Master Degree Project

INDIRECT SUBJECTIVE MEASUREMENTS OF APPLIED REAPPRAISAL AND DISTRACTION

An Online Study

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Abstract

The struggle to regulate one's emotions can sometimes be difficult. Two emotion regulation strategies are to reappraise an emotional stimulus or to distract oneself from the stimulus. While there have been many investigations of both strategies, previous research suffers from methodological problems. Reappraisal conditions might be confounded by non-reappraisal-related cognitive processes, resulting in effects of distraction rather than reappraisal. In the current exploratory within-subjects study, participants completed an online survey where the conditions were held as equal as possible to avoid any differences in non-task-related cognitive processes. I measured variables that have been associated with an electrophysiological response correlated to the intensity level of emotions: the late positive potential. First, participants watched emotionally negativefilm clips in a reappraisal, distraction, and control condition, followed by ratings of experienced feeling. Second, participants rated the threat level of angry and neutral faces. It was hypothesized that applying ER during emotion induction compared to no ER should result in more positive ratings of experienced feeling after induction and lower threat-ratings of angry faces due to a more positive emotional state. The results showed no significant differences between conditions, most likely due to either methodological limitations or an actual lack of emotion regulation effects. I discuss future directions and improvements of the method.

Keywords: emotion regulation, reappraisal, distraction, emotion induction, cognitive load

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1. Introduction

Let one think about the inner battles in oneself that stand between acting on a negative emotion or behaving in a more constructive and socially acceptable way. There are also inner battles with more internal goals, such as trying to making oneself less anxious or to process someone's death without going into depression. These are examples of trying to control and adjust one's emotions: or, in other words, to regulate one's emotions. One common perspective for research on emotion regulation (ER) is the process model of emotion regulation (Gross, 1998b). It consists of five so called ER strategies: to a) select a situation, b) change a situation, c) direct attention elsewhere, d) change how one thinks about a situation, and e) change one's behavior (Gross, 1998b).

To give meaning to a situation is referred to as appraising the situation (Lazarus, 1991). If one changes the initial meaning one gives to a situation, one reappraises it. As an example, one can think of the stress experienced before an important examination as necessary to feel motivated instead of something negative. The effects of reappraisal and distraction have been investigated among other ways by looking at changes in an electrophysiological response called the late positive potential (LPP) (e.g., Paul,Simon, Kniesche, Kathmann, & Endrass, 2013; Schönfelder, Kanske, Heissler, & Wessa, 2014). LPP correlates with the intensity of experienced emotions, regardless of whether the emotion is positive or negative. Something that has not earned that much attention is research on responses to and regulation of angry faces (Blechert, Sheppes, Di Tella, Williams, & Gross, 2012; Olowe, 2018; Svennersjö, 2018).

A possible confound might be additional cognitive tasks during reappraisal conditions, such as recalling reappraisal instructions, creating an effect of distraction rather than an effect of reappraisal. A factor that does not seem to have been investigated well is the length of stimulus presentations during reappraisal. The question is if longer stimuli presentations than normally applied in research are required to show full effects of reappraisal.

One partial solution to the cognitive load problem would be to hold conditions as similar as possible. Differences between conditions should then be due to the actual effects of the strategies. It does not seem like the cognitive load problem has been discussed or controlled for in earlier research (Hajcak & Nieuwenhuis, 2006; Paul et al., 2013; Schönfelder et al., 2014). An alternative, and more indirect, method is to separate the implementation of ER and the moment of measurement. First participants regulate their reactions to emotional stimuli, then the researcher measures the effects of participants looking at the same emotional stimulus without any regulation attempts (e.g., Hermann, Kress, & Stark, 2017; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011).

I will in this study look at the indirect effects of reappraisal and distraction through an online experiment where I measure subjective variables associated with LPP responses (Duval, Moser, Huppert, & Simons, 2013; Gantiva, Sotaquirá, Araujo, & Cuervo, 2020). To make my experiment understandable, I need to describe a range of sub-fields. First, I put reappraisal and distraction in context to ER in general. I will then look at the neural effects of negative emotional stimuli and application of the two ER strategies. Because the emotional stimuli used in the experiment are neutral and angry faces, I will look at which brain regions are activated when looking at faces in general. The discussion of the cognitive load problem and some possible solutions for it will lead to a closer look at long-term studies on both inducing emotional states and regulation of emotional stimuli. I conclude the background section by showing common emotion induction procedures and explain how my chosen subjective measurements are connected tomeasurements of brain activity.

2. Background

2.1 Emotion Regulation

This section looks closer at ER and the process model of regulation. The focus will then be on the two ER strategies reappraisal and distraction and how they differ from each other. Two important figures for the development of the field are Sigmund Freud, who wrote about types of anxiety regulation (for an overview, see Gross, 1998b), and Richard Lazarus, one of the main figures in the stress and coping field. Lazarus was involved in one of the first research teams that found measurable evidence for the efficiency of ER. In one of the studies, participants had to change the meaning of a situation (Speisman, Lazarus, Mordkoff, & Davison, 1964): in other words, to reappraise the situation.

Thompson (1994, p. 27) defines emotion regulation (ER) as “extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals”. Gross (1998b) raises a problem in earlier categorizations of ER strategies. According to him, while categorizing strategies into subjective, physiological, or expressive responses is constructive, it makes it difficult to see differences in underlying processes. An example of changing expressive reactions is to start thinking differentially or relax one's face. Based on these considerations he developed the *process model of emotion regulation*, shown in Figure 1.

The process model contains two groups of ER strategies (Gross, 1998b). The first group of strategies is applied before an actual emotional response and contains situation selection, situation modification, attentional deployment, and cognitive change, while the second group contains different forms of response modulation (Gross, 1998b). Situation selection is to avoid

situations that invoke negative emotions while already being in a situation, one can modify it by for example go to the noisy party next door and ask them to be less noisy. When it is not possible to modify a situation one can instead direct attention away from the situation or change one's thought processes where reappraisal is only one example. To modulate one's responses, one can for example choose to ask for an excuse instead of attacking someone in anger.

