 wherein negative affect was higher in the Baseline Block than the Motivation Block for all three trial types (Baseline vs. Motivation: Reg-Neg: $t_{(91)} = 12.14, p < .001$, Look-Neg: $t_{(91)} = 11.29, p < .001$, Look-Neu: $t_{(91)} = 4.66, p < .001$), but decreased more for Regulate-Negative and Look-Negative trials than for Look-Neutral trials. Again, neither the main effect of Motivation Group ($F_{(1,90)} = .08, p = .77, \eta^2 < .001$) nor the main Trial Type by Block by Motivation Group interaction ($F_{(2,180)} = .11, p = .89, \eta^2 = .001$) reached significance. We also

found that the Trial Type by Motivation Group interaction was no longer significant for Experiment 2 ($F_{(2,180)} = 2.37, p = .09, \eta^2 = .03$).

Figure 6. Self-reported negative affect means by Block, Trial Type and Motivation Group. Mean negative affect was higher for the Baseline block than the Motivation block for all three trial types but decreased more for Look-Negative and Regulate-Negative trials.

Effort: effect of task manipulations

To examine self-reported effort as a function of task manipulations, we ran a 3x2x2 repeated-measures ANOVA with effort as a dependent variable, as conducted in Experiment 1. Mean values of self-reported effort are visualized in Figure 7. Similar to our prior findings, we observed a main effect of Trial Type ($F_{(2,180)} = 100.47, p < .001, \eta^2 = .53$), wherein reported effort was highest for Regulate-Negative trials ($M = 3.24, SD = 1.35$), followed by Look-Negative trials ($M = 2.83, SD = 1.47$), and lowest for Look-Neutral trials ($M = 2.11, SD = 1.45$). All pairwise comparisons were significant (Reg-Neg vs. Look-Neg: $t_{(91)} = 6.20, p < .001$, Reg-Neg vs. Look-Neu: $t_{(91)} = 11.91, p < .001$, Look-Neg vs. Look-Neu: $t_{(91)} = 9.25, p < .001$). Departing from the results of Experiment 1, the main effect of Block was not significant for effort ($F_{(1,90)} = .85, p = .36, \eta^2 = .009$). Again, neither the main effect of Motivation Group

($F_{(1,90)} = 2.59, p = .11, \eta^2 = .03$) nor the main Trial Type by Block by Motivation Group interaction reached significance ($F_{(2,180)} = 1.25, p = .29, \eta^2 = .01$).

Consistent with results from Experiment 1, we observed a significant Trial Type by Block interaction ($F_{(2,180)} = 3.27, p = .04, \eta^2 = .04$). However, the directionality of the interaction differed slightly from Experiment 1. In Experiment 2, self-reported effort in the Baseline Block was higher for Regulate-Negative trials (though only trending towards significance: $t_{(91)} = 1.81, p = .07$), insignificantly higher for Look-Negative ($t_{(91)} = .08, p = .39$) and insignificantly lower in Look-Neutral trials ($t_{(91)} = -0.67, p = .51$). Additionally, Experiment 2 revealed a novel Motivation by Block interaction ($F_{(1,90)} = 4.52, p = .04, \eta^2 = .05$), wherein reported effort was lower in for participants in the Intrinsic Group than the Extrinsic Group in the Motivation Block ($t_{(274)} = -2.90, p = .003$), but the two groups did not significantly differ in effort during the Baseline Block ($t_{(274)} = -1.77, p = .07$).

Figure 7. Self-reported effort means by Block, Trial Type and Motivation Group. Effort was highest for the Baseline Block for all three trial types but decreased more for Regulate-Negative trials in the Motivation Block.

Regulation strategy choice on Regulate-Negative trials

To evaluate Regulation Strategy Choice as a function of Block and Motivation Group we conducted a multinomial logistic regression analysis as previously described in Experiment 1. Reported regulation strategy choices as a function of motivation group and block are visualized in Figure 8. Again, Motivation Group and Block were modeled as fixed effects, subject was modeled as a random effect, and regulation choice outcome (Reappraisal, Distraction, Other, or None) was modeled as a categorical outcome variable. Six separate binomial contrasts were computed: Reappraisal vs. Distraction; Reappraisal vs. Other; Reappraisal vs. None; Distraction vs. Other; Distraction vs. None; Other vs. None.

Globally, across all conditions, participants indicated using reappraisal approximately 45% of the time, distraction approximately 41% of the time, no strategy (“None”) approximately 8% of the time, and a different strategy (“Other”) approximately 6% of the time. These global means were largely consistent with choice frequencies from Experiment 1 and indicated that on the majority of regulation trials, participants reported using one of the two regulation strategies (reappraisal or distraction) that they were instructed in prior to beginning the task.

Effects of Block on Strategy Choice. Consistent with Experiment 1, the contrast of Reappraisal vs. None and Distraction vs. None both revealed a significant effect of Block (Reappraisal vs None: $\beta = -0.45$, $SE = 0.13$, $z = -3.54$, $p < .001$, 95% CI [-0.70, -0.20]; Distraction vs. None: $\beta = -0.28$, $SE = 0.13$, $z = -2.26$, $p = .02$, 95% CI [-0.54, -0.04]), indicating that participants reported used Reappraisal and Distraction more than None in the Motivation block relative to the Baseline block. We also found a novel Block effect for the Reappraisal vs. Distraction contrast, indicating that participants also reported using Reappraisal more than Distraction in the Motivation block relative to the Baseline block ($\beta = -0.16$, $SE = 0.07$, $z = -2.24$, $p = .03$, 95% CI [-0.30, -0.02]). Inconsistent with Experiment 1, there was no significant effect of

Block in the Reappraisal vs. Other contrast ($\beta = -0.14$, $SE = 0.14$, $z = -1.00$, $p = .31$, 95% CI [-0.42, 0.13]).

