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Timing effects of antecedent- and response-focused emotion regulation strategies

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ABSTRACT

Distraction and cognitive reappraisal influence the emotion-generative process at early stages and have been shown to effectively attenuate emotional responding. Inhibiting emotion-expressive behavior is thought to be less beneficial due to later implementation, but empirical results are mixed. Thus, the current study examined the temporal dynamics of these emotion regulation strategies at attenuating the late positive potential (LPP) while participants were shown unpleasant pictures. Results revealed that all strategies successfully reduced the LPP and self-reported negative affect. We confirmed that distraction attenuated the LPP earlier than cognitive reappraisal. Surprisingly, expressive suppression affected emotional responding as early as distraction. This suggests that suppression was used preventively and disrupted the emotion-generative process from the very beginning instead of targeting the emotional response itself. Thus, the obtained results point to the importance of considering the point in time when response-focused emotion regulation strategies are being implemented.

1. Introduction

Emotions are useful in terms of signaling potentially significant events in the environment and mobilizing the organism to take appropriate action. However, sometimes emotions can also turn maladaptive (e.g., when being too intense or contextually inappropriate), and the ability to regulate emotional responses is crucial for goal-directed and adaptive behavior. Thus, emotion regulation involves the ability "to influence which emotions we have, when we have them, and how these emotions are experienced and expressed" (Gross, 1998a, p. 224). Moreover, emotion regulation capacities appear to be essential for mental health (Gross & Muñoz, 1995).

According to the process model of emotion regulation, emotion generation is a dynamic process that is based upon specific cognitive processes and unfolds over time (Gross, 1998b). After encountering an emotive situation, attentional deployment towards the emotional stimulus is followed by the identification of the situation's meaning. These cognitive processes give rise to the emotional response that involves changes in physiological, cognitive-emotional, and behavioral response systems. According to this model, emotion regulation strategies can be divided into antecedent-focused and response-focused regulation (Gross, 1998b). While the first influences the emotion-generative process prior to initiation of the emotional response, the latter modulates the emotional response itself. Distraction and cognitive reappraisal are two well-studied forms of antecedent-focused regulation strategies. Distraction alters emotional responses by directing attention away from the emotional situation very early on before elaborative processing has taken place. Cognitive reappraisal requires individuals to reformulate the meaning of a situation in less emotional terms and can be implemented only after an emotional situation has been attended to and appraised. Thus, reappraisal is thought to affect the emotion-generative process later than distraction. It was shown that both distraction and cognitive reappraisal are effective in reducing negative emotion processing as evidenced by self-reported affect (e.g., Lieberman, Inagaki, Tabibnia, & Crockett, 2011), neural indices of negative emotion processing like amygdala activation (e.g., Kanske, Heissler, Schönfelder, Bongers, & Wessa, 2011), and peripheral physiology (e.g., Neumann, Waldstein, Sellers, Thayer, & Sorkin, 2004; Ray, McRae, Ochsner, & Gross, 2010; but see Urry, 2009).

A prominent example of response modulation involves the suppression of emotion-expressive behavior. Regarding the consequences of expressive suppression, two contradicting hypotheses have been suggested. According to a catharsis model, emotions are thought to "pile up" if not expressed (Freud & Breuer, 1960).

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Consequently, expressive suppression should enhance emotion experience. On the other hand, facial feedback theory states that inhibiting emotional facial expressions dampens emotion experience (Adelmann & Zajonc, 1989). Prior studies investigating the effectiveness of expressive suppression have yielded inconsistent results reporting both a decrease (Dunn, Billotti, Murphy, & Dalgleish, 2009; Gross & Levenson, 1997; Hayes et al., 2010; Vrtička, Sander, & Vuilleumier, 2011) and an increase (Dan-Glauser & Gross, 2011; Goldin, McRae, Ramel, & Gross, 2008; Gross, 1998a; Kunzmann, Kupperbusch, & Levenson, 2005; Roberts, Levenson, & Gross, 2008) of emotional responding. Thus, the impact of expressive suppression on emotional processing remains to be further elucidated.

Appraisal theories of emotion (Arnold, 1960; Lazarus, 1991) supported by contemporary research (Phillips, Drevets, Rauch, & Lane, 2003) emphasize that identification of the emotional significance of a situation is a prerequisite for emotion generation. Hence, investigating how the suppression of emotion-expressive behavior affects emotional guidance of attention would complement existing research. The facilitated processing of emotional stimuli is reflected in a central-parietal slow positive deflection in the event-related potential (late positive potential, LPP). The magnitude of the LPP has been shown to be enhanced for emotionally arousing compared to neutral stimuli, beginning approximately 300 ms following stimulus onset and being sustained up to several seconds (for a review see Hajcak, MacNamara, & Olvet, 2010). The LPP is related to activity in occipital, inferotemporal, and parietal visual areas (Keil et al., 2002; Sabatinelli, Lang, Keil, & Bradley, 2007) and reflects increased attention and perceptual sensitivity to motivationally relevant stimuli (Briggs & Martin, 2009; Hajcak et al., 2010; Lang, Bradley, & Cuthbert, 1997; Schupp et al., 2000; Schupp et al., 2004; Weinberg & Hajcak, 2010). The magnitude of the LPP is sensitive to voluntary emotion regulation. Thus, a reduction of LPP amplitudes was shown when participants were instructed to distract attention from unpleasant pictures either by generating unrelated neutral thoughts (Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011) or by focusing on non-arousing picture aspects (Dunning & Hajcak, 2009; Hajcak, Dunning, & Foti, 2009; Hajcak, Moser, & Simons, 2006). Likewise, changing the meaning of an emotional scene in less emotional terms has proven a powerful technique to attenuate the LPP to unpleasant pictures either via self-generated (Hajcak & Nieuwenhuis, 2006; Moser, Krompinger, Dietz, & Simons, 2009; Thiruchselvam et al., 2011) or directed reappraisal (Foti & Hajcak, 2008; MacNamara, Ochsner, & Hajcak, 2011; Mocaiber et al., 2010). Further, LPP reductions have also been observed for positive emotion regulation using strategies targeting attentional or appraisal processes (Hajcak et al., 2006; Krompinger, Moser, & Simons, 2008). Suppressing emotional facial expressions has been shown to attenuate LPP amplitudes during positive emotion (Korb, Grandjean, Samson, Delplanque, & Scherer, 2012), but to our knowledge, has not yet been investigated during negative emotion.