Figure 1. The Process Model of Regulation

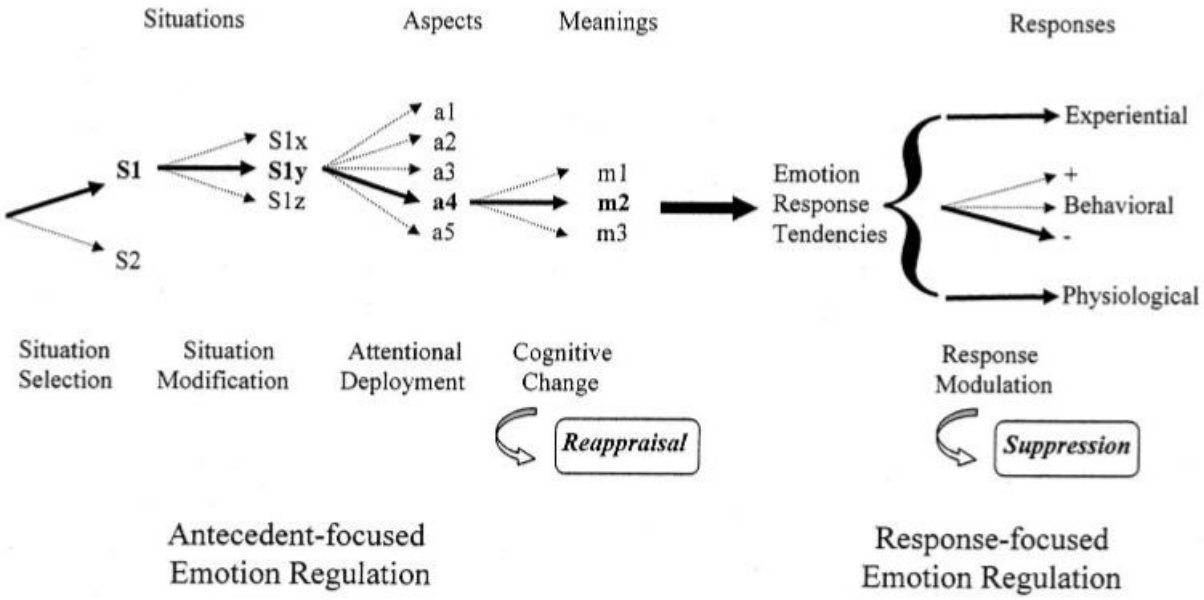

Figure 1. The process model of emotion regulation developed by James Gross. Reprinted from "Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being" by J. J. Gross and O. P. John, 2003, *Journal of Personality and Social Psychology, 85*(2), p. 349. Copyright 2003 by the American Psychological Association, Inc. Reprinted with permission.

Lieberman, Inagaki, Tabibnia, and Crockett (2011) investigated experiential effects of reappraisal and distraction. Their participants watched extremely negative, negative, or neutral images from the International Affective Picture System (IAPS) and reported any experienced distress. The pictures included in IAPS are categorized based on ratings of pleasure, arousal, and dominance (Lang & Bradley, 2007) and have been used widely in the research field of ER. The instructions given before picture presentation for the reappraisal condition were to "decrease emotion" (Lieberman et al., 2011), one example being to imagine a sick man at a hospital being on his way to recovery. The instructions in the distraction condition were to think about something other than the picture. It was shown that reappraisal was the most effective strategy for decreasing distress (Lieberman et al., 2011).

Reappraisal and distraction can be further divided into more specific strategies. In a meta-analysis, Webb, Miles, and Sheeran (2012) compared the efficiency of strategies by looking at experiential, behavioral, and physiological effects. They found that active positive distraction, which is to think about something positive and unrelated, gave the highest effect size (d =0.47) overall followed by perspective taking reappraisal, which is to see the stimuli from a more objective point of view (d = 0.45). (Webb et al., 2012). Sheppes and Gross (2011) suggested that distraction is efficient during both low and high emotion intensity while reappraisal only gives effect during high emotion intensity if stronger reappraisal strategies are used (Sheppes & Gross, 2011).

2.2 The Neural Effects of Reappraisal and Distraction

All the following observations come from functional magnetic resonance imaging (fMRI) studies. Ochsner and Gross (2005) link the dorsal prefrontal cortex (PFC) with thinking about how one can change the associations between what one experiences and one's emotional reactions. The posterior and dorsolateral PFC (dlPFC) have been associated with attention and working memory (Ochsner, Silvers, & Buhle, 2012). According to Kohn et al. (2014), the dlPFC seems to have an indirect role in ER.

A well-reported region that increases in activity during reappraisal is the dorsomedial PFC (dmPFC) (Buhle et al., 2014; Silvers, Weber, Wager, & Ochsner, 2015) which, together with the ventrolateral PFC (vlPFC), has been associated with attaching descriptive words to emotional stimuli (Hariri, Mattay, Tessitore, Fera, & Weinberger, 2003; Taylor, Phan, Decker, & Liberzon, 2003). Kohn et al. (2014) write that the vlPFC informs other brain regions when one experiences something salient and regulation is needed. A third region is the dorsal anterior cingulate cortex (dACC), which Ochsner et al. (2012) link with conflict monitoring.

Neural responses to reappraisal can be approached from a temporal perspective. Kalisch (2009) found through a meta-analysis that the duration of applied reappraisal is correlated with increased activation moving from the left areas of the lateral frontal cortex to the right areas (Kalisch, 2009). In conjunction with the process model of regulation, there seems to be a difference in activity between reappraising low-intensity and high-intensity emotions (Silvers et al., 2015). While reappraising both low- and high-intensity emotions results in increased activity in the dmPFC, dlPFC, and vlPFC, there is increased activity in the lateral PFC and a larger increase in the left dlPFC for high-intensity emotions (Silvers et al., 2015).

Perhaps the first research team comparing the neural correlates of reappraisal and distraction was McRae et al. (2010). While reappraisal increased in activity more than distraction in the dmPFC and vlPFC, distraction led to stronger activations in (among other areas) the right lateral PFC and superior parietal cortex. Contradicting McRae et al. (2010),

Kanske, Heissler, Schönfelder, Bongers, and Wessa (2011) found that the dorsomedial PFC increased more in activity during a distractive math task compared to the reappraisal condition. Two other regions with increased activity during distraction in Kanske et al. (2011) were the dorsal ACC and inferior parietal cortex. The dorsal ACC has been associated with conflict monitoring (Ochsner et al., 2012), fitting well with participants experienced conflict between their emotional processing and their processing of the math task. The inferior parietal cortex has been associated with the process of redirecting our attention (Dörfel et al., 2014). Finally, only reappraisal led to increased activity in the orbitofrontal cortex, which activity has been associated with response inhibition (Golkar et al., 2012).

2.3 Electrophysiological Correlates of Emotion Regulation and Emotional Faces

One form of recording brain activity is electroencephalography (EEG). EEG measures the electrical activity in neurons through electrodes placed on participants' scalps. To make reliable observations, a single presented stimulus is shown up to hundreds of times, creating an average electrical response referred to as event-related potential (ERP). This section looks in particular at an ERP called the late positive potential (LPP), how it correlates with viewing emotional faces and with applying ER, and what brain region and which ERP are associated with viewing faces.

2.3.1 The late positive potential. The LPP has been indicated to index the level of emotional intensity during the processing of negative and positive stimuli (Hajcak, MacNamara, & Olvet, 2010). In a study by Weinberg and Hajcak (2010), viewing erotic or mutilation pictures resulted in larger LPP amplitudes compared to viewing exciting or disgusting pictures. The neural basis of the LPP is the parietal cortex for early LPP and the central frontal cortex for late LPP (Bondy et al., 2018). Sabatinelli, Keil, Frank, and Lang (2013) looked closer at these neural bases. Their participants viewed IAPS pictures while brain activity was recorded by either magnetic resonance imaging (MRI) or EEG. The results show positive correlations between LPP and hemodynamic activity in the extrastriate occipital, posterior parietal, and insular cortex, along with the amygdala and ACC. According to Sabatinelli et al. (2013), these results build on the picture of LPP as representing the perceptual processing of emotional and motivational stimuli.