Effects of Motivation Group on Strategy Choice. The contrast of None vs. all other strategy choices revealed significant effects of Motivation Group, whereby participants in the Intrinsic Motivation group reported using no strategy vs. all other strategies relatively more than the Extrinsic Motivation Group (Reappraisal vs. None: $\beta = 0.50$, $SE = 0.13$, $z = -3.91$, $p < .001$, 95% CI [0.24, 0.75], Distraction vs. None: $\beta = 0.60$, $SE = 0.13$, $z = -4.70$, $p < .001$, 95% CI [0.35, 0.85], Other vs. None: $\beta = 0.66$, $SE = 0.18$, $z = 3.73$, $p < .001$, 95% CI [0.31, 1.00]). In contrast to Experiment 1, where we observed elevated reports of “Other” strategy use with Intrinsic vs. Extrinsic motivation, no other significant effects of Motivation Group were observed in Experiment 2.

Overall, these patterns of results are highly consistent with our observations from Experiment 1 and support the conclusion that participants 1) generally used the instructed regulation strategies, reappraisal, and distraction; and 2) the reported use of regulation strategies, relative to “None” (no use of regulation strategy), in compliance with task demands increased with the presence of a motivation manipulation.

Figure 8. Mean proportion of strategy use as a function of Block and Motivation. Participants used Reappraisal (RA) and Distraction (distract) more often in the Motivation block than in the Baseline block. Participants in the Intrinsic motivation group reported higher use of None relative to participants in the Extrinsic group.

Differences in Negative Affect as a function of Regulation Strategy, Motivation Group, and Block

Descriptives. Mean negative affect on regulation trials differed as a function of selected strategy choice. Negative affect for Regulate-Negative trials was lowest for Reappraisal ($M = 2.30$, $SD = 1.13$), followed by Other ($M = 2.42$, $SD = 1.45$), None (no strategy) ($M = 2.69$, $SD = 1.38$), and Distraction having the highest self-reported negative affect ($M = 2.81$, $SD = 1.27$).

Model comparison and selection. Following the same model comparison procedure as in Experiment 1, we tested whether reported negative affect during regulation significantly differed on a trial-by-trial basis as a function of task manipulations (Motivation Group and Block) and Regulation Strategy. Again, we found that adding Motivation Group, Block, and Regulation Strategy as fixed effects in the model predicting Affect significantly improved model fit over the model only including random effects ($LR = 38.37$, $p < .001$); thus, we describe these fixed effects below.

Model effects. Similar to Experiment 1, Motivation Group did not predict a significant difference in Affect ($\beta = 0.12$, $SE = 0.14$, $t = .89$, $p = .37$, 95% CI [-0.15, 0.39]). Also consistent with Experiment 1, Block predicted a significant difference in Affect ($\beta = -0.82$, $SE = 0.03$, $t = -25.51$, $p < .001$, 95% CI [-0.89, -0.76]), with lower negative affect reported in the Motivation vs. Baseline block. Affect also significantly differed between all pairwise contrasts of Regulation Strategy choices besides None vs. Other ($\beta = .05$, $SE = 0.10$, $t = .50$, $p = .62$, 95% CI [-0.14, -0.24]): reported negative affect was significantly lower in Reappraisal vs. Distraction ($\beta = 0.47$, $SE = 0.04$, $t = 12.49$, $p < .001$, 95% CI [0.40, 0.54]), Reappraisal vs. Other ($\beta = .22$, $SE = 0.09$, $t = -2.53$, $p = .01$, 95% CI [0.05, 0.38]), and Reappraisal vs. None ($\beta = 0.17$, $SE = 0.07$, $t = 2.42$, $p = .02$, 95% CI [0.03, 0.30]), as well as when comparing Distraction vs. Other ($B = -0.25$, $SE = .09$, $t = -2.96$, $p = .003$, 95% CI [-0.42, -0.09]), and Distraction vs. None ($\beta = -0.30$, $SE = 0.07$, $t = -4.44$, $p < .001$, 95% CI [-0.44, -0.17]).

Differences in Effort as a function of Regulation Strategy, Motivation Group, and Block

Descriptives. Similar to patterns observed with reported negative affect, reported mean Effort on regulation trials differed as a function of selected strategy choice. Participants reported the highest effort for Distraction ($M = 3.45$, $SD = 1.26$), followed by Reappraisal ($M = 3.33$, $SD = 1.30$), Other ($M = 2.46$, $SD = 1.44$), and finally None (no strategy; $M = 2.29$, $SD = 1.31$).

Model comparison and selection. To characterize Effort as an outcome, we used a linear mixed-effects model parallel in structure to that used above to examine Affect as a function of Regulation Strategy, Motivation Group, and Block. We first conducted a congruous model comparison, examining the difference in model fit between a model with random effects of subject only and a model adding Motivation Group, Block, and Regulation Strategy as fixed effects. Consistent with the results for Negative Affect in Experiment 2 and results for both

Negative Affect and Effort in Experiment 1, we found that the model predicting Effort with fixed effects added significantly improved model fit over the model with random effects alone ($LR = 190.85, p < .001$); thus, these fixed effects are described below.

Model effects. Within the updated model including Motivation Group, Block, and Regulation Strategy as fixed effects, we found that Motivation Group did not predict a significant difference in Effort ($\beta = -0.29, SE = 0.20, t = -1.44, p = .15, 95\% CI [-0.69, 0.11]$), whereas Block did predict a significant effect (with higher reported effort in the Baseline Block than the Motivation Block; $\beta = -0.13, SE = .03, t = -4.34, p < .001, 95\% CI [-0.19, -0.07]$). When examining effort as a function of Regulation Strategy, significantly lower effort was reported in Reappraisal vs. Distraction ($\beta = -0.17, SE = 0.03, t = 5.08, p < .001, 95\% CI [0.11, 0.24]$), Reappraisal vs. Other ($\beta = -0.44, SE = 0.08, t = -5.70, p < .001, 95\% CI [-0.59, -0.29]$), and Reappraisal vs. None ($\beta = -0.68, SE = 0.06, t = -11.02, p < .001, 95\% CI [-0.80, -0.56]$).

