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Effect of Suppression, Reappraisal, and Acceptance of Emotional Pictures on Acoustic Eye-Blink Startle Magnitude

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Abstract

To examine the effects of different emotion regulation strategies on acoustic eye-blink startle, 65 participants viewed positive, neutral, and negative pictures and were instructed to suppress, reappraise, or accept their emotional responses to these pictures using a within-group experimental design with separate blocks of pictures for each strategy. Instructions to suppress the emotional response led to an attenuation of the eye-blink startle magnitude, in comparison with instructions to reappraise or accept. Reappraisal and acceptance instructions did not differ from one another in their effect on startle. These results are discussed within the context of the existing empirical literature on emotion regulation.

Keywords

emotion regulation; reappraisal; acceptance; suppression; eye-blink startle

Successful regulation of emotions is an important skill that facilitates social adjustment and overall well-being. Emotion regulation refers to the ability by which people influence which emotions they have and how they experience and express them (Gross, 1998a). Emotional dysregulation has been shown to result in negative psychological outcomes and has been implicated in the development and maintenance of many forms of psychopathology, particularly anxiety and mood disorders (e.g., Campbell-Sills & Barlow, 2007; Hofmann, Sawyer, Fang, & Asnaani, 2012; Mullin & Hinshaw, 2007). Questionnaire studies indicate that some emotion regulation strategies, such as suppression, rumination, and worry, have been shown to be more strongly associated with psychopathology than other strategies, such as reappraisal and problem-solving (Aldao & Nolen-Hoeksema, 2010). In recent years, specific emotion regulation strategies have been examined in controlled laboratory settings in order to better understand the ways in which they influence physiology, behavior, and subjective experience (for a review, see Aldao, Nolen-Hoeksema, & Schweizer, 2010, Gross, 1998a; Hofmann et al., 2012).

For example, it has been shown that suppressing emotions has a counterproductive effect by increasing emotional distress and physiological arousal (Gross & John, 2003; Gross & Levenson, 1997). Subsequent studies have replicated the paradoxical effects of suppression for regulating pain (Cioffi & Holloway, 1993), craving (Szasz, Szentagotai, & Hofmann, 2012), anger (Szasz, Szentagotai, & Hofmann, 2011), anxiety (Hofmann, Heering, Sawyer, & Asnaani, 2009), and embarrassment in non-clinical participants (Harris, 2001), and also in

populations with anxiety and mood disorders (Campbell-Sills, Barlow, Brown, & Hofmann, 2005; 2006; but also see Dunn, Billotti, Murphy, & Dagleish, 2009).

Another commonly studied emotion regulation strategy is reappraisal. This strategy typically leads to lower subjective distress and physiological arousal (Gross, 1998a; Gross 1998b; Gross & Levenson, 1993; Hofmann et al., 2009; Szasz et al., 2011) as compared to other strategies. Reappraisal refers to taking an adaptive and rational perspective on a given situation that counters irrational, maladaptive, and catastrophic thinking, by generating either a range of alternative and less distressing interpretations or possible outcomes that a given situation may have (e.g., Hofmann, 2008). This strategy is an important component of cognitive-behavioral therapy (CBT; e.g., Beck, 1979; Hofmann, Asmundson & Beck, in press).

A third emotion regulation strategy is acceptance of the emotional experience. This strategy has been increasingly promoted in recent years with the advent of Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999). Acceptance refers to adopting an open, observing, non-judgmental stance towards emotions and internal experiences and thereby counter-acting experiential avoidance, which is the individual's tendency to actively avoid the experience of aversive emotions (Hayes et al., 1999). However, it should be noted that although the newer generation of CBT approaches tends to focus more on acceptance and less on reappraisal strategies, none of these techniques are unique or specific to any treatment modality (Hofmann & Asmundson, 2008; Hofmann, Sawyer, & Fang, 2010).