2.3.2 LPP and emotion regulation. Just as with behavioral and experiential studies on ER, studies on ER and LPP often use images from the IAPS. Reappraising negative images has resulted in reduced LPP in comparison with looking at the images without reappraising them (Hajcak & Nieuwenhuis, 2006; Moser, Krompinger, Dietz, & Simons, 2009; Qi et al., 2017). Suppression of negative emotional reactions to images has led to both smaller amplitude increases (Moser, Hajcak, Bukay, &Simons, 2006; Paul et al., 2013) and equal

amplitude increases (Gan, Yang, Chen, & Yang, 2015;Zhang, Lau, & Hsiao, 2019) compared to no suppression. Distraction either equals reappraisal (Paul et al., 2013) or results in smaller amplitudes (Schönfelder et al., 2014).

2.3.3 The neural correlates of face processing. Observations from fMRI studies show that facial processing is related to increased activity in a specific area of the extrastriate cortex, referred to as the fusiform face area (Kanwisher, McDermott, & Chun, 1997). With ERP research, the focus lies on the N170 component, which is a brief reduction in electrical activity in electrodes placed over the lateral occipital cortex when being presented to a face (Luck, 2014). This area is exactly where the fusiform area is located **(**Gao, Conte, Richards, Xie, & Hanayik, 2019). Gao et al. (2019) suggested that the fusiform area is the main source of N170.

2.3.4 LPP, emotional faces, and emotion regulation. Schupp et al. (2004) had participants view neutral, friendly, and threatening faces. Their results showed that the LPP responses for threatening faces recorded in centro-parietal electrodes were larger than the responses to neutral and friendly faces. Similar findings have been made by Duval et al. (2013) regarding angry faces. It is difficult to find studies where also ER is involved. All four of the following studies compared viewing angry faces with or without application of reappraisal. Blechert et al. (2012) found a significant effect of reappraisal while Wessing, Rehbein, Postert, Fürniss, and Junghöfer (2013) found only effects of increasing the emotional response to angry and threatening faces.

Svennersjö (2018) and Olowe (2018) analysed different datasets from a single experiment conducted at the University of Skövde. An important aspect to note was that there were technical problems with the electrodesduring recording, with noise from some of them causing unreadable data in their channels. While Svennersjö (2018) found no significant differences between conditions, the average ERP waveforms indicated that all forms of reappraisal used were effective in reducing emotional affect. In contrast, maybe due to a larger dataset, Olowe (2018) found significant differences between two types of reappraisal: social distancing and temporal distancing, and the control condition where no reappraisal was used. Distraction resulted in smaller LPP compared to the control condition but showed no difference from the other strategies (Olowe, 2018). The next section looks further at differences between reappraisal and distraction while considering a possible problem with the standard research methods.

2.4 Reappraisal or Cognitive Load?

Imagine that you were told to look at a negatively valenced picture while trying to reappraise the content. It is not unlikely that you would need to remind yourself of the reappraisal instructions during the picture viewing, creating an additional load coming from working

memory. Therefore, it can be discussed if physiological and experiential effects during reappraisal experiments really are true effects of reappraising the stimuli. The decrease of negative emotions could come from being distracted by memory recall or by a variety of other cognitive tasks. I will refer to this as the "*Cognitive Load Hypothesis"*. I will look at arguments for and against this hypothesis through mostly LPP-based studies and how one can reduce this problem.

Moser et al. (2009) found that use of reappraisal while watching negative pictures significantly reduced the amplitude of LPP between 400ms and 700ms post stimuli and then again from one second throughout trials compared to no use of reappraisal. Svennersjö (2018) argues that 400ms is too early to show the effect of a conscious strategy such as reappraisal and instead might be an effect of cognitive load. That Moser et al. (2009) found no LPP amplitude difference between watching neutral pictures and reappraising negative pictures from one second (Moser et al., 2009) raises a question. If reductions in early LPP are caused by cognitive load, are reductions in late LPP an effect of (a), ongoing distraction by cognitive load, (b), an aftereffect of the initial distraction, or (c), an actual effect of applying reappraisal? This question is difficult to answer.

Svennersjö (2018) referred to a second study regarding cognitive load. MacNamara, Ferri, and Hajcak (2011) had participants view a string of either two or six letters that they were told to memorize. After the presentation, the screen turned blank for a brief moment followed by a two-second-long presentation of a negatively valenced picture. The six-letter condition resulted in larger reductions of LPP amplitude than the two-letter condition (MacNamara, Ferri, et al., 2011). While the study does support an effect from explicit distraction, it cannot give a clear answer regarding cognitive load in studies where explicit reappraisal instructions are given.

Are there any other studies that support or oppose the Cognitive Load Hypothesis? Foti and Hajcak (2008) presented neutral or negative descriptions of upcoming pictures to participants before the viewing condition. Neutral descriptions of negative pictures resulted in smaller LPP amplitudes than for negative descriptions of negative pictures in the time windows of 400 to 1000ms and 2000 to 3000ms (Foti & Hajcak, 2008). Cognitive load was reduced by excluding the application of ER strategies during picture viewing, but the difference in LPP amplitudes between conditions was still related to the valence of descriptions. Does this suggest that the confound hypothesis is falsified?

Foti and Hajcak (2008) discussed the possibility that the observed reductions in LPP amplitude depended on the controlled generation of rather than controlled regulation of emotion responses (Foti & Hajcak, 2008). The question is if this can be regarded as reappraisal

or not. The study was discussed by Hajcak et al. (2010) who highlighted that the meaning of the stimuli was changed, in accordance with the definition of reappraisal (Gross, 1998b).

More evidence against the Cognitive Load Hypothesis can be found in an fMRI study by Hermann et al. (2017). While both the reappraisal and distraction conditions resulted in significantly fewer negative feelings compared to the control condition, the reappraisal condition resulted in the fewest negative feelings. During ER-free re-exposure to the same stimuli one day later, the reappraisal condition still resulted in fewer negative feelings and larger increases in right dorsolateral PFC and left ventrolateral PFC compared to the distraction condition (Hermann et al., 2017). Remember that the dlPFC has been associated with attention and working memory (Ochsner et al., 2012) and the vlPFC with regulatory cognitive processes (Lutz et al., 2014; Wager et al., 2008). If both conditions would really result in distraction, the former due to explicit distraction and the latter due to cognitive load, would there not be similar effects?

Thiruchselvam et al. (2011) conducted an EEG study with similar methods as Hermann et al. (2017). Participants were measured on individual differences unrelated to the study after the initial ER trials and then viewed the same pictures again but without applying ER. During re-exposure, participants who had distracted themselves from the pictures had significantly larger LPP amplitudes compared to participants who had watched the pictures without any ER in the control condition. The reappraisal condition resulted in significantly smaller LPP amplitudes in the 800-to-1400ms time window compared to the control condition. Overall, LPP amplitudes were larger for the distractors compared to the reappraisers (Thiruchselvam et al., 2011). In contrast to Hermann et al. (2017), Thiruchselvam et al. (2011) observed no significant differences in experienced feelings between reappraisal and distraction conditions.