Model effects. Within the updated model including Motivation Group, Block, and Regulation Strategy as fixed effects, we found that Motivation Group did not predict a significant difference in Effort ($\beta = -0.29, SE = 0.20, t = -1.44, p = .15, 95\% CI [-0.68, 0.11]$), whereas Block did predict a significant effect (with higher reported effort in the Baseline Block than the Motivation Block; $\beta = -0.13, SE = .03, t = -4.34, p < .001, 95\% CI [-0.18, -.07]$). When examining effort as a function of Regulation Strategy, significantly lower effort was reported in Reappraisal vs. Distraction ($\beta = -0.17, SE = 0.03, t = 5.08, p < .001, 95\% CI [0.11, 0.24]$), Reappraisal vs. Other ($\beta = -0.44, SE = 0.08, t = 5.80, p < .00, 95\% CI [-0.59, -0.29]$), and Reappraisal vs. None ($\beta = -0.68, SE = 0.06, t = -11.02, p < .001, 95\% CI [-0.80, -0.56]$). In contrast to Experiment 1, Effort also significantly differed for all contrasts of Distraction (Distraction vs. None: $\beta = -0.85, SE = 0.06, t = -13.91, p < .001, 95\% CI [-0.97, -0.72]$, Distraction vs. Other: $\beta = -0.61, SE = 0.08, t = -$

7.85, $p < .001$, 95% CI [-0.76, -0.46], Distraction vs. Reappraisal: $\beta = -0.17$, $SE = 0.03$, $t = -5.08$, $p < .001$, 95% CI [-0.23, -0.11]). The contrast of None vs. Other was also significant in Experiment 2 ($\beta = 0.24$, $SE = 0.09$, $t = 2.74$, $p = .006$, 95% CI [0.07, 0.42]). The change in effort instructions from Experiment 1 to Experiment 2 may have contributed to these differences in effort across regulation strategies.

Discussion

Experiment 2 was conducted as a replication with a fully-powered sample to examine our main hypothesized interaction of interest (alterations in emotion regulation in motivated versus baseline task blocks, varying with between-subjects motivation type). Many of the effects previously observed in Experiment 1 were also observed in Experiment 2, with a few exceptions. As in Experiment 1, no significant main differences for either reported Effort or Affect were found between Motivation Groups, and negative affect was significantly reduced in the Motivation block relative to the Baseline block. However, reported effort did not significantly differ between the Baseline block and the Motivation block in Experiment 2, as opposed to an observed decrease in reported effort in the Motivation block in Experiment 1. It is possible that these inconsistencies may be due to the difference in wording for the effort question from Experiment 1 to Experiment 2 described in the Methods section above.

Further, while we again observed that motivation impacted the reported frequency with which different regulation strategies were spontaneously used, a few key differences emerged in Experimental 2. Specifically, participants reported using Reappraisal significantly more often than Distraction in the motivation block and did not report increased use of “Other” strategies, as observed in Experiment 1. We also again observed differences in strategy use as a function of

Extrinsic vs. Intrinsic motivation. However, in contrast to Experiment 1, where Intrinsically vs. Extrinsically motivated participants reported elevated use of “Other” regulation strategies, in Experiment 2, Intrinsically vs. Extrinsically motivated participants reported significantly more “None” trials – i.e., trials where no regulation strategy was used. Possible explanations for this inconsistency across experiments, as well as its implications, will be detailed in the General Discussion.

Overall, these results are consistent with Experiment 1 in indicating that participants were able to successfully perform our emotion regulation task consistent with instructions, and that regulation was more successful when participants were presented with a motivator. Taken together, Experiment 1 and 2 both demonstrate the importance of motivation in emotion regulation success and provide empirical evidence that motivation can influence both how and how well individuals control their emotions.

General Discussion

Emotion regulation is a motivated process, but the effects of motivational modulation on emotion regulation outcomes have not been well-characterized systematically. In the present study, we examined the impact of motivation on emotion regulation implementation and success by directly manipulating extrinsic and intrinsic motivation experimentally and comparing their effects relative to a baseline condition. Replicating prior trial-type effects found in classic emotional regulation paradigms (Mcrae et al., 2008; Ochsner et al., 2004; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008; Webb, Miles, & Sheeran, 2012) individuals reported feeling the most negative when viewing a negative image without regulating, and the least negative when viewing neutral images, while viewing negative images while implementing a

regulation strategy was associated with an intermediate level of reported negative affect. Interestingly, across both studies, participants reported the least difficulty or effort when implementing cognitive reappraisal; the other regulation strategy options (use of distraction, use of no strategy, and use of a strategy other than reappraisal and distraction) did not significantly differ in reported difficulty or effort. This finding is surprising, given prior work suggesting that cognitive reappraisal is considered a particularly cognitively effortful regulation strategy (Suri et al., 2015). Given that use of a cognitive reappraisal strategy was also associated with lower reported negative affect, one possibility that might account for these observations is that higher reported effort or difficulty may have reflected participant difficulty engaging with the negative emotional content of the images, rather than difficulty implementing the regulation strategies themselves.