The aim of the present study was to specifically examine the effects of suppression, acceptance, and reappraisal of emotions on acoustic eye-blink startle response, a reliable, robust, involuntary, and reflexive emotional response in both animals (Davis, Antoniadis, Amaral, & Winslow, 2008; Lang & Davis, 2006) and humans (Lang, Bradley & Cuthbert, 1990; Lang & Davis, 2006; Vrana, Spence, & Lang, 1988). In humans, sudden closure of the eyelids is one of the first, fastest, and most stable elements in the reflex sequence, occurring within 25–40 ms after startle stimulus onset. It is believed to be a primitive defensive reflex that serves a protective function, avoiding organ injury (Lang, Bradley, & Cuthbert, 1998). The startle response has been shown to be modulated by the affective state of the individual. More specifically, the motivational priming hypothesis predicts that the eye-blink startle response is greater in amplitude when the aversive motivational system is active, whereas the startle reflex is attenuated if the appetitive system activation predominates (Lang et al., 1998). A considerable body of research has supported this hypothesis (Lang & Bradley, 2010).

In contrast, relatively little is known about the effect of different experimentally-induced emotional regulation strategies on acoustic eye-blink startle. Jackson and colleagues (2000) examined 48 college students who were instructed to enhance or reduce their emotional reactions to negatively-valenced pictures. Participants were given the freedom to employ whichever emotion regulation strategy they deemed most effective to up- or down-regulate their emotions. The results suggested that instructions to down-regulate were associated with smaller eye-blink startle amplitude, whereas instructions to up-regulate were associated with greater startle amplitude. The results of this study have been replicated in a sample of 10 healthy adults (Driscoll, Tranell, & Anderson, 2009) and in a sample of 48 healthy adults (Dillon & Labar, 2005). Results from both studies were consistent with findings from Jackson and colleagues (2000) showing greater eye-blink magnitude response when individuals were enhancing the intensity of emotion, as compared to when they were attempting to decrease it, thus indicating the ability to influence this reflex by manipulation of one's emotional response.

These findings were replicated and extended to a threat-of-shock paradigm by Lissek and colleagues (2007). In this study, healthy adults were instructed to enhance, maintain, or decrease their emotional reactions when viewing unpleasant pictures and also when provided with threat-of-shock cues. Results again showed that startle magnitudes were smallest when individuals were trying to decrease their emotional experience and largest when attempting to enhance it, suggesting that individuals can successfully regulate startle response not only to negative pictorial stimuli, but also to physical threat. An important commonality among these studies is the way in which participants were instructed to enhance and decrease their emotional experience. In these studies, subjects were not instructed to use any one specific emotion regulation strategy, but rather, to employ whichever strategies they deemed effective, singularly or in combination, to up- or down-regulate their emotional experience, including reappraisal, change in attentional focus, and distancing from the picture content.

The present study aimed to build upon and extend previous findings by experimentally manipulating specific emotion regulation strategies and examining the effects of these on eye-blink startle. In addition, rather than asking participants to up- or down-regulate their emotions, participants were specifically asked and trained to employ suppression, reappraisal, and acceptance strategies. These three strategies were then directly compared to each other. We chose not to include a control “no regulation” condition because such a condition would be very heterogeneous and the information gleaned would neither be particularly meaningful, nor provide us with a clearer idea about the effects of one strategy over the other. In order to effectively compare the effects of these strategies, the present study used a within-subject design (i.e., each participant was instructed to employ all three separate emotion regulation strategies – reappraisal, acceptance, and suppression – in successive blocks). The instructions for the reappraisal and acceptance blocks were delivered in a way that is consistent with how these skills are typically explained in therapy for emotional disorders, to allow more meaningful interpretation of results on implications for techniques employed in the clinical realm.

Most importantly, our study will test a number of hypotheses about the effects of emotion regulation on startle response. Reappraisal is an antecedent-focused emotion regulation strategy, whereas suppression is a response-focused strategy (Gross, 1998a). Eye-blink startle has been shown to be coordinated by the amygdala and other limbic structures (e.g., bed nucleus of the stria terminalis), which are involved in the early stage of emotional processing (e.g., Grillon, 2002; Hofmann, Ellard & Siegle, 2012; McTeague et al., 2009). Therefore, one might expect that reappraisal would lead to smaller eye-blink than suppression. On the other hand, suppression instructions are similar to instructions to reduce or decrease participants’ emotions in earlier studies, which reported that such instructions lead to an attenuation of the startle response (Dillon & Labar, 2005; Driscoll et al., 2009; Jackson et al., 2008). By directly contrasting suppression and reappraisal instructions, we are able to test these competing hypotheses. Cognitive appraisal models further predict that reappraisal strategies are most effective at regulating eye-blink startle magnitude, whereas acceptance-based models predict that acceptance strategies are most effective. The relative efficacy of reappraisal and acceptance was an exploratory aim of the current study.