The study by Thiruchselvam et al. (2011) raises another argument against the Cognitive Load Hypothesis. Remember that the observed early effects in LPP from Moser et al. (2009) were used as an argument for the hypothesis that reappraisal likely does not have an early effect. In contrast, Thiruchselvam et al. (2011) found no such early LPP changes. Instead, they observed a difference between watching negative pictures versus reappraising negative pictures from 700 to 1700ms. This is a more likely time window when the effects of reappraisal would be shown.

Are there any ways to get around the problems with cognitive load to find valid effects of reappraisal? One method is to keep the instructions between conditions as similar as possible which should reduce any differences in the amount of cognitive load. If there still are differences in LPP amplitude between conditions, they should more likely be caused by the ER strategy. Paul et al. (2013) compared reappraisal with distraction using only single words as pre-stimuli cues for each condition. What arguably makes this study inadequate is that the

instructions given before the study were not stated to have been given in a way as similar as possible. Moreover, being presented with only a cue word makes it more possible that the participants were required to search in their memory for the exact instructions: in other words, to be distracted.

An even more inadequate study in this way was Schönfelder et al. (2014) which had participants either being instructed to solve a mathematical equation displayed over top of the presented picture or to decrease their emotional response to unobscured pictures by reappraisal. This makes it difficult to answer which condition was more confounded by cognitive load. It might be that it requires more thinking to solve the equation than reappraising the pictures. On the other hand, it seems likely that the reappraisal condition was more loaded by memory recall of the instructions than the distraction condition because the equation itself was a reminder. To conclude, there is a need for studies where the level of cognitive load is kept as similar as possible between conditions. The next section looks at more indirect ways to measure the neural effects of emotion inductions without ER and together with ER.

2.5 Indirect Neural Measurements of Emotion Induction and Emotion Regulation

Some researchers have applied emotion induction before measuring LPP during presentations of emotional stimuli. Rumination about oneself before viewing negatively valenced images has been shown to lead to higher LPP amplitudes than being told before viewing to think about non-trivial things (Lewis, Taubitz, Duke, Steuer, & Larson, 2015). Are there any LPP studies like Lewis et al. (2015) but with ER strategies applied? Besides Hermann et al. (2017) and Thiruchselvam et al. (2011) described earlier, MacNamara, Ochsner, and Hajcak (2011) found electrophysiological long-term effects of a more passive form of reappraisal. Instead of applying reappraisal themselves, participants listened to recorded neutral or negative descriptions of upcoming neutral or negative pictures. The difference between this study and Hermann et al. (2017) and Thiruchselvam et al. (2011) was that MacNamara, Ochsner, and Hajcak (2011) used upregulating reappraisal where one increases an emotion, and recorded EEG only during the re-exposure of stimuli (MacNamara, Ochsner, et al., 2011).

2.6 Emotion-Induction Procedures

There are many types of emotion induction used to invoke negative emotions. Other than still pictures, there are among others music (Västfjäll, 2001), film clips (Gross & Levenson, 1995), and recalling of personal memories (Salas, Radovic, & Turnbull, 2012). In a meta-analysis of ER strategies and their efficiency, Webb et al. (2012) discussed factors behind the success of a strategy, with emotion induction being one. They reason around two possibilities. Participants

might find it too difficult to regulate their reactions to strong negative stimuli, leading to less success; or the inclusion of an external stimulus might result in greater regulation attempts, leading to greater success. Webb et al. (2012) found greater regulation success for pictures followed by films.

Lench, Flores, and Bench (2011) conducted a meta-analysis on types of emotion induction looking at judgmental, experiential, behavioral, and physiological effects. The three induction types with the largest overall effect, measured with Hedges' *g,* were pictures (0.81 *g*), films (0.60 *g*), and music (0.53 *g*). However, the number of articles analysed for each type was 25, 162, and 49, respectively, which makes a comparison difficult. Lench et al. (2011) found that sadness was more effectively induced with films than with pictures or music while pictures were more effective in inducing anxiety than film or music.

2.7 The Experiment

This online experiment measures variables associated with LPP. Because angry faces most often are perceived as threatening (e.g., Jones, 2019) and LPP shows larger responses to angry (Duval et al., 2013) and threatening (Schupp etal., 2004) faces, higher threat ratings for angry faces should be correlated with larger LPP amplitudes. Ratings of current experienced feelings have been associated with LPP amplitudes (e.g., Gantiva et al., 2020). I will measure current experienced feelings after the first set of emotional stimuli followed by threatening ratings of angry faces.

Regarding the unanswered question whether reappraisal requires longer stimulus presentations to produce an effect, I chose film clips as emotion induction. Based on the effect sizes in Webb et al. (2012), the choice of specific strategies will be active positive distraction where one thinks about something positive and unrelated; and reappraisal perspective-taking where one sees the stimuli from a more objective point of view. In the control condition, the participants will experience the resulted emotions without any attempts to regulate the stimulus.

2.8 Aim and Hypothesis

The primary aim of this thesis is to measure the effects of reappraisal and distraction while decreasing the problem of possible cognitive load during reappraisal. In addition, a more exploratory aim is to see if there are any differences between the effects of reappraisal and distraction. To decrease distracting cognitive load during measurements, I separate the moment of ER application from the moment of measurements, making this an indirect way to measure effects of ER. Since there still could be problems with cognitive load during the regulation of the first set of stimuli, I keep the conditions as similar as possible regarding instructions. Ideally, differences

between conditions should then be explainable by differences in the actual effects of the strategies and not of cognitive load. To aid with this, I keep the instructions visible during presentation of the first set of stimuli. The hypothesis is that applying ER during emotion induction compared to no ER should result in more positive ratings of experienced feeling after induction and lower threat-ratings of angry faces due to a more positive emotional state.

3. Method

3.1 Participants

The online survey was programmed using PsyToolkit (Stoet, 2010, 2017) and displayed in the PsyToolkit web forum and the Facebook group "Students at the University of Skövde". A link to it was mailed to all undergraduate students in the cognitive neuroscience program. I displayed the survey on my own Facebook page and messaged my current online Facebook friends. Participants were informed that the survey contained strongly emotional film clips and that they could cancel the survey at any point if the film clips were too overwhelming. The starting page indicated the length of the survey and assured respondents that all data would be anonymous. It gave a summary of the aim of the study, instructions for each task, and my university email address for contact purposes. The only constraint to participation was to be at least 18 years old.

3.2 Materials

The stimuli were negatively valenced film clips and still pictures of angry and neutral faces. I first selected eight film clips from feature movies on YouTube to test in a small pilot study. Eight participants ranked the film clips from lowest to highest in negative affect. They were told to report if any film clips were too overwhelming or that they could not finish watching. Four of the participants were colleagues in the master's program at the University of Skövde and received the film clips by email; the remaining four were students approached on the university campus. The latter saw the film clips with me in a closed room.

