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„How the way we look at art changes our emotional experience – the influence of reappraisal on negative emotions"

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How the way we look at art changes our emotion – the influence of reappraisal on negative emotions

Research offers plenty of literature about the emotion regulation strategy *reappraisal*, which is a strategy that aims to change an emotional response by reinterpreting the affective stimulus (e.g., Gross & John, 2003; Ray, McRae, Ochsner, & Gross, 2010). Several studies that supported this hypothesis used pictures as affective stimuli (e.g., Ray et al., 2010; van Dongen, van Strien, & Dijkstra, 2016), but to the best of our knowledge, there is yet no literature using artworks. Hence, this study aims to investigate reappraisal effects on affective artworks. Furthermore, prior research did not examine if reappraisal effects could be implicitly transferred further along the line. Thus, the present study aims to investigate whether implicitly teaching how to reappraise affects behavioral and physiological responses to later experienced emotional stimuli.

Emotion

When you ask non-psychologists about the term *emotion*, they may describe it as a strong feeling, as an inner state or process that could well influence your physical behavior. This kind of emotion could be either positive like joy or happiness, or negative like sadness or anger. When you ask psychologists, they may struggle with giving you one valid definition of emotion. In a meta-analysis, Kleinginna and Kleinginna (1981) found 92 different definitions of the term emotion in previously published psychological literature. They classified these into categories based on the fundamental characteristics of emotion mentioned in the definitions. Some emphasized the subjective experience of emotion, including affective responses like feelings of pleasure and unpleasure (e.g., Arieti, 1970; Brenner, 1974) and cognitive processes like *labeling* and *appraisal* (e.g., Bowlby, 1969; Schachter, 1970). Some defined emotion according to the *stimulus-organism-response paradigm* (S-O-R paradigm), whereby emotion consists of an external emotional stimuli, that mediates physiological mechanisms and leads to (expressive) emotional behavior (e.g., Clynes, 1977; Plutchik, 1980; Silverman, 1978). They also differentiated based on the scope of the definition. There are *multiaspect* definitions (e.g., Davitz, 1970), involving the many facets of emotion, *restrictive* definitions (e.g., Ewert, 1970), isolating emotion from other psychological processes, and *motivational* definitions, overlapping emotion and motivation (e.g., Ochs, 1965). Others used *functional* definitions, where emotions can be either disruptive by having a great potential for maladaptive effects (e.g., Wickens & Meyer, 1961), or adaptive by meeting the person's

needs (e.g., Rado, 1969). Taken together, emotions can be considered as a "complex set of interactions among subjective and objective factors, mediated by neural/hormonal systems […]" (Kleinginna & Kleinginna, 1981, p. 355). Moreover, they can alter executive functions like attention processes, decision making, and memory performance, but also physiological responses, behavior, and social interactions (Goldin, McRae, Ramel, & Gross, 2008). Emotion generation can be understood as a process that unfolds over time beginning with the perception of a stimulus, followed by the appraisal of a stimulus' emotional significance and triggering of an affective, physiological, and behavioral response (Scherer et al., 2001).

Emotions arise whenever an individual attends to a situation and evaluates it as important to one's own goals (Frijda, 1986). Sometimes, these emotions arise automatically, such as when we back off fearfully when a snake suddenly appears in front of us (LeDoux, 1995). Emotions may also arise non-automatically, after an extensive analysis of meaning, such as when we turn angry after listening to an excoriating conversation about our best friend (Frijda). In both cases, these emotions lead to behavioral, experiential, and physiological response tendencies that influence our response to challenges and opportunities (Scherer Schorr, & Johnstone, 2001).

Often, our emotional responses fit well to the demands of our environment and hence, meet our personal needs (Gross, 2002). If we think that another's joke is funny and we respond by laughing about it, this may be a helpful emotional response by strengthening our social relations. However, emotions do not always dovetail nicely with the demands of our environment, but can also mislead us, especially when the current physical and social environment is different to what we are used to. In these cases, our emotional response may be quite harmful. When it seems to us that our emotions are inappropriate in a certain situation, we commonly try to regulate our emotional responses so that they are more helpful to achieve our goals. Although we might find something outrageously funny, we would avoid laughter during a business meeting with our boss, because we would expect negative consequences.

Emotion regulation

Whenever we influence which emotions we have, when we have them, and how we experience and express them, we refer to these processes as emotion regulation (Gross, 1998). One might think we use emotion regulation strategies only to decrease negative emotions, but in fact, we use it to increase, decrease, and maintain both, negative and positive emotions (Parrott, 1993). Hence, emotion regulation is not mandatory beneficial, but the same strategies could lead to a completely different outcome. Sometimes we regulate emotions consciously,

such as when we try to stay calm when provoked, but emotion regulation can also proceed without conscious awareness, such as when we quickly move away our head from something disturbing or upsetting (Boden & Baumeister, 1997) As emotion generation is a long-lasting dynamic process, it allows emotion regulation changes in emotion dynamics or in the qualities of the responses like latency, rise time, magnitude, duration, or offset (Thompson, 1990).

Process model of emotion regulation. Gross (2002) developed a process model of emotion regulation, that approached to organize the limitless number of emotion regulation strategies by differentiating when during the unfolding process of emotion generation the strategy has its primary impact. In this model, it was differentiated between antecedent- and response-focused emotion regulation strategies. *Antecedent-focused* strategies describe strategies where we do something before the emotion response tendencies are fully developed and have changed our behavioral and physiological responses. For example, you might be nervous about an impending job interview, but you tell yourself that this is a great opportunity to see whether you like the company's principles instead of seeing it as a pass-fail test. *Response-focused* strategies describe strategies where the emotion is fully developed and has already generated response tendencies. For example, you might be very disappointed about getting told that you do not have the job, but instead of showing your emotion you keep a smile on your face to stay professional.

Within this very broad scheme, there are five specific types of emotion regulation strategies (Figure 1). The first strategy is called *situation selection*, illustrated in Figure 1, where a heavy line shows a tendency to choose one situation (S1) rather than the other one (S2). You can decide which situation, people, places, or things you select in order to regulate your emotions. Imagine, it is the night before a big exam. You got invited to two different events: Either you could go to the cinema with one of your best friends (S1) or you could go to your study-group that has a last-minute meeting for the exam on the next day (S2). Maybe you would select the cinema instead of the last-minute meeting with other nervous students. Situation selection is always a consideration of short- and long-term emotional benefits (Leary, 1986). Thus, the cinema would increase your short-term emotional well-being by having a funny, relaxed evening, but may lead to disappointment, anger, or sadness when you fail the exam because you would have needed some repetition the night before.

Once you have selected a situation, this situation can be adjusted to modify its emotional impact, resulting in S1x, S1y, or S1z. This strategy is called *situation modification* and refers to changing the external environment. Returning to our example, you are now in the cinema and your friend asks you about your exam on the next day. As this evokes

nervousness in you, you make it clear that you would rather not talk about the exam again but about something different. Hence, you modify the selected situation.

Attentional deployment refers to the different aspects of situations (a1, a2, a3, a4, a5). You can choose on which of the many aspects of a situation you focus on. There are two main strategies of attentional deployment, *distraction* and *rumination.* To give you an example of distraction, imagine you accidentally meet a friend in the cinema that is also a fellow student. He/she starts talking about the exam on the next day, but instead of listening to the conversation, you start counting ceiling tiles (a4). Thus, you distract yourself from an emotional aspect of the situation and concentrate on pleasant or neutral aspects (Nix, Watson, Pyszczynski, & Greenberg, 1995). Rumination, however, refers to getting to the bottom of the emotional situation, to extensively thinking about its reasons and consequences (Nolen-Hoeksema, 1991). You might return from your evening with your best friend and ruminate why you chose this evening and not the last-minute study group and what consequences this may have for your exam on the next day.

In attentional deployment, you have decided on which particular aspect of a situation you will focus on. Afterwards, during *cognitive change*, you select one of many different meanings (m1, m2, m3) that you attach to this aspect. It refers to modifying one's appraisal of a situation towards shifting its emotional impact. For example, you think about the exam on the next day, but instead of thinking about it as the most important event in life, that will decide about your whole future (m1), you might think about it as one of many tests (m2). Cognitive change can be applied to external situations, such as the example above. Likewise, it can be applied to internal situations (e.g., "My racing heart is not a sign for anxiety but my body is preparing for the speech"; Gross, 2015). One form of cognitive change, *reappraisal*, is especially well-studied so that it is often coextensive with the term cognitive change (e.g., Hajcak & Nieuwenhuis, 2006; Kelley, Glazer, Pornpattanangkul, & Nusslock, 2019; Ray, Wilhelm, & Gross, 2008; Sai, Wang, Ward, Ku, & Sang, 2015; Wolgast, Lundh, & Viborg, 2011). It targets to alter either the meaning of a probable emotion eliciting situation as in the aforementioned example or the self-relevance (e.g., reading about a car accident may elicit negative emotions, but telling yourself that neither you nor one you love was involved may decrease these emotions). However, there are other forms of cognitive change such as *humor* or *distancing*, a strategy where one changes the emotional meaning of a situation by adopting a detached 3rd person perspective (Ochsner, & Gross, 2008).

Unlike the abovementioned antecedent-focused strategies, *response modulation* refers to the emotion after it is fully developed and influences experiential, behavioral, or

physiological response tendencies afterwards. Response modulation includes using alcohol, cigarettes, drugs, and food to change the experiential component, the feeling state (Khantzian, 1985). The physiological response may be altered by physical exercise or deep breathing (Thayer & Lane, 2000). Anyway, *suppression* is one of the best studied strategies within response modulation. It refers to ongoing efforts of inhibiting the expressive component of an emotion. Imagine, you had a disappointing day at university because you failed that test and everybody else did good. Instead of showing these emotions, you might not tell your fellow students about your failure but hide these emotions and fake a smile to not ruin the group evening.