Methods

Participants

A total of 72 participants were recruited from an undergraduate student body for this experiment and each received psychology course credit. One participant declined to participate because of a vasovagal reflex to blood/injury-related stimuli. Equipment malfunction resulted in the removal of an additional 6 participants. Thus, the final sample

consisted of 65 individuals. Of these, 46 were females (70.1%), with a mean age of 18.9 years. The majority of participants reported being single (76.6%), and were ethnically/racially Caucasian (41.5%), East/South Asian (35.4%), Hispanic 9.2%, African American (3.1%) or other race/ethnicity (10.8%). The study was approved by the Institutional Review Board at Boston University.

Experimental Procedure

After providing informed consent, participants were escorted to the experimental room where the overall procedure was briefly reviewed, and they completed a brief battery of self-report measures, including the Beck Depression Inventory (BDI-II), Social Anxiety Interaction Scale (SIAS), and Anxiety Sensitivity Inventory (ASI). Upon completion of this, the physiological sensors were applied. The participants completed a two-minute baseline measurement period and then were presented with the first set of emotion regulation instructions. For the practice trial they were shown a negatively-valenced training picture to ensure accurate utilization of the presented instruction. The emotion regulation instructions were presented in both written form to the participant and simultaneously read out over an intercom by the experimenter to ensure that participants were fully aware of what each strategy entailed. The instructions for the acceptance and suppression conditions were adapted from those used in a study by Campbell-Sills and colleagues (2005). The reappraisal instructions were devised to match the format and structure of the other two condition instructions for consistency, and the content was taken from the reappraisal instructions presented in the emotion regulation study by Hofmann et al. (2009) and from a text on cognitive therapy by Beck (1979). Again, we purposely omitted a “no-regulation” condition to avoid the confounding effect of habitual emotion regulation tendencies, which is consistent with the design features found in other studies examining these emotion regulation strategies (Szasz et al., 2011; Hofmann et al., 2009).

Each instruction consisted of approximately 1.5 pages of text and took about 10 minutes to introduce and practice. Briefly¹, for the acceptance instructions, participants were asked not to attempt to modify their emotional response and instead to be mindful and accept their emotional response. For the suppression instructions, participants were asked to suppress their emotional response by actively minimizing their emotions, and in addition, to behave in such a way that a person watching them would not know that they were feeling anything at all. Finally, as part of the reappraisal instructions, participants were asked to generate alternative explanations of the picture content to take a more realistic perspective as they viewed the pictures. For example, for negative pictures eliciting emotions of fear or sadness, participants were asked to generate multiple objective explanations for the picture content (e.g., for a picture of firefighters descending from helicopters towards a burning building, possible explanations could be: the persons are just actors, or people inside are being saved versus being harmed). For positive pictures, participants were instructed to generate a greater range of possible interpretations of the picture to challenge their first interpretation of the picture. The specific details of the reappraisal instructions are provided in Figure 1.

Participants were asked to employ these strategies regardless of the type of emotions they may experience during the experimental block, whether these emotions were positive or negative. To account for order effects within the experimental design, the three blocks were counter-balanced across participants, such that the same instruction was not always associated with the same pictures, and the three instruction types were provided in 6 different possible orders. All participants completed the entire experimental procedure in one sitting that lasted approximately 3 hours.

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¹Complete instructions for each emotion regulation strategy are available upon request from corresponding author SGH.

The visual stimuli used to elicit emotional reactions were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005), a widely used picture set that provides both arousal (low to high) and valence (negative to neutral to positive) ratings for each picture. Consistent with other studies (Dillon & Labar, 2005; Gros, Hawk, & Moscovitch, 2009), this experiment utilized both negative (low valence) and positive (high valence) pictures that also showed equally high arousal ratings (i.e. at least a 6.5 out of 8.0), along with neutral pictures with low arousal ratings (i.e. less than 3.0 out of 8.0). A total of 54 pictures were presented in 3 blocks of 18 pictures each. Each block consisted of 6 pictures of each valence type, and these were presented in each block in quasirandom order, such that the same valence was never presented three times in succession. In addition, an acoustic startle probe (a 105-dB, 50-ms burst of white noise) was delivered during 12 of the 18 pictures in each block, at varying presentation times (i.e. either 3 s, 7 s, or 12 s post-stimulus onset). This probe time was also randomized to ensure that probes did not occur at the same time for three consecutive pictures.