To avoid emotional distress and too many dropouts, I excluded the film clip with the highest mean score, which also had reports of being overwhelming or unwatchable. The final choices of film clips were from *Sophie's Choice* (Barish & Pakula, 1982), *Crash* (Cheadle et al., 2004), and *Blood Diamond* (Gorfil, Herskovitz, King, Weinstein, & Zwick, 2006). To make all clips more similar in length, I exchanged the film clip from Blood Diamond (Gorfil et al., 2006) with a longer but similar clip from the same movie; see links and descriptions of the clips in Appendix A.

The included pictures of faces were taken from the Umeå University Database of Facial Expressions (Samuelsson, Jarnvik, Henningsson, Andersson, & Carlbring, 2012). Samuelsson et al. (2012) validated their database by showing faces with simulated emotional expressions for participants, who reported how much they agreed on how well each intended emotion was expressed. This process created a mean score for each face. I used 30 unique faces, with each person showing both a neutral and angry expression, making a total of 60 pictures. These were evenly divided into three groups with one group for each film clip.

Each face group contained ten neutral and ten angry faces of differing ethnicity with a balance of gender in both types of facial expressions. The three groups had similar grand-mean values and standard deviations in scores from Samuelsson et al. (2012) and age distribution. The age range was between 17 and 67, with a majority under 35 years old. No person was shown twice during the same block.

Ratings of participants' current experienced feelings were obtained with the Self-Assessment Manikin (SAM) (Lang & Bradley, 2007). SAM is a visual scale containing five digitally drawn faces, going from a negative to a neutral and then a positive expression from left to right. Rating is based on a Likert scale from 1 to 9, with 9 being the most positive. For the threat rating of faces, participants chose from a Likert scale of1 (least threatening) to 5 (most threatening).

3.3 Design

I used a within-subjects partial counterbalanced block design with affective experience ratings of emotional film clips and ratings of threat in response to angry andneutral faces as dependent variables.

3.4 Procedure

The survey was programmed into nine versions with one of the versions randomly assigned to each participant. There were three orders of conditions with each experimental condition placed first, second, or third in three of the versions, respectively. Among all nine versions, each film clip belonged to the same condition three times. To clarify with an example, the film clip from Blood Diamond (Gorfil et al., 2006) belonged to the distraction condition in three of the survey versions, but the order placement of the film clip was different for each version (see the detailed description in Appendix B). The strategy instructions were presented above the embedded YouTube videos, which had to be started manually, constructed to be as similar as possible in wording. All instructions began "you are about the see a short film clip, which may give rise to some strong emotions" followed by one of the three strategies. All finished with "click the play button to start the film clip".

The instructions for active positive distraction was “please try to distract yourself from any negative emotional impact by actively thinking of something unrelated and positive”, for reappraisal perspective-taking “please try to counteract any negative emotional impact by keeping in mind that you are only viewing movie actors”, and for the control condition “please do not try to counteract any negative emotional impact; just be aware of and experience your emotions naturally”. These formulations were inspired by the definitions of each strategy given in Webb et al. (2012).

After each video, participants rated their current experienced feeling according to the SAM scale. The final component of each block was to look at the neutral and angry faces, presented in randomized order, and rate their level of induced threat. After the three blocks, participants reported their gender and their age group to divide them into one of eight categories.

4. Results

4.1 Descriptive Statistics

Because the total time for the film clips was 10 minutes, the inclusion criteria for analysis was to have completed the survey in no less than 11 minutes. This resulted in data from 33 participants (19 males), out of 62. The number of participants for each age group was 18-30: n=14; 31-40: n=11;41-50: n=4; 51-60: n=3; and 61-70: n=1. As the survey versions were randomly assigned to participants, the resulting distribution of the nine survey versions was uneven (V1: n=1; V2: n=2; V3: n=6; V4: n=6; V5: n=7; V6: n=1; V7: n=7; V8: n=2; V9: n=1). For threat scores of angry faces, the mean values were 3.02(SD = 0.55) for reappraisal, 2.85 (SD = 0.50) for distraction, and 2.96 (SD = 0.66) for control. The mean values for SAM scores were 3.88 (SD = 2.37) for reappraisal, 3.70 (SD = 2.02) for distraction, and 3.18 (SD = 1.91) for control.

4.2 Main Analysis

To control that the threat scores for angry and neutral faces differed, I aggregated the individual mean scores in all three conditions into two grand means: one for each face valence. A paired sample t-test revealed that the grand mean for angry faces (M = 2.97, SD = 0.96) were significantly larger than the grand mean for neutral faces (M = 1.53, SD = 0.45), $t(32)$ = 8.74, $p < .001$. The first part of the hypothesis was that regulating one's emotions during the emotion induction should result in a more positive experienced feeling after the induction compared to no ER. Several participants reported positive feelings after some film clips regardless of conditions, violating the assumption of a normal distribution. I conducted a non-

parametric Friedman's 2-way ANOVA but the differences in mean scores werenon-significant, $x^2 2 = 1.63$, $p = .366$. The second part of the hypothesis was that regulating one's emotions during the emotion induction should result in lower threat ratings of angry faces due to a more positive emotional state compared to no ER. A repeated-measures ANOVA showed no significant differences in mean threat scores between conditions, $F(2, 64) = 1.904$, $p = .157$.

4.3 *Post-Hoc* Analyses

The first *post-hoc* analysis investigated differences in threat scores between angry male and female faces. A two-way repeated-measures ANOVA with face gender as the first within-subjects factor and conditions as the second within-subjects factor revealed a significant difference between male (M = 3.02, SD = 0.17) and female faces (M = 2.75, SD = 0.17),$F(1, 32) = 47.74$, $p < .001$ (see Figure 2). To control that each face group received similar mean threat scores, I conducted a repeated-measures ANOVA with conditions as the within-subjects factor and face groups as the between-subjects factor. The results show an unexpected significant interaction effect between conditions and face groups, $F(4,54) = 61.5$, $p < .001$ (see Figure 3).

Figure 2. Gender Differences in Mean Threat Scores of Angry Male and Female Faces.

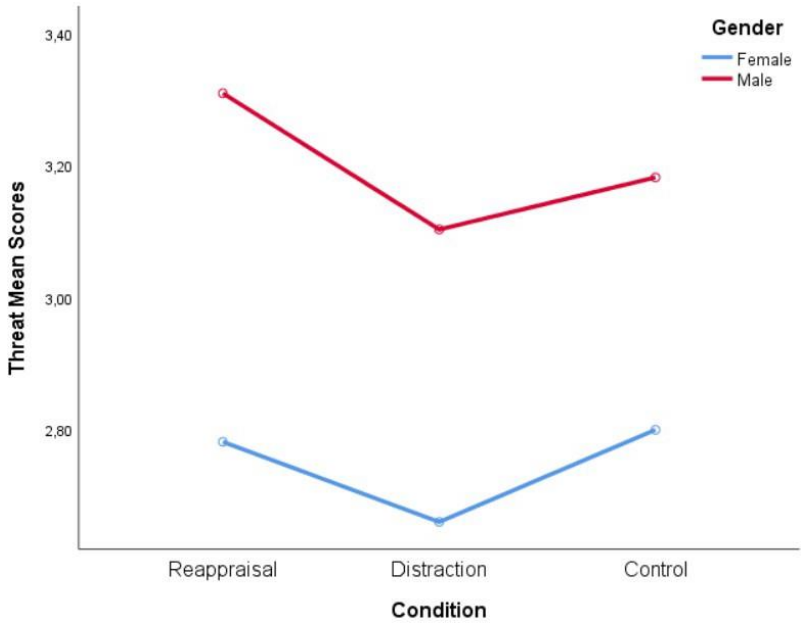

Figure 2. Mean threat scores of angry male and angry female faces in all three conditions. The effect of gender was significant, $F(1, 32) = 47.74$, $p < .001$.

