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Mood Effects and Individual Differences on Reappraisal and Distraction: An ERP Study of the Sensitivity of Emotion Regulation Strategies

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MOOD EFFECTS AND INDIVIDUAL DIFFERENCES ON REAPPRAISAL AND DISTRACTION: AN ERP STUDY OF THE SENSITIVITY OF EMOTION REGULATION STRATEGIES.

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by

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ABSTRACT

MOOD EFFECTS AND INDIVIDUAL DIFFERENCES ON REAPPRAISAL AND DISTRACTION: AN ERP STUDY OF THE SENSITIVITY OF EMOTION REGULATION STRATEGIES.

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The present research evaluated the effect of mood and individual differences on the regulatory process of emotions by using a regulation task with negative and neutral images to assess reappraisal and distraction ability. Specifically, this research evaluated the average amplitude of the latent positive potential (latent positivity, LPP) brainwave linked to distraction and reappraisal using an ERP analysis. In addition, the current study compared the modulation of the LPP to the self-reported mood of the participants and their individual differences in regulation ability through scores of a self-report emotion regulation questionnaire. The latent positive potentials from an emotion regulation task of 25 participants (7 males, 18 females) from Central Washington University were examined and compared to current mood state and individual differences in prior practice using reappraisal. The present study supported past evidence that distraction seems to be the most efficient emotion regulation strategy to utilize when quickly assessing negative stimuli. In comparison to distraction, reappraisal seems to be a strategy that requires heightened thought processes, making it valuable in long term but not in short term appraisal situations. The current study also found that current mood produced no

change in the efficiency of the two emotion regulation tasks. Additionally, individual differences among the participants showed no relationship to the efficiency of the reappraisal tasks.

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CHAPTER I

INTRODUCTION

Emotions are a core part of everyday human existence. They dictate human social interactions, productivity, and set priorities for different tasks (Watson, 2000). On average, humans experience a wide range of both positive and negative emotions. The ability to recognize and project these emotions has been widely studied in the field of psychology (Panksepp, 2004). In order to keep emotions stable, the brain has to consistently regulate them. Emotion regulation (ER) is the term used to describe the brains ability to keep emotional responses stable in the presence of new and or intense stimuli. Without emotion regulation, humans are not able to control the type of emotions they feel and the intensity of their responses (Gross, 1998). Past researchers have found that the ability to regulate emotions can be attributed to various positive outcomes such as greater control of aggression or even decreases in depressive tendencies (Denson, Moulds, & Grisham, 2012; Hajcak & Folti, 2008). Individuals also differ in their ability to regulate emotions depending on prior practice; however, research has yet to clearly pinpoint any other individual differences that may affect emotion regulation (Aldao, 2013).

Collectively, studies on emotion regulation contribute to the knowledge of how individuals choose to deal with different emotions, what happens in the brain during such processing, and the important and positive side effects from engaging in emotion regulation over time. Although the current literature on emotion regulation is extensive, there are gaps in the literature related to understanding the true breadth of particular external variables and their effect on emotion regulation strategies. The following sections will focus on emotion regulation strategies, the neural bases of emotion regulation, individual differences in ER strategies and mood effects.

CHAPTER II

LITERATURE REVIEW

Emotion Regulation Strategies

To date, there are two broad categories of emotion regulation: implicit and explicit. Implicit emotion regulation carries many different descriptions but is broadly defined as regulation that operates without the need for conscious manipulation or explicit intentions (Koole & Rothermund, 2011). Typically, in a lab setting, these processes are demonstrated using cognitive techniques such as Stroop Tasks or priming (Braunstein et al., 2017). In contrast, explicit emotion regulation is defined as a conscious desire to change one's emotion. Explicit emotion regulation strategies are frequently researched in the field of affective and cognitive neuroscience, as they often have external implications. When people understand how to consciously change emotions, they additionally understand how to better their environment due to the ability to implement protective strategies (Braunstein et al., 2017). On account of the extensive research performed on explicit emotion regulation, and the ease by which researchers can control for it in a lab setting, the current review only focuses on explicit emotion regulation and the strategies used to elicit it.