Each picture was preceded by a prompt to remind the participant which strategy they were instructed to use. Each picture was then displayed for 8 seconds, followed by a fixation cross lasting 12 seconds. Therefore, each picture trial lasted 20 seconds until the prompt word was re-displayed before the next picture stimulus onset (Figure 2). At the end of the experimental block, participants completed the short form of the state version of the State-Trait-Anxiety-Inventory (STAI-B, Marteau & Bekker, 1992). In addition, they completed an experimenter-created manipulation check questionnaire to assess level of adherence to the instructed emotion regulation strategy. This 9-item questionnaire asked participants to rate on a 0–8 scale (with 0 representing “strongly disagree” and 8 representing “strongly agree”) the extent to which they attempted to employ each of the three strategies during each block. For example, after the reappraisal block, participants were asked how strongly they agreed with statements such as, “I attempted to view the pictures from an objective stance” and “I tried to generate alternative explanations for what I saw in the pictures and take a realistic perspective on this task.” Participants also rated the degree to which they employed the other two strategies during the block in order to ensure that the instructed emotion regulation strategy was employed to a greater degree than the other two strategies.

Following this, participants completed two additional identical blocks for the other two emotion regulation strategies. At the end of the three experimental blocks, participants completed a rating task of arousal and valence of the pictures viewed using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) to ensure that the selected stimuli were adequately arousing and similar to the intended valences for the purposes of this experiment. Finally, participants were debriefed orally about the experimental procedure and purpose.

Measuring Acoustic Eye-Blink Startle Magnitude

Startle amplitude was recorded with equipment by James Long Company (Caroga Lake, New York) and with the data acquisition program Snap-Master™ for Windows. This physiological measure was digitized at 512 samples per second with a 31-channel A/D converter operating at a resolution of 16 bits and having an input range of –2.5 volts to +2.5 volts. The high-pass filter (HPF) was set at 80 Hz and the low-pass filter (LPF) was set at 240 Hz for measurement of eye-blink amplitude, consistent with the technical specifications for use of this physiological equipment (Schmidt, Fox & Long, 1998).

In accordance with current guidelines (Blumenthal et al., 2005), two E-21 disk 6-mm lead electrodes, placed 1–2 cm apart, were secured to the distal area of the lower eyelid (i.e. on the orbicularis oculi muscle) of the left eye to record the magnitude of eye-blink response during the picture viewing. To account for individual differences in eye-blink magnitude, we calculated the difference scores of the maximum eye-blink magnitude occurring within a 21

ms-120 ms window after the startle probe was delivered, with the signal occurring during the window of 50 ms prior to probe onset to 20 ms after the probe occurred. Further, to control for inter-individual variability in baseline and response eye-blink startle magnitudes, all the eye-blink values (measured in microvolts) were z-transformed. Finally, these scores were collapsed to obtain a mean score for startle eye-blink magnitude (in standardized units) for positive, negative and neutral pictures in each strategy block at each startle probe time (i.e. 3s, 7s, and 12s after picture onset).

Results

Acoustic Eye-Blink Startle Magnitude

To examine the effects of picture valence and emotion regulation strategy on the acoustic eye-blink startle magnitude, we conducted a two-way, repeated-measures ANOVA with Valence (a 3-level within-subjects variable: negative vs. neutral vs. positive) and Strategy (a 3-level within-subjects variable: acceptance vs. suppression vs. reappraisal) as independent variables, and startle response as the dependent variable. There were no differences between analyses when the three startle probe times (3s, 7s, and 12s) were treated as separate variables versus when they were grouped together to produce an average eye-blink magnitude for each picture type in each strategy condition. Therefore, all results reported below refer to grouped probe times for each valence and strategy. We found significant main effects for both Valence (Wilks' $\lambda = 0.89$, $F_{(2, 63)} = 3.86$, $p = 0.03$, partial $\eta^2 = 0.11$) and Strategy (Wilks' $\lambda = 0.80$, $F_{(2, 63)} = 8.03$, $p = 0.001$, partial $\eta^2 = 0.20$). The Valence X Strategy interaction effect was non-significant (Wilks' $\lambda = 0.92$, $F_{(4, 61)} = 1.34$, $p = 0.27$, partial $\eta^2 = 0.08$).