Figure 3. Mean Threat Scores for Angry Faces in Each Group of Faces.

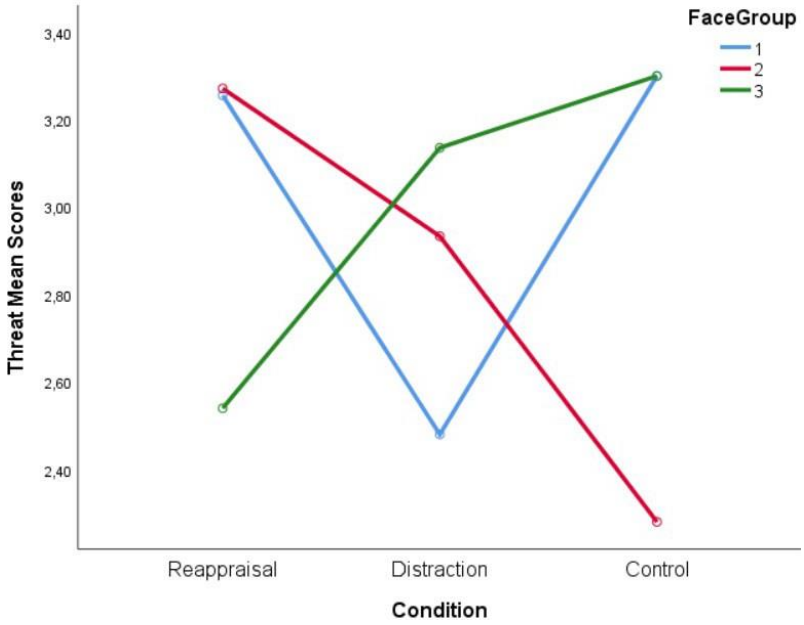

Figure 3. Mean threat scores of the three groups of angry faces in all three conditions. The interaction effect between conditions and face groups was significant, $F(4, 54) = 61.5$, $p < .001$.

Upon closer inspection of the raw data, many participants gave similar threat scores to angry and neutral faces. Moreover, some SAM scores were highly positive regardless of condition. Were these results caused by participants not being affected by the film clips or angry faces or taking the survey less seriously than if they would have completed it in the university lab? Based on this uncertainty, I performed a post-hoc analysis with new exclusion criteria to investigate whether the original dataset is the reason for the non-significant results. An additional goal was to see if the unexpected significant interaction effect between conditions and face groups would be removed. All participants with a score difference between angry and neutral faces less than one or SAM scores higher than 6 in the control condition were excluded.

There were 21 remaining participants after the exclusion process. For threat scores, a repeated-measures ANOVA revealed no significant difference between conditions, $F(2, 40) = 1.03$, $p = .367$. This was also the case for SAM scores, shown by a Friedman's 2-way ANOVA, $x^2 2 = 1.164$, $p = .559$. repeated-measures ANOVAs revealed a significant difference between male (M = 3.75, SD = 0.14) and female faces in threat scores (M = 3.25 , SD = 0.17), $F(1, 20) = 30.53$, $p < .001$ (see Figure 4), and a significant interaction effect between conditions and face groups, $F(4, 54) = 16.39$, $p < .001$ (see Figure 5).

Figure 4. Gender Differences in Mean Threat Scores of Angry Male and Female Faces.

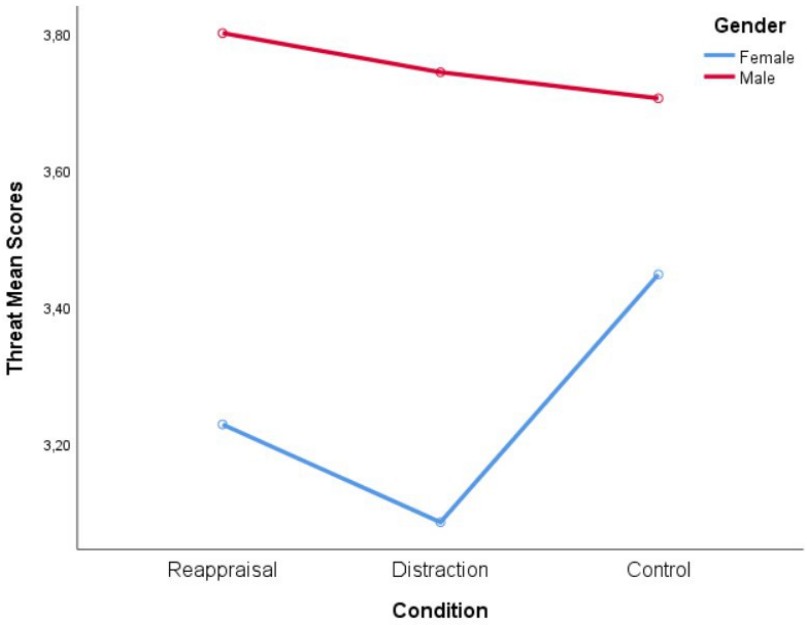

Figure 4. Mean threat scores of angry male and angry female faces in all three conditions after new exclusion criteria had been applied. The effect of gender was significant, $F(1, 20) = 30.53$, $p < .001$.

Figure 5. Mean Threat Scores for Angry Faces in Each Group of Faces.

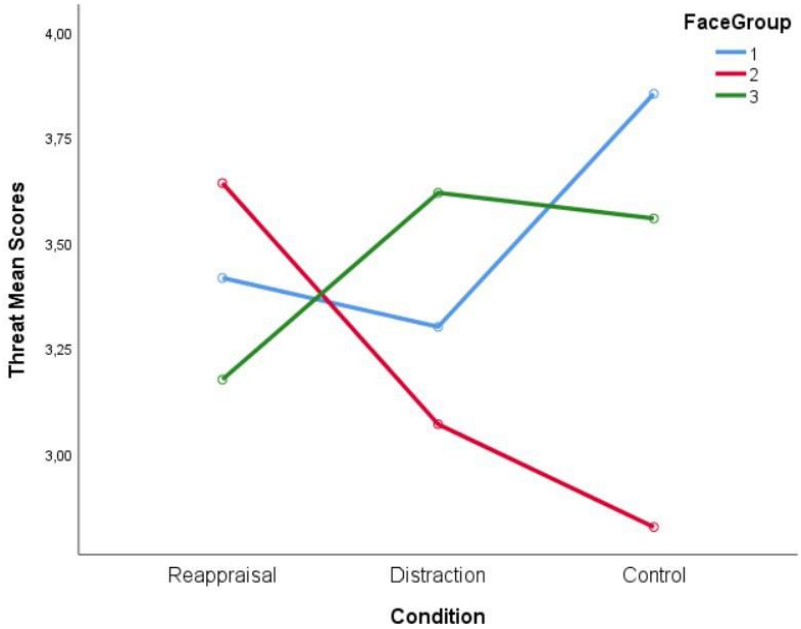

Figure 5. Mean threat scores of the three groups of angry faces in all three conditions after new exclusion criteria of participants had been applied. The interaction effect of conditions and face groups was significant, $F(4, 54) = 16.39$, $p < .001$.