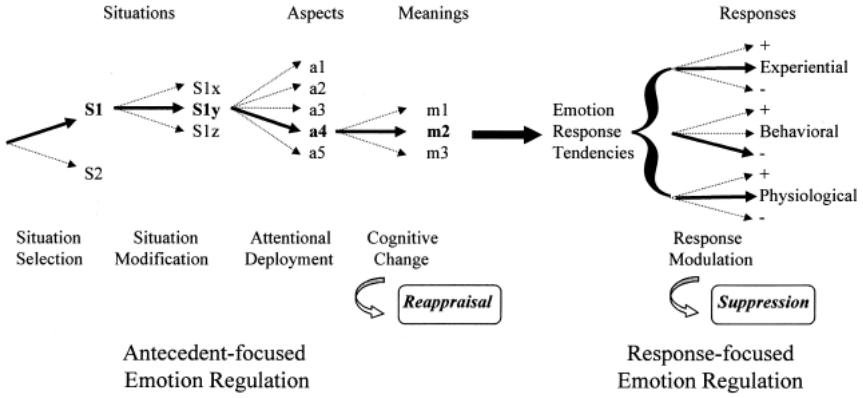

Figure 1. A process model of emotion regulation. According to this model, emotion can be regulated at five stages in the emotion generation process: (1) selection of the situation; (2) modification of the situation; (3) deployment of attention; (4) change of cognition; and (5) modulation of physiological, behavioral, or experiential responses. The first four of these stages are antecedent focused, the fifth is response focused. The number of response options at each stage is random, and the heavy line depicts the selected option from the example in the text. From "Emotion regulation: Affective, cognitive, and social consequences", by J.J. Gross, 2002, *Psychophysiology, 39*(3), 281-291.

Reappraisal. Prior research mainly focused on investigating two strategies of the process model: the antecedent-focused strategy cognitive reappraisal and the response-focused strategy expressive suppression (see Webb, Miles, and Sheeran, 2012 for a meta-analysis of 306 experimental comparisons of emotion regulation). Suppression is assumed to have little impact on the negative emotion experience but to decrease positive emotions (Roberts, Levenson, & Gross, 2008), while it increases the sympathetic activation of the cardiovascular system inducing stress reactions like higher blood pressure and higher cortisol levels (Demaree et al., 2006). However, prior literature suggests consistent evidence for cognitive reappraisal as a more effective emotion regulation strategy (e.g., Gross, 2002; Gross, 2015; Gross & Thompson, 2007; Kelley et al., 2019; Webb et al., 2012). Directing participants to reappraise their reactions decreases the experiential and physiological expression of negative emotion (Gross, 1998; Ray et al., 2010; Szasz, Szentagoi, & Hofmann,

2011). Studies on individual differences support these experimental findings by associating reappraisal tendencies with more daily positive affect and less daily negative affect (Brans, Koval, Verduyn, Lim, & Kuppens, 2013), less psychopathology (Hu et al., 2014), and better physical health (Appleton & Kubzansky, 2014). Understanding the processes and effects of cognitive reappraisal can be approached by using different instructions, measurements, and stimuli. Studies varied in their way how participants were instructed to reappraise. Hajcak and Nieuwenhuis (2006) used an elaborated training to teach participants how to reappraise (see also Ochsner, Bunge, Gross, & Gabrieli, 2002). Therefore, the experimenter explained the concept of reappraisal and used exemplary stimuli to demonstrate, how it was possible to come up with less negative interpretations of these stimuli. Participants were then encouraged to think about reinterpretations of other examples until the experimenter determined that the participants were successfully reappraising negative pictures. Other studies (Butler et al., 2003; Butler, Wilhelm, & Gross, 2006; Coats, 2008; Goldin et al., 2008; Gross, 1998; Ray et al., 2010; Szasz et al., 2011) used short, written instructions, such as "think about your situation in such a way that you can remain calm and dispassionate" (Butler et al., 2003, p. 52), "try to look on the bright side" and "try to find anything positive you can find in the film or in the conversation" (Butler et al., 2006, p. 615). Coats (2008) instructed participants to "focus on the positive aspects of the movie. […]" (p. 54). Ray and colleagues (2010) instructed participants to "think about the picture in a way that decreases your negative response" (p. 588). Irrespective of the mode of instruction, studies showed similar results assuming reappraisal as one effective emotion regulation strategy and similar effect sizes (Webb et al., 2012).

Reappraisal has been examined using a wide-ranging variation of measurements. Most of the studies used questionnaires to request the subjective experience of the emotion, such as the *Positive and Negative Affect Schedule* (PANAS) or the *Emotion Regulation Questionnaire* (ERQ). Wolgast and colleagues (2011) used the ERQ to measure individual differences in habitual emotion regulation (e.g., if participants tend to use reappraisal or suppression in their everyday life). The PANAS however was used to measure changes in participants' emotional state before and after a negative mood induction. In the field of neuropsychological research, several studies were conducted combining these behavioral methods with physiological measurements, such as *electroencephalography* (EEG), *facial electromyography* (EMG), *skin conductance level* (SCL, an indicator of stress), and heart rate or neuroimaging measurements, such as *functional magnetic resonance imaging* (fMRI). To research brain regions that are more or less activated during reappraisal, Goldin and colleagues (2008) showed participants

disgust evoking films during fMRI, whereby they should either reappraise, suppress, or watch neutrally (they received elaborated teaching in advance). They found that activity in brain areas that normally increases in response to disgust (*amygdala* and *insula*) was reduced during the reappraisal condition. In a meta-analysis, Buhle and colleagues (2014) contrasted results from 48 neuroimaging studies of healthy individuals to identify brain regions that consistently support reappraisal. They found increased activation in brain regions commonly associated with so-called cognitive control tasks, including prefrontal areas of the brain, the posterior dorsomedial prefrontal cortex, the bilateral dorsolateral prefrontal cortex, and the ventrolateral prefrontal cortex, and in one region of the parietal lobe, the posterior parietal cortex. They also observed increases in activation in the left posterior temporal cortex, associated with supporting semantic and perceptual representations. Using EMG and self-reports, Ray and colleagues (2010) found that reappraisal as a down-regulating mechanism led to lesser report of negative affect and lesser responses in the *corrugator muscle* (a muscle on our forehead that we need to frown). As an increasing heart rate is associated with higher stress levels, Hofmann, Heering, Sawyer and Asnaani (2009) investigated whether reappraisal leads to lower heart rates than suppression. And indeed, they found lower heart rates in participants that had been assigned to the reappraisal group than in participants of the suppression group, indicating less physiological responses to an emotionally negative situation due to reappraisal. EEG in emotion regulation research was used to either investigate specific *event-related potentials* (ERP) or to investigate *frontal EEG alpha asymmetry*. Asymmetrical activity over the frontal cortex is an underlying process in the experience and expression of emotions and motivations. Although research is not consistent (cf. Harmon-Jones, 2003; Smith, Reznik, Stewart, & Allen, 2017), most studies suggest that asymmetrical activity is due to motivational direction of the emotion. Hence, a relatively greater left frontal activity was often associated with approach motivation, and a relatively greater right frontal activity was associated with withdrawal motivation. However, confounds between approach motivation and positive emotional valence spawned greater left frontal activity in most positive emotions (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Tomarken, Davidson, Wheeler, & Doss, 1992). Likewise, greater right frontal activity can predict negative emotions, such as crying in response to maternal separation in 10-months infants (Davidson & Fox, 1989). ERP is a method where responses to specific stimuli are averaged over many trials to detect patterns that are unique to this kind of stimuli (Hajcak, MacNamaria, & Olvet, 2010). The *Late Positive Potential* (LPP), a reliable component of the ERP, is a slow and positive deviation that lasts for milliseconds to seconds, depending on the duration of the stimuli (Cuthbert,

Schupp, Bradley, Birbaumer, & Lang, 2000). Literature offers multiple time windows for the LPP, from 300 to 800 ms (Langeslag & van Strien, 2013) to 600 to 900 ms (van Dongen et al., 2016) after stimulus onset, but consistently reports larger amplitudes in response to emotionally intense and arousing stimuli than to neutral stimuli (Cuthbert et al., 2000; Schupp, Junghöfer, Weike, & Hamm, 2003). When participants were asked to reinterpret negative images, their LPP amplitudes were attenuated, reflecting reductions in self-reported emotional intensity as a consequence of emotion regulation (Hajcak & Nieuwenhuis, 2006; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011).

Prior studies used different stimuli to investigate effects of reappraisal. Within this broad variation, three stimuli types were used the most: imagination of an emotionally event, film clips, and pictures from the *International Affective Picture System* (IAPS; Lang, Bradley, Cuthbert, 1999). The IAPS is a data bank that contains evaluated pictures eliciting different target emotions. Ray and colleagues (2008), for example, used imagination in their study examining the effect of rumination and reappraisal on negative affect. Participants were asked to project their thoughts to an angering event within the last two weeks for two minutes. They reported significantly higher levels of anger after this imagination of an emotionally event compared to the baseline values gathered at the beginning of the experiment (see also Szasz et al., 2011). Among many other options like imagination, feedback, facial expressions, or music, film clips are a standardized, highly ecological, and effective way to induce mood (Westermann, Spies, Stahl, & Hesse, 1996). In 2005, Hewig and colleagues published a revised film set (after Gross & Levenson, 1995) for the induction of mood, that contained 20 film clips targeting the emotions happiness/amusement, sadness, anger, and disgust. Within these stimuli, a short scene from *The Champ* (Marion, Newman, Lovell, & Zeffirelli, 1979) received highest sadness ratings (M = 7.21, SD = 2.07) on a scale from 0-9 on the inventory for assessment of the emotional reaction. While the mood induction procedure is often used in emotion regulation research (Butler et al., 2003; Butler et al., 2006; Coats, 2008; Rottenberg, Ray, & Gross, 2007; Wolgast et al., 2011), a meaningful part of these studies used pictures as affective stimuli (Jackson, Malmstadt, Larson, & Davidson, 2000; Ray et al., 2010; Van Dongen et al., 2016) that were retrieved from the IAPS. Ray and colleagues (2010) showed that negative evaluated pictures effectively elicit more negative emotion that neutral evaluated ones.