Contrary to predictions, we did not observe a significant effect of Motivation Group (Intrinsic vs. Extrinsic motivation) on reported negative affect or effort/difficulty in either experiment. However, we did observe a significant effect of Block on negative affect in both experiments as well as on reported difficulty in Experiment 1, with both reported negative affect and effort decreasing in the Motivation block relative to Baseline (reported effort did not significantly differ between Baseline and Motivation blocks in Experiment 2). Taken together, these results suggest that the presence of a motivator may increase the ease and efficacy of implemented ER strategies. Limited differences in emotion regulation outcomes were observed as a function of Intrinsic versus Extrinsic Motivation: in particular, reported negative affect and effort did not significantly differ by Motivation Group in either experiment. Interestingly, reported regulation strategy use did differ under Intrinsic vs. Extrinsic motivation, but patterns of strategy use as a function of Motivation Group were not consistent across experiments. Overall,

participants in both experiments globally reported using Reappraisal and Distraction on the majority of Regulate trials (across both task blocks, ~85% in Experiment 1, ~86% in Experiment 2). However, Intrinsic Motivation participants in Experiment 1 reported elevated use of “Other” strategies relative to Extrinsic Motivation participants, whereas in Experiment 2 Intrinsic Motivation participants reported elevated use of “No” regulation strategy relative to Extrinsic Motivation participants. While “Other” strategies were not associated with lower negative affect or reported difficulty in either experiment, we speculate that the elevated use of “Other” strategies by Experiment 1’s Intrinsic Motivation condition participants may have reflected spontaneous use of mindfulness or contemplative regulation strategies. The specific intrinsic motivation induction we used was health-focused in nature, instructed participants to try to “minimize stress” and employed a lotus flower image as a trial cue throughout the Motivation block, which may have led to use of mindfulness as an “Other” regulation strategy (although note that this pattern was not observed in Experiment 2’s Intrinsic Motivation condition, which used the same motivation induction). If Intrinsic Motivation participants were using a mindfulness strategy to emotionally regulate, such an approach might differ fundamentally from reappraisal in terms of underlying processes acted upon (Chambers, Gullone, & Allen, 2009). Specifically, reappraisal often involves reacting to an emotional stimulus, while mindfulness is more focused on becoming aware of the emotions generated by a stimulus. Importantly, mindfulness might not always successfully down-regulate negative affect – a growing body of evidence suggests that mindfulness can lead to unpleasant emotional experiences for a substantial number of individuals who engage in meditation practice (up to 25%; Jones, Id, Sparby, & Vo, 2019). While the possibility that our Intrinsic Motivation induction encouraged use of mindfulness strategies remains speculative, given that participants were not required to

report their “Other” strategy during the task and post-task open-ended reports were inconclusive, prior evidence suggesting that mindfulness may not necessarily be associated with ER success could account for the fact that “Other” strategy trials were not associated with reported decreases in negative affect or difficulty. Future work should explore spontaneous use of a broader range of emotion regulation strategies more thoroughly.

To our knowledge, this is one of the first studies to experimentally manipulate motivation in an emotion regulation paradigm. Our results suggest that introducing a motivator may increase use of regulatory strategies that are more effective but cognitively demanding, particularly cognitive reappraisal. Given that ER is thought to rely on fundamental control processes (Martins-Klein, Alves, & Chiew, 2020; Oschner, Silvers, & Bulet, 2012; McRae, 2012), this observation is consistent with findings from the classic cognitive control literature suggesting that people increase cognitive effort as a function of motivational incentives (Braver et al., 2014; Botvinick & Braver, 2015). Interestingly, while we expected motivation to increase reported effort, participants reported lower overall effort and lower difficulty in strategy implementation as a function of motivation, relative to baseline. This may be because participants were reporting on difficulty in engaging with the emotional stimulus, rather than difficulty implementing the strategy itself. It is also possible that being motivated makes difficult tasks subjectively easier, which is in line with research on *flow state* (Keller, 2008), defined as the subjective experience of being completely immersed in an activity, which in turn makes the activity both easier and more rewarding (Engeser & Rheinberg, 2008). Increased ease of strategy implementation, particularly for cognitive reappraisal, combined with decreased negative affect, could have led to more effective emotion regulation but lower reported difficulty or effort with increased motivation.

Limitations and Future Research

The present study has several limitations. Importantly, this study was run in the early stages of the COVID-19 (Novel Coronavirus) outbreak in the United States and coincided with the implementation of stay-at-home orders (Spring 2020). This event could have very well impacted the emotional state of our participants. Previous research on disasters and mental health have found that these high-stress events are associated with elevated reports of stress and anxiety (Gallagher, Zvolensky, Long, Rogers, & Garey, 2020). High stress and prolonged uncertainty could have potentially increased our participants' baseline negative affect or decreased their ability to regulate their emotions effectively. Despite these considerations, we were able to observe highly significant effects of regulation cues as well as effects of the motivation manipulations, indicating that participants were still able to successfully complete the task and respond to motivational cues; we also eliminated participants with BDI scores >2 SDs above our sample mean from final analyses. However, it is possible that observed emotion regulation and motivation effects may have been attenuated relative to possible effects had the study been conducted prior to the onset of COVID-19. Additionally, because of limits on testing and social distancing measures, this study was run online. Challenges in recruiting an undergraduate student sample during the early stages of COVID-19 meant that our sample in Experiment 1 did not reach our goal sample size as estimated in our power analysis (see *Methods* section); however, by conducting Experiment 2 with a fully-powered, online community sample, and observing results that largely replicated Experiment 1, we were able to confirm our initial findings.

Additionally, in Experiment 1, we asked participants to report task difficulty as an indirect measure of effort for strategy implementation. In Experiment 2, we modified the phrasing of this prompt, asking participants to report the effort involved instead. Across both

studies, self-reported difficulty and effort were lower in motivated vs. baseline Regulation trials. It is possible that this phrasing could have led participants to report their difficulty or effort engaging with the negative stimulus instead of in implementing the chosen regulation strategy. Future studies could mitigate this issue by obtaining independent measures of cognitive effort (i.e., pupillometry; Martins et al., 2018) during emotion regulation performance and its modulation by motivation. Finally, because the Motivation Block was always preceded by the Baseline Block in this task design, we cannot completely disentangle block effects from practice or fatigue effects. However, a time on task analysis in which we examined task performance by within-block quartile as well as between blocks did not reveal linear effects of time on task on either Affect or Effort in either experiment, suggesting that results were generally not driven by practice or fatigue effects. Instead, across both experiments, reported negative Affect and Effort were higher overall in the Baseline block and sharply decreased at the beginning of the Motivation block, consistent with an effect of motivation manipulation (Appendix V).