5. Discussion

The primary aim of this thesis was to measure the effects of reappraisal and distraction while decreasing the problem of possible cognitive load during reappraisal. The secondary aim was to see if there were any differences between the effects of reappraisal and distraction. I hypothesized that performing ER during emotion induction should result in more positive feelings and in lower threat ratings of angry faces compared to no ER. The results do not confirm the hypothesis and there were no significant differences between reappraisal and distraction. There are three possibilities behind my results that I will touch upon. The first is that the experiment was set up in such a way that there *are* no significant differences between conditions. The other possibilities are non-serious answers from participants or the dataset was too small to pick up significant differences.

5.1 SAM, Threat Scores, and Angry Males Versus Angry Females

5.1.1 SAM scores. Even though there were fewer neutral and positive SAM ratings during the control condition compared to the reappraisal and distraction conditions, the difference was not significant. The SAM scores were not normally distributed. Because the distribution was expected to be skewed toward the lower scores the more participants were negatively affected, I controlled the distribution by log transforming the data. Once again, the data was not normally distributed: some participants gave highly positive valence ratings after some film clips regardless of condition.

I had two possible explanations in mind before conducting the *post-hoc* analyses. Either these participants were not affected by the film clips, or they did not take the survey as seriously as if they had completed it in the university lab. This was the reason I excluded participants with SAM scores higher than 6 for the control condition from the *post-hoc* analysis. In retrospect, it is more likely that these participants simply did not get affected by the film clips, as some outliers should have been expected.

Even if all film clips in the pilot study had negative emotional content, some of the clips had happy endings. Due to lack of time, I did not have the possibility to edit these film clips. When I watched the clips with the four students on campus I paused the clips before the moments of joy or relief. I should have let them watch the clips alone, as I did with my master's student colleagues, to keep the conditions equal.

One of the film clips with a happy ending included in the main study showed a couple who thought their daughter had been shot by a gun instead of, as it turned out, a wax bullet. The question is if the participants would be happy that the child survived or if they still would

be affected by the initial shock. The results from the pilot study suggested the latter explanation, which is why I included the film clip. Looking more closely at the data, the majority of SAM scores for the film clip were negative or neutral, regardless of what condition the clip was watched in.

5.1.2 Threat scores. There were no significant differences between conditions in threat scores of angry faces. If the observed differences had been larger, it would support the conclusion that the reappraisal condition resulted in higher threat scores of angry faces compared to the control condition. This likely says something about methodological limitations and the possibility that the results were due to random chance rather than effects of ER.

Regarding the significant difference between angry and neutral faces in threat scores, some participants had a score difference less than 1 between the two. Eight of the participants had mean scores for angry faces between 1 and 2 while three had mean scores between 2 and 3. Two perceived neutral faces as more threatening than angry faces. This data is not consistent with Samuelsson et al. (2012) -- at least not if it is true that angry faces are perceived as more threatening than neutral faces, which is exactly what Jones (2019) found support for. The difference between my study and hers was that I used real faces while she used computer-generated ones.

A question arises, would these participants LPP responses in an EEG study differ as little as the small score differences between angry and neutral faces suggest? Arguably, it is expected that a few participants in any neural study deviate from the majority. However, if an EEG study had shown that these participants' LPP did not differ between angry and neutral faces, there might have been serious methodological limitations. Another explanation is that subjective measurements do not always correlate with neural measurements. While Thiruchselvam et al. (2011) observed no significant differences between reappraisers and distractors in experienced feeling during re-exposure, there were significant differences in LPP amplitudes (Thiruchselvam et al., 2011). Without EEG measurements, it is difficult to say if my results show a lack of emotional reactions to the angry faces or a possible non-correlational relationship between LPP responses and threat ratings.

5.1.3 Angry males versus angry females. Even though it was not part of the hypothesis, the observation that angry male faces resulted in higher threat scores than angry female faces was expected. A range of findings support my results. For example, Goos and Silverman (2002) found that perception of angry faces was more accurate for male faces, while Becker, Kenrick, Neuberg, Blackwell, and Smith (2007) observed faster detection of angry male faces than female faces. Tay (2015) discusses the different responses to angry male and angry female faces from a functional-evolutionary perspective. It is theorized that male's more

protective and competition-driven nature compared to females leads to male's expressing anger more than females. Tay (2015) argues that the larger bodies signal a bigger threat, and the chance of survival should be greater the more one reacts in fear to an angry male.

5.2 Cognitive Load and Stimulus Length

As said, there is a possibility that the effects of reappraisal could be explained by participants being distracted by needing to recall the reappraisal instructions. One way to minimize this problem is to follow the "Hillyard principle", which states that researchers should hold all variables as equal as possible between conditions (Luck, 2014). The question is if the chosen methods in this study decreased the confound of cognitive load. I tried to follow the Hillyard principle by presenting as-similar-as-possible instructions above the film clips in all conditions. Further, measurements were made *after* the ER phase. In this way, the problems of participants choosing their own reappraisal formulations, trying to remember instructions, or being distracted by applying ER during measurements were hopefully removed.

However, even if participants read the reappraisal instructions before starting the film clip, as intended, they could have been distracted by re-reading the instructions while watching the clip. It seems difficult to include reappraisal instructions without at least *some* possible resulting distraction. The question is if having instructions and stimuli presented at the same time is more distracting than having instructions presented before the stimuli. This question is impossible to answer without further research.

While Webb et al. (2012) in their meta-analysis saw a larger effect size of ER for high numbers of stimuli repetitions compared to lower numbers, I found no answers regarding the time length of a single presented stimulus and its effect on reappraisal success. The possibility that reappraisal requires more time than a few seconds to produce an effect stands in opposition to earlier observations. Hajcak and Nieuwenhuis (2006) and Moser et al. (2009) found significant LPP differences between the reappraisal condition and the control condition when the stimuli were presented for 4.5 and 4 seconds, respectively. I asked earlier if reductions in late LPP observed in the field are an actual effect of applying reappraisal, ongoing distraction by cognitive load, or an aftermath of the initial distraction. They could also be due to initial distraction followed by actual reappraisal effects.