Emotion and Art

Art can elicit strong positive and negative emotions (Blood & Zatorre, 2001; Gerger, Leder, & Kremer, 2014; Juslin, 2013; Silvia, 2005, 2009), such as pleasurable shivers down

the spine (Schoeller, 2015), but also unusual aesthetic emotions, such as anger, confusion, disgust, pride, or surprise (Silvia, 2009) and can even move people to tears (Elkins, 2001). However, there is a debate about the quality of these emotions elicited by art. There is no consensus whether emotional experiences elicited by art are either similar (Juslin, 2013) or different from emotional experiences elicited in our everyday life (Scherer, 2005). Everyday perception is mainly pragmatic and goal-oriented and induces motivational and action tendencies (Markovic, 2012), whereby artworks usually do not pose any risk for health and well-being (Dissanayake, 2007) and do not afford effectively recognizing, adequately reacting, and performing goal-oriented and action motivating (Cupchik & Winston, 1996). Literature suggests that perceivers pay more attention to stylistic and formal features of the stimuli in an art context (Cupchik, Vartanian, Crawley, & Mikulis, 2009; Kirk, Skov, Christensen, & Nygaard, 2009) as they would in a real-world context, where it is more about simple object recognition (Nadal, Munar, Capo, Rossello, & Cela-Conde, 2008). This might be the reason that the physiological component of the emotional reaction as well reveals different patterns for art context and real-world context (Scherer, 2004; Kubovy, 1999; Frijda, 1988). Suddenly facing the silhouette of a person with a knife, alone in the middle of the night, would lead to physiological arousal like faster heart rates and breathing, and would release more of the hormone adrenaline and hence, trigger fear (Gerger et al., 2014), preparing the body to fight or flight. In contrast, emotional aesthetic experiences, such as watery eyes, goose bumps, or shivers down the spine might not directly provoke action readiness (Scherer, 2004). However, Goldstein (2009) argues that emotional aesthetic experiences are comparable or even more intense than real-life emotions, as participants did not show reduced levels of sadness or anger in response to film clips when they were claimed to be fictional compared to realistic. Puliot and Cowen (2007) even found more intense emotional ratings when a film was presented in a fictional context than in a realistic context. Gerger and colleagues (2014) reported mixed results in investigating context effects on the emotional experience. Participants were either told that the ensuing pictures (artworks and pictures from the IAPS) are artworks retrieved from art books or catalogues (art context) or press photographs (realistic context). Afterwards, they should rate their positive and negative emotions and their liking. EMG was also recorded. The positive aspects of the emotional experience (joy ratings, *M. zygomaticus* activations) were reduced in their intensity by the art context, however, negative aspects of the emotional experience (negative emotion rating, *M. corrugator supercilii* activations) hardly changed due to context. Taken together, research provides mixed findings about the emotional aesthetic experience, and further, no study has

been conducted investigating the effect of reappraisal on artworks. While not finding an effect of reappraisal would be indicative for a different emotional quality, finding a reappraisal effect in artworks would suggest a rather similar emotional experience in artworks and real-life situations.

Research Question and Hypotheses

This master thesis aims to expand knowledge about the effect of reappraisal on emotional responses by (1) using artworks as stimuli and by (2) measuring an implicit effect of reappraisal. In prior literature, it was measured whether participants have fewer negative emotions when they were instructed and taught to reappraise (see Webb et al., 2012 for a meta-analysis of reappraisal studies and study designs; see Buhle et al., 2014 for a meta-analysis of neuroimaging studies). Other studies compared habitually reappraisers with non-reappraisers by measuring emotional response during a negative mood induction (Sai et al., 2015; Shafiei et al., 2018). To the best of our knowledge, there is no study which investigated an implicit influence of unconsciously learning to reappraise on the emotional response to a following negative mood induction before. A successful assessment of reappraisal to subsequent emotional situations however could imply a sequence of positive consequences for healthy individuals in form of more well-being, better relationships, less negative emotions, and a higher life quality (Goldin et al., 2008; Gross & John, 2003; Kelley et al., 2019; Shafiei et al., 2018), but also for non-healthy individuals with anxiety disorders or depression (Aldao, Nolen-Hoeksema, & Schweizer (2010). None of the studies used artworks as stimuli, whereas most of them used pictures from the IAPS (Jackson et al., 2000; Van Dongen et al., 2016) or they used different induction methods like film clips (Coats, 2008; Wolgast et al., 2011), the *Velten Mood Induction Procedure* (Velten, 1968; a technique that instructs participants to read statements about emotional situations and to try to react emotionally like they actually are in this situation), or social interactions (Butler et al., 2003; Butler et al., 2006). However, if reappraisal also affects emotional experience in artworks, this would suggest a similar emotion processing in artworks and real-life and would shed light to the debate about the quality of emotion in an art context (cf. Juslin, 2003; Scherer, 2005). Therefore, this study aims to answer these open questions, if reappraisal can be applied to artworks as well and if it can be implicitly learned and used in another context.

Hypotheses. We tested the behavioral hypotheses that (1) a reappraisal group gives lower ratings of negative affect on the PANAS after viewing the artwork stimuli compared to a control group, that (2) a reappraisal group gives higher ratings of positive affect on the PANAS after viewing the artwork stimuli compared to a control group, that (3) a reappraisal

group gives lower ratings of negative affect after viewing the film clip compared to a control group, and that (4) a reappraisal group gives higher ratings of positive affect after viewing the film clip compared to a control group. We tested the physiological hypothesis that (5) a reappraisal group shows attenuated amplitudes in the LPP (600-900ms after onset of the artwork stimuli) compared to a control group.

Exploratory analysis of liking ratings. In our task, participants had to give a liking rating after the presentation of each stimuli. This was included to reduce effects of fatigue and to keep the task interesting. Although our focus was on changes in state emotion and corresponding brain states through reappraisal, we conducted exploratory analysis on the liking ratings as well (Van Dongen et al., 2016). Moreover, in the oral debriefing at the experiment, it seemed like participants focused highly on this rating task as their main task.

Method

Ethics Statement

The study was conducted with prior approval of the ethic commission for research of the University of Vienna. The corresponding approval can be found in Appendix A. All the participant data are stored on servers of the University of Vienna.

Participants

Ray and colleagues (2010) found large effect sizes that varied between $\eta^2 = .20$ and $\eta^2 = .85$ for main effects of instruction (participants were either instructed to increase, to be aware of or to decrease their negative response). Considering these results, we conducted an a-priori power analysis using G*Power (version 3.1.9.4; Faul, Erdfelder, Lang, & Buchner, 2007) and assuming a large effect size, $f = 0.5$, $\alpha = .05$, $1 - \beta = .95$. Analysis suggested a total sample size of 42 participants.

Forty-five undergraduate Psychology students were recruited via the recruitment system of the University of Vienna. They received course credit for their participation. Five additional participants were recruited by the experimenter from a student population. This resulted in a total sample size of 50. Data of ten participants had to be excluded as the experiment crashed due to technical issues during the testing. Hence, for further analysis data from 40 participants remained (19 female, M_{age} = 22.73 years, SD_{age} = 2.86 years). Participants were equally but randomized assigned to the experimental group (20 participants, 12 female, M_{age} = 23.25 years, SD_{age} = 3.21 years) and the control group (20 participants, 7 female, M_{age} = 22.20 years, SD_{age} = 2.42 years). Before as well as during the experiment, the experimenter did not know whether the participant was in the experimental or in the control

group. According to declarations in the recruitment system, vision was normal or corrected to normal. To ensure that there were no linguistic misunderstandings concerning the instructions, participants' German had to be mother tongue.

Participants were treated in accordance with standards of the Declaration of Helsinki: First, they were precisely instructed about the procedure and were informed about the neuropsychological methods that were used in the study, which were EEG and *functional near-infrared spectroscopy* (fNIRS; data were not analyzed due to a lack of time and resources). They gave written consent. During the experiment, participants were constantly monitored to assure their well-being. After the experiment, participants were informed about the theoretical background, study design, and hypotheses of the study in oral form.

Measures and Materials

Apparatus. The experiment was programmed and executed in OpenSesame (version 3.2.7) running on a desktop computer with Windows 10 Professional (Microsoft, Inc.). Visual stimuli were presented in front of a black background on a 39.5-inch flat screen monitor (iiyama Prolite X4071UHSU-B1; resolution 3,840 x 2,160 pixels). Participants were seated in front of the monitor without a chin rest, hence viewing distance varied slightly. They responded by keypress on a standard keyboard.

Stimuli. Thirty-nine *artworks* (artworks with a negative content) were chosen from various sources on the internet (Appendix B). Several criteria had to be fulfilled for the artwork to get added to the set: (a) painted artworks (no photographs, sculptures, or collages), (b) rather unknown artworks, (c) negative content like violence or profanity (we mainly used figurative artworks, in which the negative event is clearly visualized, but not abstract art or concrete art).