Post-hoc tests of the Valence effect revealed that the startle response for positive pictures ($M = -0.08$, $SD = 0.03$) was significantly lower than for negative pictures ($M = 0.06$, $SD = 0.04$; Wilks' $\lambda = 0.91$, $F_{(1, 64)} = 6.01$, $p = 0.02$, partial $\eta^2 = 0.09$) and for neutral pictures ($M = 0.07$, $SD = 0.04$; Wilks' $\lambda = 0.93$, $F_{(1, 64)} = 5.00$, $p = 0.03$, partial $\eta^2 = 0.07$). Negative and neutral pictures were not different from each other (Wilks' $\lambda = 0.99$, $F_{(1, 64)} = 0.03$, $p = 0.85$, partial $\eta^2 = 0.00$).

Post-hoc tests of the main Strategy effect revealed that the startle response when employing suppression ($M = -0.19$, $SD = 0.05$) was significantly lower than when using acceptance ($M = 0.13$, $SD = 0.06$; Wilks' $\lambda = 0.84$, $F_{(1, 64)} = 12.33$, $p = 0.001$, partial $\eta^2 = 0.16$) and reappraisal strategies ($M = 0.10$, $SD = 0.06$; Wilks' $\lambda = 0.86$, $F_{(1, 64)} = 10.17$, $p = 0.002$, partial $\eta^2 = 0.14$). Acceptance and reappraisal were not different from each other (Wilks' $\lambda = 0.99$, $F_{(1, 64)} = 0.06$, $p = 0.80$, partial $\eta^2 = 0.00$). This pattern was similar across eye-blink startle magnitudes for negative, neutral and positive and pictures as shown in Figure 3.

In order to probe for moderator effects, we explored the possible effects of gender, age, ethnicity, marital status, depression, social anxiety, and anxiety sensitivity on startle response. We repeated the above ANOVA analyses with gender, ethnicity and marital status as between-subjects variables, and age, depression, social anxiety and anxiety sensitivity as covariates. No significant effects were found for any of these moderator variables (all $ps > 0.05$).

Subjective Distress

To examine the effects of emotion regulation strategy on levels of subjective distress we conducted a one-way, repeated-measures ANOVA with Strategy (a 3-level within-subjects variable: acceptance vs. suppression vs. reappraisal) as the independent variable, and STAI-B scores as the dependent measure. No significant effect for Strategy was found on this

measure of subjective distress across the three emotion regulation blocks (Wilks' $\lambda = 0.95$, $F_{(2, 63)} = 1.66$, $p = 0.20$, partial $\eta^2 = 0.05$).

Manipulation Checks

In order to ensure that the experimental stimuli elicited the emotional responses that they were designed to, we examined participants' valence ratings on the SAM for positive, neutral and negative pictures. We found significant differences in ratings for the pictures that differed in valence ($F_{(2, 63)} = 428.58$, $p < 0.001$, partial $\eta^2 = 0.93$). Specifically, participants rated positive pictures ($M = 5.59$, $SD = 0.82$) as more pleasurable than neutral pictures ($M = 3.74$, $SD = 0.82$; $F_{(1, 64)} = 171.06$, $p < 0.001$, partial $\eta^2 = 0.72$), and negative pictures ($M = 1.16$, $SD = 0.76$; $F_{(1, 64)} = 792.19$, $p < 0.001$, partial $\eta^2 = 0.92$). Neutral pictures were also rated as more pleasurable than negative pictures ($F_{(1, 64)} = 474.27$, $p < 0.001$, partial $\eta^2 = 0.88$). We also examined arousal ratings on the SAM for the picture stimuli and found significant differences among the pictures ($F_{(2, 63)} = 216.42$, $p < 0.001$, partial $\eta^2 = 0.87$). Negative pictures ($M = 4.46$, $SD = 1.68$) were rated as more arousing than positive pictures ($M = 3.74$, $SD = 1.71$; $F_{(1, 64)} = 22.84$, $p < 0.001$, partial $\eta^2 = 0.26$), and neutral pictures ($M = 0.57$, $SD = 0.68$; $F_{(1, 64)} = 427.09$, $p < 0.001$, partial $\eta^2 = 0.87$). Positive pictures were also rated as more arousing than neutral pictures ($F_{(1, 64)} = 279.07$, $p < 0.001$, partial $\eta^2 = 0.81$).