Questionnaire data was collected to determine whether individual differences may have interacted with motivation type (intrinsic versus extrinsic, between-subjects) to impact emotional outcomes. We collected measures that have previously been found to influence either ER success (STAI, ERQ, BDI) or reward responsivity (BIS/BAS). While relationships between these measures and task performance were not examined here, we observed that our two motivation groups (Extrinsic and Intrinsic) did not significantly differ on any of these individual difference measures. While we did not have *a priori* predictions regarding the impact of individual differences on motivated emotion regulation in the present study, examining how these measures might account for individual-level variance in emotion and emotion regulation outcomes remains an important direction for future research.

Finally, future research investigating motivated emotion regulation will benefit from the incorporation of psychophysiology measures to characterize ongoing cognitive effort and emotional experience. The ER literature has previously utilized physiological markers as objective measures of emotional arousal, complementing and enriching self-reported data (Zaehringer, Jennen-Steinmetz, Schmahl, Ende, & Paret, 2020). For instance, instructed up and down-regulation of emotions has been associated with increased and decreased skin conductance (indexing emotional arousal) respectively (Giuliani, McRae, & Gross, 2008). As alluded to previously, pupillometry has been used to characterize differences in cognitive effort as a function of emotion regulation strategy (Martins et al., 2018). Heart rate variability has also been posited as a measure of regulated emotion response, with higher heart rate variability indicating successful emotion regulation (Appelhans & Luecken, 2006). Measures of psychophysiological activity may be particularly helpful in disentangling differences in exerted effort during regulation and difficulty implementing a given strategy, as well as help clarify the strong association between emotion regulation success (reported as decreased negative affect) and decreased reported effort observed in the present study.

Conclusion

In conclusion, the results of this study provide new evidence that experimentally manipulating motivation can modulate emotion regulation performance, in terms of reported negative affect, difficulty and effort, as well as regulatory strategy choice. These findings contribute to a growing literature confirming that emotion regulation is a motivated process that relies on fundamental cognitive control mechanisms, and similarly to classic cognitive control, is sensitive to motivational modulation. Further, we observed that use of extrinsic versus intrinsic

motivators did not lead to differences in reported emotional outcomes or perceived difficulty, but were associated with differences in the relative frequency of emotion regulation strategies deployed. Importantly, we demonstrated that under motivation induction, relative to baseline, participants increased the use of potentially more effective and effortful regulation strategies such as cognitive reappraisal. Future studies should explore further how different types of motivators (i.e. social belonging, achievement, etc.) might modulate emotion regulation choice and success in everyday situations involving these motivators. Additionally, distinguishing between effort and difficulty in experimental paradigms of emotion regulation may help to clarify situations in which individuals are more willing to expend cognitive resources to regulate their emotions effectively. While these are still important questions to explore, the present study shows that a closer examination of motivation in the context of emotion regulation might connect this literature with the rich empirical literature on motivation and fundamental cognitive control as well as informing a stronger theoretical understanding of the emotion regulation process.

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Appendix I. Participant Demographics

	Experiment 1		Experiment 2	
	Intrinsic	Extrinsic	Intrinsic	Extrinsic
Ethnicity (%)				
Hispanic	18	14	14	18
Non-Hispanic	82	86	86	82
Race (%)				
American Indian	0	0	0	2
Asian	4	0	0	4
Black	4	3.5	12	14
Central/South American	0	0	2	0
Multiracial	7	0	0	0
White	81	93	81	76
No response	4	3.5	5	4
Sex (%)				
Female	71	55	42	43
Male	29	41.5	56	53
No Response	0	3.5	2	4
Gender (%)				
Female	71	55	42	43
Genderqueer/ Gender non-conforming	4	0	2.5	4
Male	25	41.5	53	49
No Response	0	3.5	2.5	4
Age	$M = 20.2$ $SD = 2.53$	$M = 19.8$ $SD = 2.37$	$M = 32.98$ $SD = 11.49$	$M = 33.06$ $SD = 11.42$
Education (years)	$M = 14.0$ $SD = 1.51$	$M = 12.5$ $SD = 3.66$	$M = 15.76$ $SD = 2.92$	$M = 15.57$ $SD = 3.58$