To date, only two studies addressed the question whether emotion regulation strategies differentially affect the temporal dynamics of emotional responding. It was shown that distraction reduced emotional responding prior to cognitive reappraisal (Thiruchselvam et al., 2011), and reappraisal in turn exerted its influence earlier than expressive suppression (Goldin et al., 2008), confirming predictions derived from the process model of emotion regulation (Gross, 1998b). However, Thiruchselvam et al. (2011) investigated emotion-related ERPs, whereas Goldin et al. (2008) focused on neural responses associated with the cognitive control of emotion, making comparisons difficult. Therefore, examining all three emotion regulation strategies within one experimental design using one index of emotion regulation would complement these findings. In this regard, the LPP constitutes a potentially powerful electrophysiological index to examine the differential temporal dynamics of the regulation strategies due to the high temporal resolution of the electroencephalogramm (EEG).

This study aims at investigating effectiveness and timing of the response-focused emotion regulation strategy *expressive suppression* in relation to the two antecedent-focused strategies *distraction* and *cognitive reappraisal*. ERPs during processing of neutral and unpleasant pictures were recorded along with valence and arousal ratings while participants either maintained or reduced their emotion via cognitive reappraisal, distraction, or expressive suppression. We expected to replicate the previous finding that distraction modulates LPP amplitudes prior to cognitive reappraisal (Thiruchselvam et al., 2011). Further, we hypothesized that expressive suppression should affect the time course of the LPP later than both distraction and cognitive reappraisal (Goldin et al., 2008; Gross, 1998b). Additionally, we examined whether emotion manipulation and regulation instructions modulated the LPP and self-reported affect in the expected direction in order to validate the experimental design. Specifically, we expected an emotion effect as reflected by increased unpleasantness and arousal ratings and enhanced LPP amplitudes for unpleasant compared to neutral pictures. Regarding emotion regulation, we predicted that distraction and cognitive reappraisal successfully decrease subjective emotion experience and LPP amplitudes. Because few studies have examined the effects of expressive suppression on emotion-related ERPs, we will explore how the LPP is modulated by this response-focused emotion regulation strategy.

2. Method

2.1. Participants

A sample of 20 students participated in this study (10 males and 10 females, mean age: 24.0 ± 2.4), all of whom had clean data and entered the analyses. Participants had no psychiatric or neurological disorder, were medication-free and reported normal or corrected-to-normal vision. All procedures were approved by the local ethics committee. Participants received course credit for their participation.

2.2. Apparatus and stimuli

Stimuli were presented on a black background of a 17-in. computer monitor using *Presentation* software, version 14.7 (Neurobehavioral Systems, San Francisco, CA). Twelve neutral and 24 unpleasant pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008).[1] According to the norm data of the IPAS pictures, the selected neutral and unpleasant pictures differed in their mean arousal (neutral: $M = 2.49$, $SD = 1.8$; unpleasant: $M = 6.64$, $SD = 2.07$) and valence (neutral: $M = 5.15$, $SD = 1.15$; unpleasant: $M = 2.52$, $SD = 1.55$) values. At a viewing distance of approximately 76 cm, each picture covered a horizontal visual angle of 4.1° and a vertical visual angle of 2.9°.

2.3. Experimental procedure

Participants were informed about the procedure of the study and provided written informed consent. They were given detailed task instructions regarding the concept of emotion regulation. Participants were told that they should respond to pictures by either *maintaining* the emotional response elicited or by using the emotion regulation strategies *reappraisal*, *distraction*, or *expressive suppression*. The reappraisal condition required participants to reinterpret the displayed situation in such a way that the depicted scene becomes less unpleasant (e.g., imagining the situation being unreal or assuming a different outcome of the scene than the one suggested). Participants were free to use any reappraisal strategy they felt was most effective. Distraction was defined as generating thoughts or mental images that were unrelated to the presented picture and of neutral content (e.g., imagining the way to the supermarket) because positive experiences could have provoked pleasant arousal states. Expressive suppression required participants to voluntarily inhibit emotion-expressive behavior. They were instructed not to let their feelings show so that a person watching them would not know they were feeling anything. On maintain trials, participants were asked to attend to and respond naturally to the picture without trying to alter the feelings elicited. This instruction type served as

[1] The IAPS identification numbers of the selected pictures were the following for neutral: 5390, 5720, 7004, 7009, 7010, 7026, 7035, 7041, 7150, 7175, 7233, 7950; for unpleasant: 1120, 1201, 1300, 1304, 1930, 1932, 2811, 3500, 3530, 5972, 6350, 6520, 6550, 9050, 9075, 9163, 9250, 9410, 9412, 9413, 9414, 9635.1, 9910, 9921.