Then, an online survey was conducted for stimuli set validation. The survey was generated using SoSci Survey (Leiner, 2019) and was made available to participants via https://www.soscisurvey.de. Seventy-four persons took part, whereby nine had to be excluded due to art expertise as prior literature suggests differences between art experts and art novices in their emotional responses (Locher, Smith, & Smith, 2001; Silvia, 2013). The remaining 65 participants rated the stimuli set in a randomized order on a 7-point Likert scale for liking (*I like that picture very much*; from *I don't agree at all* to *I totally agree*) and for negativity (*This picture seems very emotional negative for me*; from *I don't agree at all* to *I totally agree*). Additionally, they were asked to add the name of the artist and/or the artwork if known. We calculated means of negativity ratings and excluded nine artworks with $M_{negativity} < 4.49$ (see Appendix B for means). The exclusion criteria for artworks was set at

an overall recognition rate of more than 20%. This wasn't the case in any artwork. Hence, 30 artworks (see Figure 2 for examples) remained for the final stimuli set.

Figure 2. Two examples of the stimuli set. On the left*:* Alenza y Nieto, L. (1844). *El sacamuelas* [Oil on canvas]. Retrieved from: https://www.museodelprado.es/coleccion/obra-de-arte/el-sacamuelas/3cf7b7f6-c0c4-4fc4-9047-bec8e6557a15 and on the right: Gericault, T. (1819). *Anatomical pieces.* [Oil on canvas]. Retrieved from: https://www.amazon.com/Anatomical-Pieces-by-Theodore-Gericault/dp/B07C86V3ZF

Mood induction. We used a short film clip (111 seconds) from the movie *The Champ* (Marion et al., 1979). It was already used and validated in prior studies to induce negative mood (Gross & Levenson, 1995; Hewig et al., 2005). The selected scene shows a little boy standing next to his father's body and crying over his death in a boxing match.

To ensure that the film clip would induce negative affect and hence would be appropriate to test our hypotheses, we conducted a comparative online validation survey. The survey was generated using SoSci Survey (Leiner, 2019) and was made available to participants via www.soscisurvey.de. One-hundred-four participants were randomly assigned to one of two groups. One group watched the negative film clip of "The Champ" (Marion et al., 1979) and the other group watched a neutral film clip, a scene from "Hannah and her sisters" (Allen & Greenhut, 1986), in which two women go shopping and talk about their last evening. Procedure was equal in both groups: First, participants completed the PANAS. Then, they watched the film clip and afterwards, they completed the PANAS again. Results of the between-subject ANOVA with repeated measures (film clip as between-subject factor, PANAS as repeated measures within participants) revealed a significant difference between groups, indicating that the negative film clip increases negative affect significantly more than the neutral one ($F(1, 101) = 5.99$, $p = .01$, $\eta^2 = .05$).

Mood measurement. The German version of the PANAS (Krohne, Egloff, Kohlmann, & Tausch, 1996) was used to measure participants' mood. Positive and negative affect should be understood as two highly distinctive factors, not as opposites. Positive affect describes the extent to which a person feels enthusiastic, active, and alert. Negative affect describes the extent to which a person feels distress and unpleasurable engagement, e.g. including anger and fear (Watson, Clark, & Tellegen, 1988). We used the instruction asking participants to rate how they felt right at the moment. The instruction and the schedule can be found in Appendix C.

Affect regulation instructions. Experimental group and control group differed in their instructions preceding the picture stimuli. The control group was instructed to look at the pictures and to rate them for liking afterwards. The experimental group was instructed to look at the pictures and to meanwhile focus on the positive aspects of the artworks (Ray et al. 2010; Butler et al., 2003). As we expected participants to be non-art-experts, we also added some examples of what positive, nice aspects could be in the sense of an artwork. Hence, the experimental group was instructed to look at the pictures, but focus on especially nice aspects of the picture, e.g. colors, details, style, and artistic value, and to rate the pictures for liking afterwards.

Electroencephalography. Continuous electroencephalography (EEG) was recorded by using the LiveAmp amplifier, Brain Vision Recorder software and the actiCAP slim electrode cap with 64 electrodes (Brain Products GmbH, Gilching, Germany). EEG recordings were obtained with active electrodes from 64 sites on the scalp, based on the 10-20 system. The *AFz* (an electrode on the middle line of the scalp in the prefrontal area) electrode served as the ground and the *FCz* (an electrode on the middle line of the scalp in the frontal central area) electrode served as the reference. During recording, the EEG signal was sampled at a rate of 500 Hz and was band-pass filtered from 0.05 Hz to 100 Hz. Impedance levels were kept below 5 kΩ.

Procedure

The experiment used a *double-blind* between-subject design with the between-subject factor group, dividing participants into the control group and the reappraisal group. Hence, procedure was identical in both groups, only the instructions differed.

All participants were tested individually in a laboratory of the EVAlab (Research focus Empirical Visual Aesthetics) at the Institute of Psychology in Vienna, Liebiggasse 5. At the beginning, participants were welcomed and orally instructed about the operating mode of EEG and fNIRS, as fNIRS was also recorded, but is not analyzed in this work due to time and

effort. Then, they were asked to carefully read and sign the informed consent. Demographic information (name, gender, and date of birth) was also required. We did not explain the hypotheses of the study in advance to avoid biases caused by the participants' expectations. We only told them that this was a study on art perception.

For the application of the EEG, we measured the center of the skull. Therefore, we measured the distance between the *nasion* (the upper point of the nose where it meets the forehead) and the *inion* (an up-sticking point at the lower rear part of the skull) and the distance between the *tragus* of the left and of the right ear. The crossing point of these lines refers to the center of the skull. We also measured skull circumference for right cap size. Then, we applied the 64 active electrodes to the cap according to the 10-20 electrode placement system and filled in some conductivity gel between skull and electrodes. We improved conductivity until the impedances on each electrode were at least less than 5 kΩ.

Afterwards, we attached the optodes of the fNIRS with elastic springs and checked for good signal. Sometimes, participants had to wear a black cap on top of the electrodes and optodes, as there was high *dark noise*, considered to be provoked by effect of outer lights. We assumed that this has no effect on the functioning of the EEG.

After finishing the application of the EEG and the fNIRS, the actual experiment started. Participants were orally instructed in advance in order to keep artifacts in the EEG signal as low as possible. They should avoid head and body movements, chewing motion, and eye-blinks, especially during the presentation of the stimuli. They were also instructed to read carefully through all the instructions. The first 30 seconds of the experiment consisted of a baseline recording, where participants were instructed to not move and to look at a white *fixation cross* presented on a black screen.

Then, participants received the written instruction for the PANAS (Figure 3). They were asked to rate to which extent the following words describing emotions and sensations correspond with their current affective state. They should use the keys 1-5 on the keyboard with 1 = *not at all* and 5 = *absolutely* (see Appendix C for the German instructions). Then, they were confronted with ten items of the positive affect scale and ten items of the negative affect scale in randomized order. There was no time limit, participants could determine the duration of the PANAS (we did not observe any participant being conspicuous fast or slow).

After completing the PANAS, participants received the stimuli instructions. Here, groups differed. Participants could be either in the control group or in the reappraisal group. Then, they were confronted with the artwork stimuli in a randomized order. Each stimuli was presented in a 1920 x 1080 pixels resolution and lasted for ten seconds. After each stimuli,

participants received the instruction to rate how much they liked the picture on a 9-point-scale from 1 = *not at all* to 9 = *very much*. They responded via keypress on the keyboard.

Then again, participants received the exact same instruction for the PANAS again and were asked to report their current mood. There was no time limit and the items were equal to the first PANAS. Next, participants did not receive any instruction, but the film clip instantly started to play with audio on a medium volume. The film clip lasted 1:51 minutes. After that, participants were asked one more time to rate their mood on the PANAS, again with the same instructions.

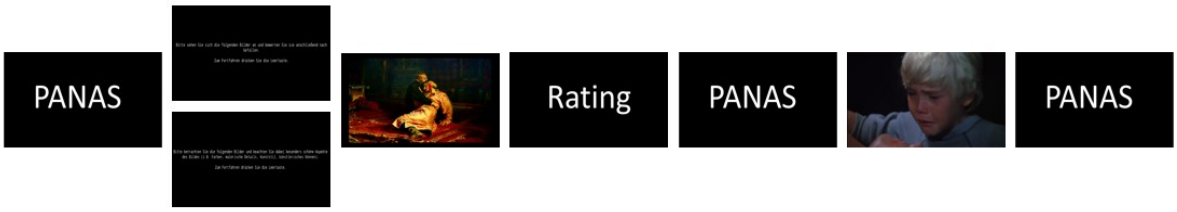

Figure 3. Simplified representation of the experimental procedure. From left to right: (1) First, participants had to rate their current emotional state on the PANAS; (2) then they were randomly assigned to either the experimental or the control group; (3) artworks were presented for 10 seconds respectively and (4) after each, participants had to give a liking rating; (5) second rating of the current emotional state; (6) presentation of the film clip for 1:51 minutes and (7) third rating of the current emotional state.

After the experiment, an oral manipulation check was done by asking participants if they knew any artworks or the film clip and if they could figure out the research aim. We then explained the hypotheses and the study design and we assured us of the participants' well-being.