Appendix II. List and Descriptive Statistics for IAPS Images

Picture	Catalog Number	Valence	Valence M	Valence SD	Arousal M	Arousal SD
ManInPool	2055.1	Negative	3.15	1.84	4.95	2.11
Toddler	2095	Negative	1.79	1.18	5.25	2.34
GrievingFem	2141	Negative	2.44	1.64	5	2.03
Hospital	2205	Negative	1.95	1.58	4.53	2.23
Girl	2276	Negative	2.67	1.66	4.63	1.93
BloodyKiss	2352.2	Negative	2.09	1.5	6.25	2.1
Woman	2375.1	Negative	2.2	1.31	4.88	2.21
War	2683	Negative	2.62	1.78	6.21	2.15
Riot	2691	Negative	3.04	1.73	5.85	2.03
DrugAddict	2710	Negative	2.52	1.69	5.46	2.29
DrunkDriving	2751	Negative	2.67	1.87	5.18	2.39
CryingBoy	2900.1	Negative	2.56	1.41	4.61	2.07
DeerHead	2981	Negative	2.76	1.94	5.97	2.12
Mutilation	3051	Negative	2.3	1.86	5.62	2.45
BatteredFem	3180	Negative	1.92	1.13	5.77	2.21
BatteredFem	3181	Negative	2.3	1.43	5.06	2.11
Hospital	3220	Negative	2.49	1.29	5.52	1.86
DyingMan	3230	Negative	2.02	1.3	5.41	2.21
DisabledChild	3300	Negative	2.74	1.56	4.55	2.06
InjuredChild	3301	Negative	1.8	1.28	5.21	2.26
Infant	3350	Negative	1.88	1.67	5.72	2.23
Attack	3500	Negative	2.21	1.34	6.99	2.19
Attack	3530	Negative	1.8	1.32	6.82	2.09
Harassment	4621	Negative	3.19	1.59	4.92	2.24
Tornado	5972	Negative	3.85	2.33	6.34	2.2
AimedGun	6210	Negative	2.95	1.83	6.34	2.14
Soldier	6212	Negative	2.19	1.49	6.01	2.44
AimedGun	6230	Negative	2.37	1.57	7.35	2.01
AimedGun	6250	Negative	2.83	1.79	6.54	2.61
Knife	6300	Negative	2.59	1.66	6.61	1.97
DistressedFem	6311	Negative	2.58	1.56	4.95	2.27
Abduction	6312	Negative	2.48	1.52	6.37	2.3
Attack	6313	Negative	1.98	1.38	6.94	2.23
Attack	6350	Negative	1.9	1.29	7.29	1.87
Attack	6360	Negative	2.23	1.73	6.33	2.51
Attack	6370	Negative	2.7	1.52	6.44	2.19
DeadTiger	6415	Negative	2.21	1.51	6.2	2.31
Attack	6510	Negative	2.46	1.58	6.96	2.09
Attack	6540	Negative	2.19	1.56	6.83	2.14
Attack	6560	Negative	2.16	1.41	6.53	2.42
Gang	6821	Negative	2.38	1.72	6.29	2.02
Guns	6830	Negative	2.82	1.81	6.21	2.23
Police	6831	Negative	2.59	1.5	5.55	2.16
Police	6834	Negative	2.91	1.73	6.28	1.9
Police	6838	Negative	2.45	1.44	5.8	2.09
MeatSlicer	7361	Negative	3.1	1.73	5.09	2.48
Cemetery	9000	Negative	2.55	1.55	4.06	2.25
HIVTattoo	9005	Negative	3.69	2.23	5.18	2.11
Needles	9007	Negative	2.49	1.41	5.03	2.32
StarvingChild	9040	Negative	1.67	1.07	5.82	2.15
StickThruLip	9042	Negative	3.15	1.89	5.78	2.48

PlaneCrash	9050	Negative	2.43	1.61	6.36	1.97
Heroin	9102	Negative	3.34	1.76	4.84	2.5
Cow	9140	Negative	2.19	1.37	5.38	2.19
Seal	9180	Negative	2.99	1.61	5.02	2.09
Cemetery	9220	Negative	2.06	1.54	4	2.09
WarVictim	9250	Negative	2.57	1.39	6.6	1.87
Mutilation	9253	Negative	2	1.19	5.53	2.4
Smoke	9280	Negative	2.8	1.54	4.26	2.44
Dirty	9300	Negative	2.26	1.76	6	2.41
Pollution	9341	Negative	3.38	1.89	4.5	2.1
Garbage	9373	Negative	3.38	1.48	5.01	2.16
Soldier	9410	Negative	1.51	1.15	7.07	2.06
Handicapped	9415	Negative	2.82	2	4.91	2.35
Soldier	9421	Negative	2.21	1.45	5.04	2.15
Fire	9495	Negative	3.34	1.75	5.57	2
Kids	9520	Negative	2.46	1.61	5.41	2.27
Boys	9530	Negative	2.93	1.84	5.2	2.26
DuckInOil	9560	Negative	2.12	1.93	5.5	2.52
Dog	9570	Negative	1.68	1.23	6.14	2.31
Injection	9592	Negative	3.34	1.75	5.23	2.09
Ship	9600	Negative	2.48	1.62	6.46	2.31
PlaneCrash	9611	Negative	2.71	1.95	5.75	2.44
Shipwreck	9620	Negative	2.7	1.64	6.11	2.1
Skinhead	9800	Negative	2.04	1.57	6.05	2.71
KKKrally	9810	Negative	2.09	1.78	6.62	2.26
Cigarettes	9830	Negative	2.54	1.75	4.86	2.63
CarAccident	9910	Negative	2.06	1.26	6.2	2.16
CarAccident	9920	Negative	2.5	1.52	5.76	1.96
Dog	1301	Negative	3.7	1.66	5.77	2.18
NeutFace	2200	Neutral	4.79	1.38	3.18	2.17
Secretary	2383	Neutral	4.72	1.36	3.41	1.83
Factoryworker	2393	Neutral	4.87	1.06	2.93	1.88
NeutGirl	2440	Neutral	4.49	1.03	2.63	1.7
ElderlyMan	2480	Neutral	4.77	1.64	2.66	1.78
NeutralMale	2493	Neutral	4.82	1.27	3.34	2.1
ElderlyWoman	2516	Neutral	4.9	1.43	3.5	1.88
Man	2570	Neutral	4.78	1.24	2.76	1.92
Women	2595	Neutral	4.88	1.24	3.71	1.88
Woman	2830	Neutral	4.73	1.6	3.64	2.23
Chess	2840	Neutral	4.91	1.52	2.43	1.82
Twins	2890	Neutral	4.95	1.09	2.95	1.87
Artist	4000	Neutral	4.82	1.66	3.97	2.15
Mushrooms	5534	Neutral	4.84	1.44	3.14	2.03
Outlet	6150	Neutral	5.08	1.17	3.22	2.02
Towel	7002	Neutral	4.97	0.97	3.16	2
Spoon	7004	Neutral	5.04	0.6	2	1.66
Bowl	7006	Neutral	4.88	0.99	2.33	1.67
Mug	7009	Neutral	4.93	1	3.01	1.97
Basket	7010	Neutral	4.94	1.07	1.76	1.48
Fan	7020	Neutral	4.97	1.04	2.17	1.71
Stool	7025	Neutral	4.63	1.17	2.71	2.2
Shoes	7031	Neutral	4.52	1.11	2.03	1.51
Hammer	7034	Neutral	4.95	0.87	3.06	1.95
Shipyards	7036	Neutral	4.88	1.08	3.32	2.04
Trains	7037	Neutral	4.81	1.12	3.71	2.08
Shoes	7038	Neutral	4.82	1.2	3.01	1.96