5.3 Possible Limitations

5.3.1 Face groups. Because I presented different faces in each block, resulting in three face groups, some requirements needed to be satisfied. One was that the three face groups needed to be equal in mean values of the original scores from Samuelssonet al. (2012). The second was that participants' mean threat ratings for angry faces also needed to be equal. If not, it

would complicate the subsequent analyses. As shown in Figure 3, the mean threat ratings for each face group in each condition were in fact not equal, with the largest difference between the second and third face groups in the control condition.

The most likely reason is the low and uneven number of participants behind each combination of face groups and conditions in the survey. The reason for the uneven numbers was the limited time to find a hosting website that perfectly matched my needs, resulting in a survey that could not be as evenly distributed to the participants as desirable. Even had I found such a website, the numbers of participants would likely still have been too low to result in reliable threat-score differences between the face groups.

5.3.2 Counterbalancing. There were three film clips and three conditions, meaning that attaching each unique film clip to each condition and presenting the film clips in three different orders would result in 27 survey versions. Because I was on a time limit, I chose to program nine versions. Even if it was necessary to avoid repetition effects, attaching different face groups and film clips for each block raises potential problems: for example, it might be that it is easier to distract oneself during the least emotional film clip compared to the most emotional. Having, say, five participants in the distraction condition watching the most emotional film clip but one participant watching the least emotional film clip should result in a lower mean SAM score for the condition compared to if participants were evenly distributed. Another problem might have been the order of film clips. One example is if Sophie's Choice (Barish & Pakula, 1982) was in the first or second block, it was always followed by Blood Diamond (Gorfil et al., 2006).

5.3.3 The emotional film clips and ER instructions. There is a possibility that the emotional intensity of the film clips might have been too high to allow any effect from the two ER strategies. This seems to be more a concern for the reappraisal condition. According to Sheppes and Gross (2011), reappraisal seems to only be effective during high emotion intensity if stronger reappraisal strategies are used. This is the reason I chose perspective-taking reappraisal. which in the meta-analysis conducted by Webb et al. (2012), had the largest experiential effect. However, as there are many ways to change perspective, some might give weaker effects. The question is if this study's instructions were among them.

The reappraisal instructions were “please try to counteract any negative emotional impact by keeping in mind that you are only viewing movie actors”. Olowe (2018) used another set of instructions and took use of the term “situation-focused reappraisal” when describing the objectifying type of reappraisal. She observed no significant effect of this strategy on LPP amplitude reductions. Neither did Urry (2009) when measuring experienced feelings and behavior.

5.3.4 Concluding limitations. As the participants completed the survey at home, it is likely that it was completed at different times of the day and that some participants took pauses. These two factors could have been controlled for by including the relevant instructions in the starting page. While the film clips from Crash (Cheadle et al., 2004) and Blood Diamond (Gorfil et al., 2006) were similar in length, the clip from Sophie's Choice (Barish & Pakula, 1982) was one minute, seven seconds longer than the shortest film clip. This shows the difficulty of finding suitable film clips of similar length.

5.4 Future Directions

The most obvious limitation of the current study was that it could not be performed as an EEG study due to the COVID-19 situation. The original plan was to measure LPP responses to the presented faces but, as EEG measurements entail physical contact with participants, I had to turn to an online-based solution. If I had the opportunity to redo my experiment with all brain-imaging tools given to me, I would use both EEG and fMRI to make use of the findings from Thiruchselvam et al. (2011) and Hermann et al. (2017). They found that reappraisal led to smaller LPP amplitudes (Thiruchselvam et al., 2011) and larger hemodynamic increases in ER related brain regions (Hermann et al., 2017) during re-exposure of stimuli compared to distraction.

The primary aim in my future hypothetical study would have been to compare reappraisal with distraction to test the Cognitive Load Hypothesis. I would have included a larger group of participants to increase the statistical power. Other changes would be to vary the order of film clips, to use only unambiguous clips, and of course avoid uneven randomization of survey versions. I would have researched the reliability of measuring participants' feelings further to try avoid a non-correlational relationship between subjective and neural measurements in my own study. Finally, I would like to conduct more research on what ER instructions are most effective. Webb et al. (2012) found in their meta-analysis that perspective-taking reappraisal was effective, but others have made opposite observations (e.g., Olowe, 2018).

5.5 Conclusion

The primary aim of this study was to investigate the effects of reappraisal and distraction in an indirect way to decrease the possible problem of distractive cognitive processes during experimental settings. The secondary aim was to look for any differences between the effects of reappraisal and distraction. While both direct and indirect studies in general have shown support for reappraisal and distraction being effective in decreasing emotional distress, I did not find confirming results. I hypothesized that performing ER during emotion induction should result in more positive feelings and in lower threat ratings of angry faces compared to

no ER. Neither subjects' feelings nor their threat ratings of angry faces showed any significant differences between conditions. That said, ratings of subjects' feelings were lower for the control condition compared to the two ER strategies. The non-significant differences could be due to a) limitations in the method, b) lack of participants, or c) participants giving non-serious answers. To investigate the effects of reappraisal and the confound of cognitive load, research on differences between reappraisal and distraction is necessary.

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Appendix A

Links to and Descriptions of the Film Clips

Sophie's Choice (1982): While standing in the line for a concentration camp, a German officer asks what nationality and religion Sophie belongs to. He then asks her to choose which of her two children will survive and, when she has made her choice, the child is taken from her while screaming. Sophie's face is locked in a silent scream.
Link: https://www.youtube.com/watch?v=RaPBzhEsCL0

Crash (2004): A father is threatened by a man with a gun on his driveway while his daughter runs out to him and jumps up in his arms. Her mother runs after her but stops when the man with the gun pulls the trigger and a shot is heard. The father and mother cry out but suddenly the daughter talks. The gun was loaded with wax bullets. The family walks inside in relief while the man with the gun stands there for a moment with a surprised expression then slowly walks away.
Link: https://www.youtube.com/watch?v=dxBw8RB1H54

Blood Diamond (2006): A montage of a gang of children who are trained to become soldiers. They are getting beaten and get to train shooting with rifles at human dolls. One of the children executes an adult man while wearing a blindfold. The child later receives support and affirmation from one of the adult leaders and becomes captain.
Link: https://www.youtube.com/watch?v=QaiKMayEUOw

Appendix B

The Nine Versions of the Online Survey: Film Clips and Their Attached Conditions

Version 1
Sophie's Choice - reappraisal
Crash- distraction
Blood Diamond – control

Version 2
Sophie's Choice - distraction
Crash - control
Blood Diamond - reappraisal

Version 3
Sophie's Choice - control
Crash - reappraisal
Blood Diamond - distraction

Version 4
Crash - reappraisal
Blood Diamond - distraction
Sophie's Choice - control

Version 5
Crash - distraction
Blood Diamond - control
Sophie's Choice - reappraisal

Version 6
Crash - control
Blood Diamond - reappraisal
Sophie's Choice - distraction

Version 7
Blood Diamond - reappraisal
Sophie's Choice - distraction
Crash - control

Version 8
Blood Diamond - distraction
Sophie's Choice - control
Crash - reappraisal

Version 9
Blood Diamond - control
Sophie's Choice - reappraisal
Crash - distraction