EEG signal analysis

All EEG signal analyses were executed in Matlab (release 2014b) using the EEGLAB toolbox (Delorme & Makeig, 2004) and the ERPLAB toolbox (Lopez-Calderon & Luck, 2014). We had to exclude two participants from further analysis, because the triggers were not correctly sent. The EEG signals were referenced to the averaged mastoid electrodes (TP9 for the left mastoid and TP10 for the right mastoid) and phase-shift-free filtered with a band pass of 0.10-30 Hz (24dB/Oct). Correction for ocular artifacts due to eye-movement and eye-blinks was done using an *independent component analysis* (ICA). ERP epochs were extracted lasting from 200 ms before stimulus onset (artworks) to 2000 ms after stimulus onset (artworks). The ERP signals were defined relative to the mean amplitude of the 100 ms period before stimulus onset. For each participant and each group, average ERPs were computed. Epochs with a baseline-to-peak amplitude difference larger than 100 µV or smaller than -100

μV on any channel were excluded from further analysis. We had to exclude seven participants as more than 25% of the epochs were rejected due to artefacts. The mean percentage of valid epochs at analysis-relevant electrodes was 89.25 %. Suggested by prior studies (Langeslag & Van Strien, 2009; Van Dongen et al. 2016), the 600-900 ms time window best represents the later part of the LPP and is mainly affected by context effects and emotion regulation. The LPP has a symmetrical distribution over the scalp with a maximum amplitude at midline electrodes. Throughout the process of affective processing, the LPP shifts from a posterior to a more central position (Hajcak, Weinberg, MacNamara, & Foti, 2012). Therefore, the 600-900 ms LPP was scored at central and parietal electrodes (Cz, Pz, CP1, and CP2).

Statistical analysis

All statistical analysis were conducted using R Studio 3.5.1 (R Core Team, 2018) using the tidyr (Wickham & Henry, 2018), the dplyr (Wickham, François, Henry, & Müller, 2018), and the ez (Lawrence, 2016) package.

Behavioral data. Data were analyzed separately for the Positive Affect Scale and the Negative Affect Scale of the PANAS as outlined above. Separate 2 × 3 mixed design ANOVAS with the between subjects factor group (reappraisal, control) and within subject factor time (PANAS 1, PANAS 2, PANAS 3) were calculated for the emotion rating (responses to the PANAS). We performed paired t-tests using the Bonferroni correction as post-hoc tests to reveal contrasts within significant main effects.

EEG data. Data were analyzed using a one-tailed two-sample *t*-test to compare means of the two groups, control group and experimental group.

Results

Behavioral data

To analyze whether the instruction to reappraise influenced participants' expressive emotional behavior compared to a neutral instruction (see Table 1 for descriptive statistics), we conducted a mixed design ANOVA.

Test assumptions. Prior to statistical analyses, normal distribution of the ratings was tested separately for each group and scale by using the Shapiro-Wilk test. Although results indicate non-normality in each test ($ps < .05$), mixed-design ANOVA is considered as a very robust F-statistic. Thus, this violation can be neglected (Blanca, Alarcón, Arnau, Bono, & Bendayan, 2017). Sphericity of within-subject factors was measured by using the Mauchly's

test for sphericity. Non-sphericity in the negative affect scale ($p < .05$) was corrected with Greenhouse-Geisser correction.

Table 1. Means and standard deviations of participant's scores on the positive affect and the negative scale of the PANAS in control and experimental group at three measuring points.

	Control Group			Experimental Group	
PANAS	*M*	*SD*		*M*	*SD*
			Positive Affect		
PANAS 1	2.96	1.06		3.13	1.10
PANAS 2	2.53	1.14		2.78	1.17
PANAS 3	2.11	1.12		2.51	1.19
			Negative Affect		
PANAS 1	1.20	0.47		1.21	0.54
PANAS 2	1.51	0.76		1.68	0.86
PANAS 3	1.59	0.86		1.75	0.98

Analysis of variances. We found no significant main effect for group on the positive affect scale, $F(1, 38) = 2.26$, $p = .141$, $\eta^2 = .05$, and on the negative affect scale, $F(1, 38) = 0.98$, $p = .329$, $\eta^2 = .02$, indicating no differences in emotion response in control and experimental group. Furthermore, interactions of group × timepoint of PANAS revealed no significant results as well in both scales, positive, $F(1, 38) = 1.38$, $p = .257$, $\eta^2 = .01$, and negative affect, $F(1, 38) = 0.89$, $p = .414$, $\eta^2 = .01$, indicating no differences in emotion response change in both groups. However, we found a significant main effect for timepoint on the positive affect scale, $F(1, 38) = 56.59$, $p < .05$, $\eta^2 = .19$, indicating less positive emotions in both groups over time, and on the negative affect scale, $F(1, 38) = 25.68$, $p < .05$, $\eta^2 = .17$, indicating more negative emotions in both groups over time. Post-hoc pairwise comparisons using Bonferroni corrected paired *t*-tests revealed that positive affect was rated significantly different between PANAS 1 (the first timepoint) and PANAS 2 (the second timepoint; $p < .05$) and as well between PANAS 2 and PANAS 3 (the third timepoint; $p < 0.5$). Negative affect was rated significantly different between PANAS 1 and PANAS 2 ($p < .05$), but not between PANAS 2 and PANAS 3 ($p = .50$). Surprisingly, visualizing the means and confidence intervals (Figure 3) revealed a non-significant trend for negative affect to be higher in the reappraisal than in the control group at PANAS 2 and PANAS 3 (Figure 4).

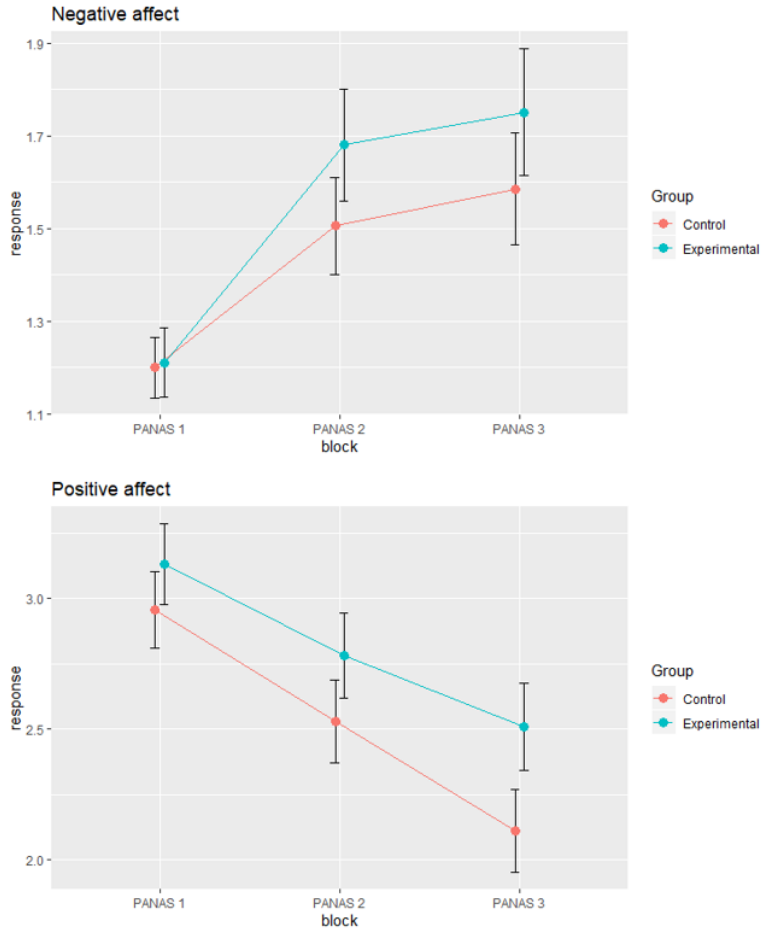

Figure 4. Means of positive and negative affect. Error bars represent confidence intervals. The upper figure represents the negative affect scale of the PANAS in both groups over time; the lower figure represents the positive affect scale of the PANAS in both groups over time.

EEG Data

To investigate whether the instruction to reappraise attenuated the mean amplitude of the LPP (in the time window between 600 and 900 ms) we performed a one-tailed two-sample *t*-Test to compare means of groups (see Figure 5 for data visualization).

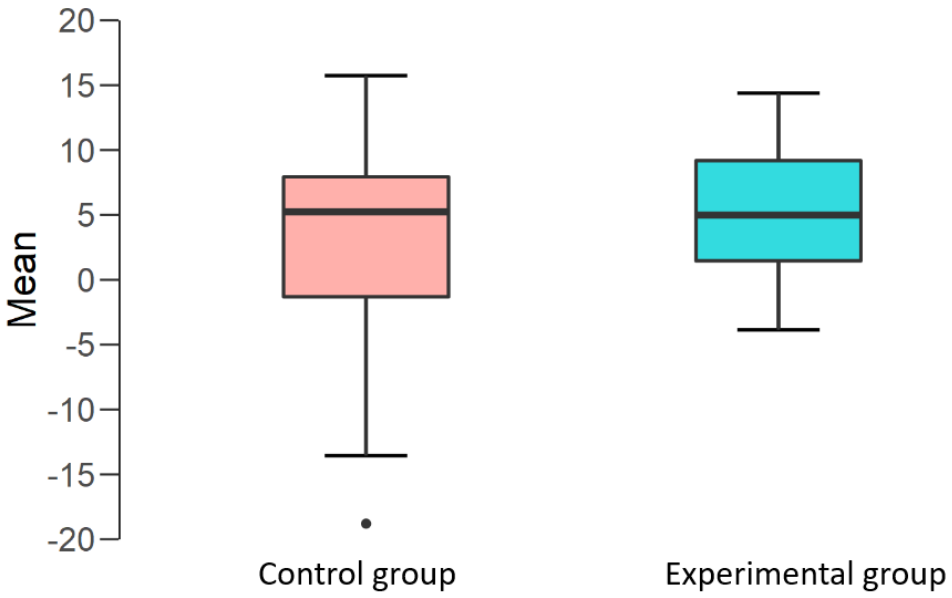

Figure 5. Boxplot of ERP means. ERP means were averaged over the Cz, Pz, CP1, and CP2 electrodes, separately for each group.