HairDryer	7050	Neutral	4.93	0.81	2.75	1.8
Truck	7130	Neutral	4.77	1.03	3.35	1.9
Umbrella	7150	Neutral	4.72	1	2.61	1.76
Lamp	7175	Neutral	4.87	1	1.72	1.26
NeonBuilding	7180	Neutral	4.73	1.31	3.43	1.95
AbstractArt	7186	Neutral	4.63	1.6	3.6	2.36
ClothesRack	7217	Neutral	4.82	0.99	2.43	1.64
Chair	7235	Neutral	4.96	1.18	2.83	2
Building	7491	Neutral	4.82	1.03	2.39	1.9
Man	7493	Neutral	5.35	1.34	3.39	2.08
Cabinet	7705	Neutral	4.77	1.02	2.65	1.88
Tissue	7950	Neutral	4.94	1.21	2.28	1.81
Trash	9700	Neutral	4.77	1.24	3.21	1.92

Appendix III. Online Experiment Instructions

In this task, what we are really interested in is people's ability to change how they are feeling. The way we are going to ask you to change how you are feeling is by **changing the way you think about something** that we show you, or **by paying attention to a non-emotional part of the image**. So, what's going to happen is that you will see a series of pictures, and some of them are going to make you feel somewhat negative or very negative, and some pictures might not make you feel very negative at all.

Before each picture, you are going to see one of two instructions which tells you what you are going to do while the picture is on the screen. The first instruction you might see is the **LOOK** instruction, and it will have a GREEN border, as shown below. The border will remain on the screen with the image to help you remember the instructions. When you see the instruction to **LOOK**, we want you to **look at the picture, keep your eyes on it the whole time, and allow yourself to respond naturally to it**. So have whatever thoughts and feelings you would naturally have in response to that picture.

The other instruction you will see is to **REGULATE**, and it will have an orange border as shown below. When you see the instruction to **REGULATE** you will decide how you want to decrease your negative emotion. We want you to either **think of something to tell yourself that helps you to feel less negative about the picture (rethink)**, or **focus on a specific part of the picture that doesn't make you feel negative (distract)**. For example, when you rethink, you could tell yourself something about the outcome, so that whatever is going on will soon be resolved, or that help is on the way. You could also focus on a detail or aspect of the situation that isn't quite as bad as it first seemed. When you want to distract, you could look at the background or a particular object in the image that doesn't make you feel negative. But we want you to stay focused on the picture and not think of random things that make you feel better. Remember, you can **rethink** you feel about the picture or **distract** yourself by focusing on a different part of it so that it helps you to feel less negative about it.

After each picture, you will see a scale like this which will ask you to indicate how negative you feel. It goes from 1 to 5, where 1 means that you don't feel negative at all, and 5 means that you feel strongly negative. 2, 3, 4 are in between. We realize that sometimes you won't feel negative at all, sometimes you might have started to feel negative and then tried to decrease how negative you felt and that worked really well, and sometimes you attempt to decrease how negative you feel but couldn't think of something in time or it didn't really work that well. **No matter what happened through the course of looking at the picture, try to rate at the end how negative you feel when all is said and done, so where you ended up after all you tried to do**. Try to be as honest as you can about how you feel.

Experiment 1 Effort Instructions

After you see each image, you will also be asked to indicate how hard it was for you to use the strategy that you chose. This could be your feeling of **how difficult it was to rethink the situation, or how difficult it was to look at or distract from the image**. Again, the scale will go from 1 to 5. If using the strategy was very hard, you will press 5, if it wasn't hard at all you will press 1, with 2, 3, and 4 being in between.

Experiment 2 Effort Instructions

After you see each image, you will also be asked to indicate how much effort you put into using the strategy that you chose. This could be your feeling of **how effortful it was to rethink the situation, or how effortful it was to look at or distract from the image**. For this question, **please notice that the scale will be flipped** and go from 5 to 1, with 5 being the most effort and 1 being the least effort. If you put a lot of effort into using the strategy, you will choose 5, if you did not put in any effort at all you will choose 1.

After each **REGULATE** image, you will be asked to indicate which strategy you chose. The choices will be rethink, distract, neither (you did not try to decrease your negative emotions), or other (you decreased your negative emotions some other way). Again, this rating will only appear after images where you are instructed to **REGULATE**.

Motivational Framing

Experiment 1 - Extrinsic

Now we will do the same task again, but this time I would like you to pay extra attention to decreasing your negative emotions. Being able to regulate your emotions effectively will allow you to earn more money during the task, up to \$10. You will only earn money for trials in which you were able to decrease your negative emotions effectively. One way that we can tell how you're feeling is by analyzing the movements from your computer mouse. We will be monitoring your computer mouse's movement during this task and using those measurements to decide how much money you will earn. Research has shown that people who are able to decrease their negative emotions tend to earn more over their lifetime overall. For this part of the study, it is important that you do your best to decrease how negative you feel in order to maximize your total earnings.

For each image that you see following the instructions "Regulate", you will see a dollar sign to remind you to decrease your negative emotions in order to maximize your earnings

Experiment 1 - Intrinsic

Now we will do the same task again, but this time I would like you to pay extra attention to decreasing your negative emotions. Being able to regulate your emotions will help you feel better and decrease unwanted stress. One way that we can tell how you're feeling is by analyzing the movements from your computer mouse. We will be monitoring your computer mouse's movement during this task, and using those measurements to see if decreasing negative emotions reduces negative impacts on the body. Research has shown that people who are able to decrease their negative emotions tend to have improved overall emotional well-being. For this part of the study, it is important that you do your best to decrease how negative you feel in order to maximize the benefits for your overall well-being.