Next, in order to verify that participants followed the experimental instructions, we examined participants' reports on their use of suppression, reappraisal, and acceptance strategies in dealing with the emotional response elicited by the pictures using scores on the manipulation check questionnaire, whereby higher mean scores on each of three subscales indicate greater adherence to each type of emotion regulation strategy. In the suppression condition, participants reported using suppression ($M = 6.82$, $SD = 1.46$) significantly more than reappraisal ($M = 5.11$, $SD = 2.17$; $F_{(1, 64)} = 28.65$, $p < 0.001$, partial $\eta^2 = 0.31$), and acceptance ($M = 1.86$, $SD = 2.21$; $F_{(1, 64)} = 197.52$, $p < 0.001$, partial $\eta^2 = 0.76$). In the reappraisal condition, participants reported using reappraisal ($M = 6.97$, $SD = 1.10$) significantly more than suppression ($M = 4.62$, $SD = 2.25$; $F_{(1, 64)} = 60.52$, $p < 0.001$, partial $\eta^2 = 0.49$), and acceptance ($M = 2.31$, $SD = 2.08$; $F_{(1, 64)} = 229.11$, $p < 0.001$, partial $\eta^2 = 0.78$). Finally, in the acceptance condition, participants reported using acceptance ($M = 6.69$, $SD = 1.09$) significantly more than reappraisal ($M = 3.08$, $SD = 2.39$; $F_{(1, 64)} = 104.69$, $p < 0.001$, partial $\eta^2 = 0.62$), and suppression ($M = 1.77$, $SD = 1.63$; $F_{(1, 64)} = 289.21$, $p < 0.001$, partial $\eta^2 = 0.82$). Thus, the manipulation checks indicated that both Valence and Strategy (the two independent variables of interest) were successfully manipulated.

Discussion

This study aimed to directly compare the effects of reappraisal, suppression and acceptance on acoustic eye-blink startle magnitude and subjective distress ratings to a range of emotional visual stimuli, to better understand emotion regulation effects on negative, neutral, and positive emotional states. The manipulation check supported the validity of the stimulus material and the experimental manipulation instructions. The study findings revealed that, consistent with past studies, experimentally induced emotion regulation strategies had an effect on eye-blink startle magnitude. Specifically, instructions to suppress the emotional response to visual stimuli led to an attenuation of the eye-blink startle magnitude in contrast to reappraisal and acceptance. These two emotion regulation strategies did not differ from each other, suggesting that both strategies are similar in their impact on startle eye-blink magnitude. Finally, and as hypothesized, the study paradigm showed a heightened eye-blink startle magnitude in response to negative pictures as compared to positive pictures (Lang et al., 1998).

However, there were no differences in eye-blink startle magnitude between negative pictures versus neutral pictures, despite the fact that participants subjectively rated the negative and positive pictures as more arousing than the neutral pictures. While a lack of difference in startle blink reactivity between negative and neutral valence pictures has been observed elsewhere (Driscoll et al., 2009), this is not the typical effect observed. It is highly possible that the emotion regulation strategies employed in this study are more suited to stimuli eliciting high levels of emotion, and thus participants found it difficult to employ such strategies with neutral stimuli (Jackson et al., 2000). Thus, for pictures of neutral valence, startle effects may have been influenced by a difficulty in employing emotion regulation strategies over and above the specific strategy used.

The different effects of the emotion regulation strategies on eye blink startle magnitude may be related to different cognitive processes underlying these strategies. More specifically, it is possible that suppression resulted in a lowered eye-blink magnitude as compared to reappraisal or acceptance because this strategy may serve as a way for individuals to distance themselves from unpleasant emotional material in a self-protective fashion, especially when confronted with highly distressing events or situations, such as the loss of a loved one (Safer, Bonanno, & Field, 2001) or after a traumatic event (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004). Therefore, suppression may be associated with distraction (Gross, 1998b; Kron, Schul, Cohen, & Hassin, 2010), because individuals reallocate their attention when confronted with the emotional stimuli. This process of distancing and distracting while suppressing may also explain why suppression led to an attenuated startle response when viewing positive pictures. This strategy appears to be associated with increased amygdala activation during exposure to emotionally-laden stimuli (Pessoa, 2005), but impaired processing of the affect-laden content (Andrade, Kavanagh, & Baddeley, 1997). In contrast, acceptance encourages individuals to immerse themselves with the emotional material (Dunn et al., 2009; Ayduk & Kross, 2008). In the current study acceptance produced effects similar to reappraisal, which is the first time either of these strategies were compared in terms of their effects on eye-blink magnitude. These findings suggest that acceptance and reappraisal strategies, two commonly employed techniques in ACT and CBT, have similar effects on eye-blink startle magnitude, a reliable physiological indicator of emotions. Future studies should examine the common and unique mechanisms through which these strategies influence psychophysiology.