Prior to statistical analysis, normal distribution of the ERP means was tested separately for each group (control and experimental) by using the Shapiro-Wilk test. The test was non-significant for control group ($p = .140$) and experimental group ($p = .798$), indicating normal distribution of the ERP means. Homogeneity in variances was tested using a *F*-test. Non-significant results, $F(1, 14) = 2.79$, $p = .065$, indicate homogeneity of variances. We found no significant effect for the 600-900 mean LPP amplitude of control group ($M = 2.46$, $SD = 9.55$) and experimental group ($M = 5.46$, $SD = 5.52$); $t(27) = -1.04$, $p = .307$, $\eta^2 = .04$. The comparison is depicted in Figure 6. This result suggests no effect of reappraisal on the LPP.

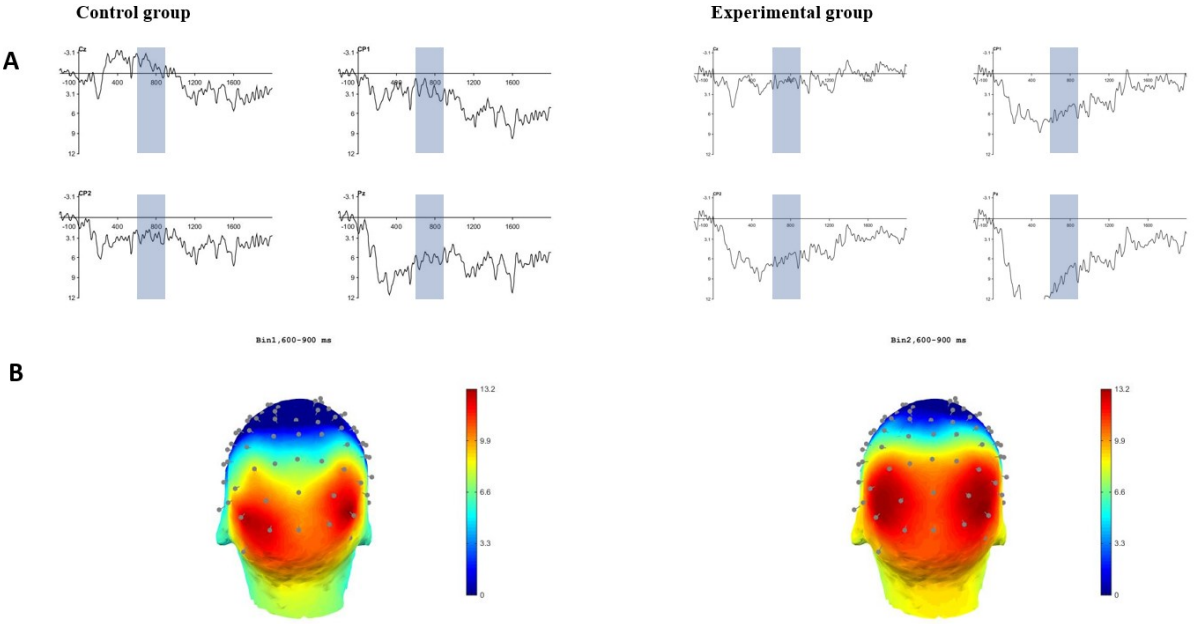

Figure 6. LPP potentials and scalp topography. A: LPP potentials (blue windows represent the 600-900 ms time window) in response to negative artworks for control (left) and experimental (right) group. B: Topographic map of activation during the LPP for control (left) and experimental (right) group.

Exploratory analysis

Visualization of the liking ratings for the control group (M = 3.26, SD = 1.99) and the experimental group (M = 4.01, SD = 2.17) revealed higher liking ratings in the experimental group compared to the control group (Figure 7). Exploratively, we performed a two-sampled t-test that turned out significant, $t(38) = -6.27$, $p < .001$, $\eta^2 = .03$. This result suggest a group difference in liking of negative artworks and hence, may be investigated in further research.

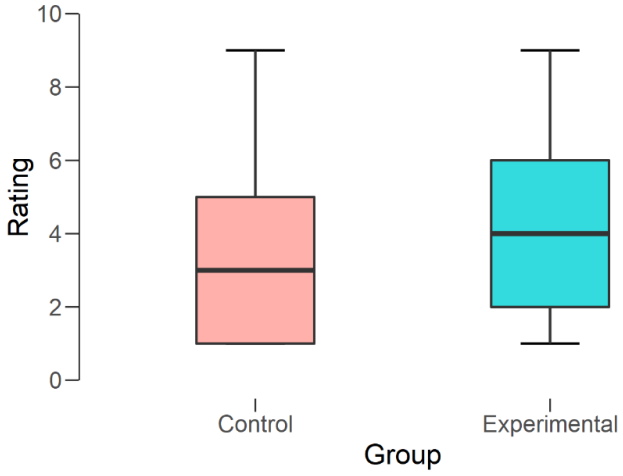

Figure 7. Liking ratings. Boxplots depicting the mean liking ratings for control group (left) and experimental group (right).

Discussion

The present study examined whether reappraisal changes the way people emotionally experience emotional negative artworks in self-reports and in physiological parameters. Participants in both groups reported less positive affect after the artwork stimuli and after the film clip, and more negative affect after the artworks, but not after the film clip. This indicates that the mood induction worked for positive affect, but contrarily to our expectations, the film clip did not induce more negative affect. We found that reappraisal, compared to a control group, had no effect on the emotional ratings in participants' self-reports. EEG data supports these results, as the mean amplitude between groups did not differ significantly.

Quality of emotion

The quality of emotion in an art context compared to a real-life context has been broadly discussed and literature is divided over it. Our results suggest that reappraisal cannot be applied to artworks with negative emotions. This supports the thesis that artworks elicit a different emotion experience (Cupchik et al., 2009; Gerger et al., 2014; Scherer, 2005) and can hence not be regulated with common emotion regulation strategies. Scherer (2005) divided emotions in utilitarian emotions and aesthetic emotions. Utilitarian emotions should facilitate our adaption to events, such as preparation of action tendencies (fight or flight) or motivational enhancement (joy and pride), and are important for survival and well-being. Aesthetic emotions, on the other hand, do not involve the adaption to events and are not goal relevant. Kant (2001) created the term disinterested pleasure, because art can elicit strong emotions, but without evoking adaptive action tendencies (Frijda, 1986). Moreover, we did not find any group difference in the LPP. This also supports the thesis that there is a difference in emotion experience as prior literature found different physiological activation in real-life emotions and aesthetic emotions (Frijda, 1988; Kubovy, 1999; Scherer, 2004). Nonetheless, this is a speculative interpretation as our study design did not include a real-life condition, e.g. with IAPS pictures (Jackson, 2000; Van Dongen et al., 2016). This would have been necessary to control if participants learned how to reappraise through our instruction or if the instruction did not induce reappraisal. However, our exploratory analysis detected significant higher liking ratings in the experimental group than in the control group that would plead for a group manipulation, whereby it is unclear if it induced actually reappraisal or another emotion regulation strategy.

Art experts vs. art novices

Silvia (2013) compared art experts and art novices regarding the knowledge emotions interest and confusion and found that experts are more interested and less confused when viewing artworks, indicating that experts and novices differently appraise emotions evoked by artworks. Concomitant, experts are assumed to have different emotional responses to art in general (Locher, Smith, & Smith, 2001) and view art differently as shown in the eye-tracking (Locher, 1996). Art novices are more confused by artworks and hence, this could be a reason why we did not find any effects. Participants were instructed to reappraise in a way that they should focus on positive aspects of the artworks. However, lack of art knowledge could have been a reason, why participants could not find positive aspects in the artworks, because they cannot evaluate e.g. artistic talent or style. So, they tried to reappraise, but were not successful. An elaborated reappraisal training (Hajcak & Nieuwenhuis, 2006; Ochsner et al., 2002) could avoid this confusion by showing participants examples of positive aspects of artworks that they can find in a similar way in the experimental block. Again, this interpretation has to be treated with caution due to the missing real-life control condition.

Awareness

As a control of the instruction effect is missing, one could argue that participants did search for positive aspects, but the negative content was more salient (Reynolds & Desimone, 2003) and hence, participants used emotional awareness instead of reappraisal. Emotional awareness describes the ability to attend to and to evaluate emotions (Bridges-Curry, Glenn, & Felton, 2019) and has been assumed to facilitate the identification of emotion causes and appropriate responses (Rieffe, Oosterveld, Miers, Terwogt, & Ly, 2008). However, Bridges-Curry and colleagues could not confirm that emotional awareness is a critical component of successful emotion regulation. This could explain why we did not find any group differences in the LPP. Moreover, the higher liking ratings in the experimental condition could also be a consequence of an evaluating process of emotional awareness instead of a reappraisal effect.