For each image that you see following the instructions "Regulate", you will see a lotus flower to remind you to decrease your negative emotions in order to minimize your stress and maximize your well-being.

Experiment 2 - Extrinsic

Now we will do the *same task* again, but this time I would like you to **pay extra attention** to **decreasing** your negative emotions.

Being able to regulate your emotions effectively will allow you to earn more money during the task, up to \$10. You will only earn money for trials in which you were able to decrease your negative emotions effectively.

One way that we can tell how you're feeling is by analyzing the movements from your computer mouse. We will be monitoring your computer mouse's movement during this task, and using those measurements to decide how much money you will earn.

Research has shown that people who are able to decrease their negative emotions tend to earn more over their lifetime overall. For this part of the study, it is important that you do your best to decrease how negative you feel in order to maximize your total earnings.

For each image that you see following the instructions "Regulate", you will see a **dollar sign** to remind you to decrease your negative emotions in order to maximize your earnings

Experiment 2 – Intrinsic

Now we will do the *same task* again, but this time I would like you to **pay extra attention** to **decreasing** your negative emotions.

Being able to regulate your emotions will help you feel better and decrease unwanted stress.

One way that we can tell how you're feeling is by analyzing the movements from your computer mouse. We will be monitoring your computer mouse's movement during this task, and using those measurements to decide how much money you will earn.

Research has shown that people who are able to decrease their negative emotions tend to have improved overall emotional well-being. For this part of the study, it is important that you do your best to decrease how negative you feel in order to maximize the benefits for your overall well-being.

For each image that you see following the instructions "Regulate", you will see a **lotus flower** to remind you to decrease your negative emotions in order to minimize your stress and maximize your well-being.

Appendix IV. Individual Difference Questionnaire Scores

	Experiment 1						Experiment 2					
	Extrinsic Motivation		Intrinsic Motivation				Extrinsic Motivation		Intrinsic Motivation			
	M	SD	M	SD	<i>t</i> -test	<i>p</i> -value	M	SD	M	SD	<i>t</i> -test	<i>p</i> -value
<i>Positive and Negative Affect Schedule</i>												
PANAS 1 Positive	26.21	7.00	24.43	6.14	1.02	.31	29.24	8.92	32.02	8.57	-1.52	.13
PANAS 1 Negative	21.62	7.46	22.46	8.09	-.41	.68	16.69	7.36	16.42	6.62	.19	.85
PANAS 2 Positive	23.34	6.78	21.11	6.10	1.31	.20	25.20	9.46	29.33	8.94	-2.15	.03*
PANAS 2 Negative	23.69	8.00	21.82	9.64	.79	.43	19.98	7.84	18.60	7.07	.88	.38
PANAS 3 Positive	20.81	6.57	19.25	4.22	1.03	.31	25.65	9.94	28.07	9.17	-1.20	.23
PANAS 3 Negative	23.73	8.51	22.43	8.91	.55	.59	17.50	8.75	17.02	6.30	.30	.77
<i>Beck Depression Inventory</i>	30.65	5.38	31.33	5.61	-.45	.65	32.81	8.91	33.24	8.13	-.24	.81
<i>Behavioral Avoidance/Inhibition Scales</i>												
BIS	15.53	2.92	14.44	2.76	1.40	.17	15.44	2.84	14.90	2.24	.99	.32
BAS-Drive	8.88	3.22	9.52	2.67	-.78	.44	9.48	2.63	9.69	3.01	-.35	.72
BAS-Fun Seeking	7.96	2.95	8.41	2.47	-.60	.55	8.67	2.27	8.60	2.31	.11	.91
BAS- Reward Responsivity	8.65	2.45	7.70	2.32	1.45	.15	8.73	3.20	8.93	2.99	-.41	.68
<i>State-Trait Anxiety Inventory</i>												
State Anxiety	50.96	6.67	52.48	6.31	-.85	.40	44.25	11.00	39.29	12.02	2.03	.05
Trait Anxiety [^]	55.62	3.76	56.89	3.78	-1.23	.22	43.29	10.66	40.64	11.73	1.11	.27
<i>Intrinsic Motivation Inventory</i>	43.00	6.02	42.96	5.33	.02	.98	50.60	8.55	49.29	8.21	.75	.46
<i>Emotion Regulation Questionnaire-Reappraisal</i>	29.38	5.17	30.04	5.65	-.44	.66	30.94	6.41	30.67	6.23	.20	.84
<i>Perceived Stress Scale</i>	32.00	4.02	33.44	3.39	-1.41	.16	29.50	5.66	30.60	3.85	-1.08	.28

* Indicates a significant ($p < .05$) difference in individual difference measure between Extrinsic and Intrinsic Motivation groups in the indicated experiment.

[^] Note that one item was missing from the STAI-Trait Anxiety measure due to a technical error for both Experiment 1 and 2. Scores were calculated without this item.

Appendix V. Time on Task

Experiment 1. *Experiment 2.*

To examine possible time on task effects, mean affect and mean effort were calculated across quartiles (15 trials per block) for each experiment. In both experiments, negative affect and effort are higher in the Baseline Block than the Motivation Block. Importantly, linear changes in affect and effort were generally not observed (with the possible exception of increases in negative affect and effort from Quartile 1 to 2 in Experiment 1) and a sharp drop in both negative affect and effort were observed from Quartile 4 of the baseline block to Quartile 1 of the motivation block. Additionally, time on task effects were not consistent across Experiment 1 and Experiment 2. As such, we did not consider it likely that observed effects of Motivation were driven by time on task.