In contrast to some studies (e.g., Dunn et al., 2009), but in line with others (Szasz et al., 2011; Hofmann et al., 2009), our experiment did not include a “no regulation strategy” condition. Such an instruction encourages individuals to default to their habitual emotion regulation strategy, which may be any one of a number of strategies, or a hybrid between several strategies, to which comparison would be complicated and difficult to interpret meaningfully across individuals. Limitations of this study, however, include the restriction to the three emotion regulation strategies (suppression, reappraisal, and acceptance), the nature of the subject sample (undergraduate students), and the limited range of dependent measures (acoustic eye-blink startle). Indeed, it is possible that such results could look markedly different in a clinical sample of individuals with more pervasive emotion dysregulation, or that differences in acceptance and reappraisal strategies may be more apparent when examining other substrates of biological reactivity (e.g. EEG, fMRI). Additionally, we cannot rule out that there are individual differences in affective style (Hofmann & Kashdan, 2010), the habitual use of emotional regulation strategies, which might have affected the results of the experimental manipulation.

Despite these limitations, our results suggest that reappraisal and acceptance strategies lead to greater eye-blink startle magnitude to emotional pictures than suppression instructions in a within-subjects design. This is a novel finding that adds to the emerging literature of

emotion regulation. Future studies should explore the mechanism through which these and other strategies act on the emotional response, and to further parse out how these findings may be applied to clinical practice.

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Reappraisal Instructions

There is a great deal of evidence that reframing some of our initial thoughts about a situation can help reduce the negative feelings we have about something.

For instance, imagine the following situation: a housewife is home alone and hears the door slam. Several explanations for the slamming door could occur to her: it could be her daughter returning from school; it could be a burglar entering the house; or it could be that the wind blew the door shut. Each of these interpretations of the door slam would make her feel very different emotions. For example, she may feel joy if she thinks her daughter is home, fear if she thinks there is a burglar in the house, or annoyance if she thinks the wind shut the door. If her initial thought is that a burglar is in the house, she may run and hide, therefore forfeiting the opportunity to disprove (or confirm) alternate explanations. Similarly, a horror movie is perceived as a lot less scary if you focus on the techniques the director used to create a specific effect in the film than if you put yourself into the actor's role.

In challenging situations, the skill to shift perspectives by taking a different look at something that is initially distressing, becomes all the more important because it enables us to react in a realistic manner to the situation, which in turn helps bring our emotions down to a more manageable level.

Given that you have most likely experienced some difficulty with feelings, such as fear, disgust, or sadness in your life, it is understandable that you would consider re-evaluating certain thoughts in the height of negative emotion to be a difficult task. So, what exactly am I suggesting here? Basically, I am suggesting that you have the ability to modify your emotional response to things by taking a different perspective on it that is less distressing. For example, you may think of alternative ways of evaluating a certain situation (particularly if it's negative). Although negative feelings fade away after a while by themselves, you are capable of making them go away more quickly by simply adopting a different, less distressing, perspective.

I would like you to really test out your ability to lessen the intensity of your reactions to strong feelings. Whenever you experience feelings, such as fear and disgust, while viewing the following pictures, please view the pictures from a perspective that makes the pictures less distressing. It may also be necessary in some situations to lessen positive feelings. Therefore, please attempt to lessen the intensity of your reactions by generating alternative explanations for the content in the following pictures even if the reaction is positive.

To make sure you understand what this process of re-evaluation might entail, please view the following sample picture and verbalize the feelings that are immediately elicited.

Figure 1.
Experimental instructions for reappraisal block.

Figure 2. Visual schematic of stimuli presentation in experimental block. Acoustic startle probes were presented randomly at 3s, 7s, or 12s after picture onset.

Figure 3. Effect of emotion regulation strategies on acoustic eye-blink startle magnitude across negative, neutral, and positive pictures. Different subscripts represent statistically significant differences: a > b.