Limitations and further research

Findings of the present study might be limited due to some reasons. First, we did not use the ERQ for a baseline of habitual emotion regulation strategy use, whereby this would have been an important control for group differences, as people who habitually use reappraisal are expectable to do so in the experimental setting as well and might be not as negatively affected as habitual suppressors (Kelley et al., 2019). Second, we did not subgroup participants with relatively high and relatively low liking ratings. However, further research

can consider if there are within-group differences, such as effects of reappraisal only on the subgroup with low liking ratings. For people who already like the pictures, there might be no effect of reappraisal because they might see the artworks in a positive way anyway and hence, reappraisal makes no difference. Third, according to the *Vienna Integrated Model of top-down and bottom-up processes in Art Perception* (VIMAP; Pelowski, Markey, Forster, Gerger, & Leder, 2017), it already takes up to 500 ms for one cycle of early stages of the model, including the detection and grouping of artwork characteristics, a basic integration of sensory and context information, and the memory integration stage. Cela-Conde et al. (2013) suggest that it may take 1-1.5 s to connect cognitive reappraisal to an affective emotion. Therefore, our chosen time window for the LPP of 600-900 ms after stimulus onset might be suited to real-life emotions that are processed faster, but not to aesthetic emotions. Further research could approach this by shifting the time window to a later ERP component. The EEG data (Figure 6) proposes a closer look on the time window around 1500 ms, as it seems that groups differ in this time window in all relevant electrodes. Fourth, further research could also analyze the duration of screen onset to liking rating. The experimental group might take longer to response – because of their elaborated examination – than the control group that might respond more automatically and faster. Fifth, further research could also include positive and neutral artworks. There is some dissent on whether arousal (Dillon & LaBar, 2005), the intensity of the emotion, or valence (Jackson et al., 2000), e.g. positive, neutral, or negative, is decisive to induce conscious emotion regulation. Integrating positive and neutral pictures would therefore be a good possibility to see if either valence or arousal let people reappraise. Last, all interpretations are limited, because we did not include a real-life condition (e.g., with IAPS pictures). Although liking ratings indicate some effect of instruction, it remains unclear, which effect the instruction elicits.

Conclusion

Reappraisal is assumed to have a sequence of positive effects on well-being. However, our results do not support an effect of reappraisal on emotions elicited by artworks, but rather a different aesthetic emotion quality. We could also not find any implicit effect of reappraisal on following negative emotions. However, further research should aim to replicate our findings by using a real-life control group and a more extensive reappraisal training instead of a short written instruction. This could also help in distinguishing between reappraisal and emotional awareness.

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List of Figures

List of Abbrevations

EEG	Electroencephalography
EMG	Facial electromyography
ERP	Event-related potentials
ERQ	Emotion Regulation Questionnaire
fMRI	Functional magnetic resonance imaging
fNIRS	Functional near-infrared spectroscopy
IAPS	International Affective Picture System
ICA	Independent Component Analysis
LPP	Late Positive Potentials
PANAS	Positive and Negative Affect Schedule
SCL	Skin conductance level
S-O-R	Stimulus-Organism-Response paradigm
VIMAP	Vienna Integrated Model of top-down and bottom-up processes in Art Perception

Appendix

Appendix A

Acceptance of the study by the Ethics Committee of the University of Vienna

Beschluss der Ethikkommission
Decision of the Ethics Committee

universität wien
Ethikkommission

Antragsteller/Applicant: **Univ.-Prof. Dipl.-Psych. Dr. Helmut Leder**
Bearbeitungsnummer/Reference Number: **00415**
Projekttitel/Title of Project: **Bildwahrnehmung und Emotionsregulation - gemessen mit EEG und fNIRS**

Die Stellungnahme der Ethikkommission erfolgt aufgrund folgender eingereichter Unterlagen/ The decision of the Ethics Committee is based on the following documents:

25.02.2019

- Ethikantrag_Bildwahrnehmung und Emotionsregulation_finale Version
- TeilnehmerInneninformation_und_Einverständniserklärung_Bildwahrnehmung mit EEG und fNIRS
- Anhang A
- Anhang B
- Anhang C

Die Kommission fasst folgenden Beschluss (mit X markiert)/The Ethics Committee has made the following decision (marked with an X):

☒ Zustimmung: Es besteht kein ethischer Einwand gegen die Durchführung der Studien/ Consent: There is no ethical objection to conduct the study as proposed

☐ Negative Beurteilung: Der Antrag wird von der Ethikkommission abgelehnt /Negative evaluation: The proposal is rejected by the Ethics Committee

Unterschrift/Signature

Datum/Date
21.03.2019

ETHIKKOMMISSION UNIVERSITÄT WIEN

Stellvertretende Vorsitzende der Ethikkommission/Deputy Chair of the Ethics Committee
ao. Univ.-Prof. MMag. Dr. Sylvia Kirchengast

Appendix B

List of all artworks primarily selected for the stimuli set. Artwork 31-39 were excluded because of low negativity ratings.

	Title **Artist, year**	**Mean negativity rating**	**Source, Date of retrieval**
1	*Abu Ghraib 45* Fernando Botero, 2005	M=4.765	https://www.kunst-gemalde.com/Abu-Ghraib-2-Fernando-Botero.html, 12.01.2019
2	*El sacamuelas* Leonardo Alenza y Nieto, 1844	M=4.922	https://www.museodelprado.es/coleccion/obra-de-arte/el-sacamuelas/3cf7b7f6-c0c4-4fc4-9047-bec8e6557a15, 12.01.2019
3	*El Tres de Mayo de 1808* Francisco de Goya y Lucientes, 1814	M=5.98	https://prometheus.uni-koeln.de, 12.01.2019
4	*L'Invidia* (detail) [Allegoria del trionfo di Venere] Angelo Bronzino, 1540-1545	M=5.412	https://prometheus.uni-koeln.de, 12.01.2019
5	*La vraie souris* BOM.K, 2013	M=5.176	https://www.widewalls.ch/friday-the-13th-10-freaky-artworks/, 12.01.2019
6	*David with the head of Goliath* Michelangelo Merisi da Caravaggio, 1610	M=4.902	https://prometheus.uni-koeln.de, 12.01.2019
7	*End of Days* Cleon Peterson, 2014	M=4.725	https://www.thegreekfoundation.com/art/a-violent-world-given-in-classical-greek-art-by-cleon-peterson, 12.01.2019
8	*Painting* Francis Bacon, 1946	M=4.824	https://prometheus.uni-koeln.de, 12.01.2019
9	*The judgment of Cambyses* Gerard David, 1498	M=4.49	https://prometheus.uni-koeln.de, 12.01.2019
10	*Pripyat beast* Keith Thompson, 2007	M=5.059	https://io9.gizmodo.com/the-most-unsettling-undead-concept-art-weve-seen-in-a-w-5882817, 12.01.2019
11	*Signs and symptoms* Ken Currie (Scottish B.), 1995-1996	M=4.569	https://www.lyonandturnbull.com/news/article/?i=196, 12.01.2019
12	*Tragic forms No. 4* Ken Currie, 2014	M=4.784	https://www.flowersgallery.com/artists/ken-currie/works/view/36496-tragic-forms-no4, 12.01.2019
13	*Wounded Man* Otto Dix, 1916	M=5.02	https://prometheus.uni-koeln.de, 12.01.2019
14	*Deterioration of mind over matter*	M=4.922	https://www.reddit.com/r/Heavymind/

	Otto Rapp, 1973		comments/557uex/deterioration_of_mind_over_matter_by_otto_rapp/, 12.01.2019
15	*The Murder* Paul Cézanne, 1867-1869	M=4.627	https://prometheus.uni-koeln.de, 12.01.2019
16	*Saturn* Peter Paul Rubens, 1636-1638	M=6.059	https://prometheus.uni-koeln.de, 12.01.2019
17	*Massacre of the Innocents* Peter Paul Rubens, 1611-1612	M=4.784	https://prometheus.uni-koeln.de, 12.01.2019
18	*The Triumph of Death* Pieter Bruegel, around 1562	M=5.02	https://prometheus.uni-koeln.de, 12.01.2019
19	*Abduction of Ganymedes* Rembrandt, 1635	M=4.961	https://prometheus.uni-koeln.de, 12.01.2019
20	*Ivan the Terrible and his son Ivan on November 16 1581* Ilja Repin, 1885	M=5.235	https://prometheus.uni-koeln.de, 12.01.2019
21	*The face of war* Salvador Dali, 1940	M=4.902	https://prometheus.uni-koeln.de, 12.01.2019
22	*The entombment* (detail from the Isenheim Altarpiece) Matthias Grünewald, 1512-1516	M=4.784	https://prometheus.uni-koeln.de, 12.01.2019
23	*The scourging on the front* James Tissot, 1886-1894	M=5.255	https://www.brooklynmuseum.org/opencollection/objects/13492, 12.01.2019
24	*The assassination of saint Peter martyr* Giovanni Bellini, 1509	M=4.686	https://prometheus.uni-koeln.de, 12.01.2019
25	*Anatomical pieces* Theodore Gericault, 1819	M=4.843	https://www.amazon.com/Anatomical-Pieces-by-Theodore-Gericault/dp/B07C86V3ZF, 12.01.2019
26	*Heads of torture victims* (Study for the raft of Medusa) Theodore Gericault, around 1818	M=5.216	https://curiator.com/art/theodore-gericault/study-of-the-heads-of-torture-victims, 12.01.2019
27	*Nature forging a baby* Unknown artist, 1490s	M=6.0	https://inpress.lib.uiowa.edu/feminae/DetailsPage.aspx?Feminae_ID=31780, 12.01.2019
28	*Autopsy of the soul* Vincent Castiglia 2015	M=4.608	http://vincentcastiglia.com/product/autopsy-of-the-soul/, 12.01.2019
29	*Mouth army* Zdzislaw Beksinski, early 70s	M=4.941	https://nightwandering.wordpress.com/2014/04/29/photographing-dreams-

			the-art-of-zdzislaw-beksinski-the-mythorealist-spirit-in-art-and-literature-part-6/, 12.01.2019
30	*Night creeper* Zdislaw Beksinski, 1973	M=5.098	https://curiator.com/art/zdzislaw-beksinski/night-creeper, 12.01.2019
31	*Dissected bodies* Nychos, 2014	M=3.059	https://www.widewalls.ch/friday-the-13th-10-freaky-artworks/, 12.01.2019
32	*The descent from the cross* Rogier van der Weyden and Robert Campin, before 1443	M=4.078	https://prometheus.uni-koeln.de, 12.01.2019
33	*The great red dragon and the beast from the sea* William Blake, 1803-1805	M=3.882	https://prometheus.uni-koeln.de, 12.01.2019
34	*Black death burning jews at Cologne* Lazer Horse, 2016	M=4.294	https://fathertheo.wordpress.com/2013/05/06/the-black-death-in-european-art/, 12.01.2019
35	*Recalled* Tetsuya Ishida, 1998	M=4.157	https://gagosian.com/news/museum-exhibitions/2019/04/12/tetsuya-ishida-autorretrato-de-otro-museo-reina-sofia-palacio-de-velazquez-madrid/, 12.01.2019
36	*Functional* Tetsuya Ishida, 1999	M=4.078	https://www.christies.com/lotfinder/Paintings/tetsuya-ishida-functional-6046708-details.aspx?lid=4&from=relatedlot&intobjectid=6046708, 12.01.2019
37	*Diomède dévoré par ses chevaux* Gustave Moreau, 1865	M=4.078	https://prometheus.uni-koeln.de, 12.01.2019
38	*Piggy boy* Christian Rex van Minnen, 2012	M=4.431	https://www.christianrexvanminnen.com/2012/#itemId=587ec780e4fcb588883d6977, 12.01.2019
39	*Dante and Virgil in hell* William-Adolphe Bouguereau, 1850	M=4.471	https://prometheus.uni-koeln.de, 12.01.2019

Appendix C

a) Positive and Negative Affect Schedule

Instruction:

"Nun möchten wir gerne von Ihnen wissen, wie sie sich fühlen. Die folgenden Wörter beschreiben unterschiedliche Gefühle und Empfindungen. Lesen Sie jedes Wort und beantworten Sie dann anhand Ihrer Tastatur, inwiefern diese Gefühle und Empfindungen momentan auf Sie zutreffen. 1 bedeutet dabei gar nicht, 2 ein bisschen, 3 einigermaßen. 4 erheblich und 5 äußerst. Zum Fortfahren drücken Sie bitte die Leertaste."

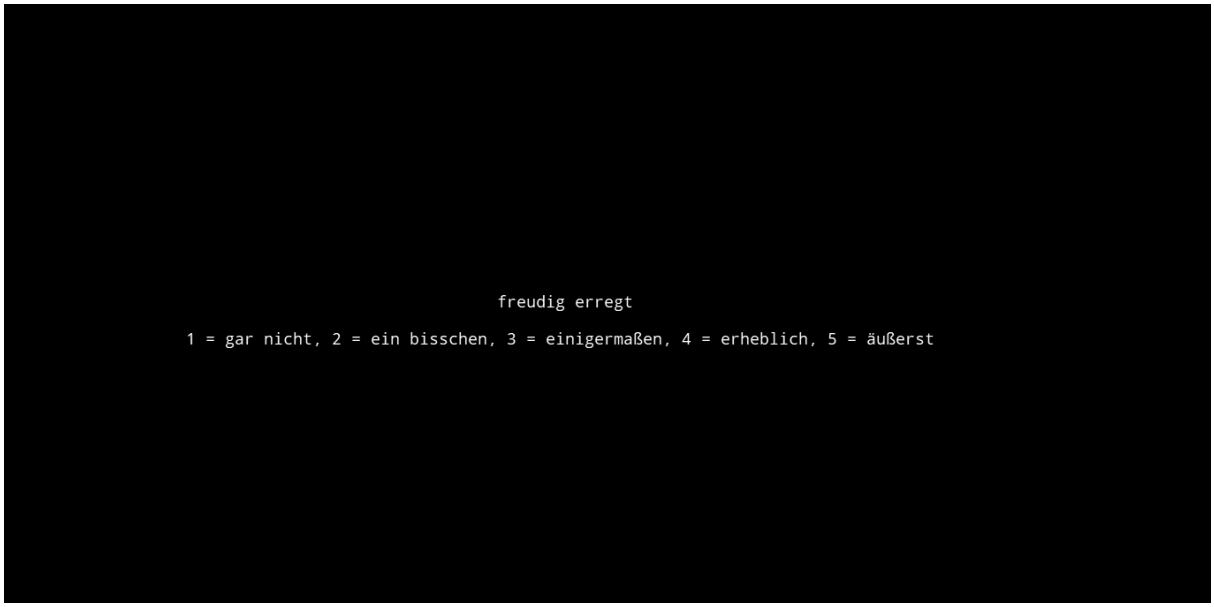
Items:

Tabelle 1: Statistische Kennwerte der Items der PANAS

Instruktion	„im Moment" (*N*=349)			„im allgemeinen" (*N*=480)		
Item	*M*	*SD*	r_{it}	*M*	*SD*	r_{it}
aktiv (active)	2.96	0.95	.56	3.49	0.78	.58
interessiert (interested)	3.19	0.84	.55	3.80	0.75	.53
freudig erregt (excited)	2.17	1.14	.58	2.96	0.92	.50
stark (strong)	2.69	1.05	.58	3.12	0.91	.55
angeregt (inspired)	2.71	1.03	.68	3.15	0.85	.54
stolz (proud)	2.12	0.99	.44	2.80	0.95	.49
begeistert (enthusiastic)	2.13	1.02	.65	3.29	0.92	.63
wach (alert)	3.15	0.95	.46	3.32	0.81	.45
entschlossen (determined)	2.98	0.96	.51	3.38	0.94	.56
aufmerksam (attentive)	3.25	0.76	.56	3.54	0.79	.50
bekümmert (distressed)	1.82	0.97	.58	2.03	0.84	.53
verärgert (upset)	1.38	0.77	.63	1.90	0.82	.65
schuldig (guilty)	1.24	0.58	.45	1.61	0.82	.58
erschrocken (scared)	1.23	0.63	.56	1.50	0.77	.59
feindselig (hostile)	1.27	0.57	.56	1.50	0.72	.45
gereizt (irritable)	1.70	0.89	.62	2.14	0.90	.58
beschämt (ashamed)	1.13	0.44	.47	1.50	0.74	.56
nervös (nervous)	1.72	0.90	.58	2.29	1.02	.58
durcheinander (jittery)	1.78	1.01	.64	1.97	0.94	.52
ängstlich (afraid)	1.42	0.79	.71	1.92	0.91	.61

Anmerkung: r_{it}=korrigierte Trennschärfe (jeweils bezogen auf die Subskala).

Example of the presentation for the different items:



b) Affect regulation instructions

Control group:

"Bitte betrachten Sie die folgenden Bilder und bewerten Sie sie anschließend nach Gefallen.

Zum Fortfahren drücken Sie die Leertaste."

Experimental group:

"Bitte betrachten Sie die folgenden Bilder und beachten Sie dabei besonders schöne Aspekte des Bildes (z.B. Farben, malerische Details, Kunststil, künstlerisches Können). Bewerten Sie sie dann nach Gefallen.

Zum Fortfahren drücken Sie die Leertaste."

Appendix D

Abstract

Reappraisal is assumed to be one of the most effective, short- and long-term, emotion regulation strategy within the process model of emotion regulation (Gross, 2015) and hence, one of the best studied strategy (Webb, Miles, & Sheeran, 2012). However, no study has been conducted to investigate reappraisal effects on artworks and no one investigated long-term effects of reappraisal on subsequent negative stimuli yet. Therefore, the present study investigated whether a reappraisal group shows lower negative affect and higher positive affect after viewing negative artworks compared to a control group and whether these effects can be transferred to a following negative situation induced by a film clip. EEG was recorded to measure mean amplitude peaks of the Late Positive Potential (LPP; 600-900 ms) after artwork stimuli onset. We did not find any significant group differences in the affect ratings and in the LPP, respectively. However, we found group differences in an exploratory analysis of liking ratings of the artworks. The findings suggest that reappraisal does not have an effect on the current affective state, but on the liking of artworks.

Keywords: Reappraisal, aesthetic emotion, emotion regulation

Zusammenfassung

Die Neu- oder Umbewertung (reappraisal) ist sowohl kurz- als auch langfristig eine der effektivsten Emotionsregulationsstrategien aus dem Prozessmodell der Emotionsregulation (Gross, 2015) und ist aus diesem Grund eine der am meisten erforschten Strategien (Webb, Miles, & Sheeran, 2012). Bisher wurde aber jedoch noch keine Studie durchgeführt, die den Effekt von Reappraisal bei Kunstwerken untersucht oder die Langzeiteffekte auf spätere negative Stimuli untersucht. Daher untersuchte die vorliegende Studie, ob eine Reappraisal Gruppe nach Betrachten negativer Kunstwerke weniger negative und mehr positive Emotionen als eine Kontrollgruppe aufweist und ob diese Effekte auf eine spätere negative Situation, die durch die Präsentation eines Filmausschnitts hervorgerufen wird, übertragbar sind. EEG diente der Messung der Amplitude des Late Positive Potentials (LPP; das Zeitfenster zwischen 600 und 900 ms nach Stimulus Präsentation im ereigniskorrelierten Potential). Es konnten weder in den Bewertungen der derzeitigen Emotionen, noch im LPP signifikante Gruppenunterschiede festgestellt werden. Allerdings unterschieden sich die Gruppen hinsichtlich der Gefallensbewertung der Bilder. Die Ergebnisse legen nahe, dass Reappraisal keinen Effekt auf den derzeitigen emotionalen Zustand hat, aber auf das Gefallen von Kunstwerken.

Schlagwörter: Neubewertung, Umbewertung, ästhetische Emotion, Emotionsregulation