There are three main ways that humans regulate emotions regarding explicit regulation (Gross, 2002; Gross & John, 2003; see appendix A for a detailed scenario that uses each strategy). The first emotion regulation strategy is reappraisal. Reappraisal is the ability to change the way certain situations are constructed to decrease emotional impact (Gross, 2002). Typically, reappraisal strategies create the most lasting changes, as the changes are generated by using positive thoughts and positive feelings to regulate emotions in certain situations (Gross & John, 2003). Second, people can regulate their emotions through suppression, which is the ability to inhibit any outward signs of a specific emotion (Gross & John, 2003). Although suppression is a popular tactic among individuals in everyday life, researchers have mainly discovered that it does not produce any beneficial outcomes (Gross & John, 2003). The third way to regulate emotions is through distraction (Thiruchselvam et al., 2011). When emotional stimuli are presented, one can easily avoid having adverse reactions or decrease the intensity of reactions by distracting oneself with a different thought. Overall, these three strategies of emotion regulation are the most common variables researchers use to assess the benefits and neural correlates of explicit emotion regulation.

Another important aspect of emotion regulation is choice. Although the brain does monitor its emotional responses apart from conscious recollections (known as implicit emotion regulation), humans can control their emotions by choosing which strategy they want to use. According to Sheppes and colleagues (2011), during low-intensity negative situations, participants decided on their own through self-report to reappraise the situation rather than engage in another form of emotion regulation. Likewise, during high-intensity negative situations, participants chose to distract themselves completely from the situation. Researchers controlled for the intensity by using less or more intense images depending on the affect level (Lang & Bradley, 1997; Sheppes et al., 2011). From their results, the researchers developed the theory that the brain does not always implicitly facilitate which strategy to use. With proper instruction and conscious decision making, individuals can explicitly regulate their emotions (Sheppes et al., 2011). Further development of this theory has been assessed neurologically with the use of brain imaging.

Neural Bases of Emotion Regulation

Gathering a cognitive understanding of emotion regulation allows researchers the ability to be confident about the presence and process of how the brain regulates emotions. Assessing the neural substrates and electrical responses of emotion regulation strategies may provide proof that these strategies are legitimate ways that emotions are regulated. These assessments further validate self-report and subjective studies of emotion regulation. We also gain further understanding of where during the cycle of emotion generation these processes occur. One of the original studies that focused on the exact point where emotion regulation is activated in the brain used fMRI imaging to review the process (Goldin et al., 2008). To assess the role of reappraisal in emotion regulation, participants were asked to think about positive situations when presented with negative images. For suppression, the researchers had the participants keep their faces still when the photos appeared. The researchers discovered that the reappraisal task showed decreased amygdala and pre-frontal cortex responses during the early stage of emotion regulation processes (0-4.5s). In contrast, the suppression task displayed lower neural activity in the pre-frontal cortex during the late stage of the emotion generation process (10.5s-15.s) and increased activity in the amygdala throughout. This indicated that both regulation strategies assisted the individuals in processing the negative stimuli and helped to create a calm and controlled reaction toward negative stimuli. Suppression, however, may have created a delay of emotion processing in the pre-frontal cortex due to increased amygdala activity during the early stages of the emotion processing. This research not only developed markers of when and where emotion processing occurs but showed that reappraisal may be a more efficient emotion regulation strategy compared to suppression.

To further supplement knowledge of emotion regulation, Drabant et al. (2009) used fMRI to investigate how individual differences effected amygdala responses among participants. In their study, the researchers compared a self-report analysis that measured individual differences in emotion regulation (i.e. what strategy the participants used the most) to amygdala responses during emotion elicitation. The researchers discovered that people who reported to use reappraisal more frequently as a strategy to regulate emotions decreased amygdala activity during the processing of the negative stimuli. Moreover, the results indicated that the practice of reappraisal matters greatly in one's ability to regulate negative emotions that they might experience.

A similar study conducted in 2010 sought to validate the claim that reappraisal decreases activation of the amygdala during the late stage of emotion generation. The authors also included an analysis of distraction to gain further understanding of the neural bases of emotion regulation (McRae et al., 2010). In addition, the study recorded the negative mood of the participants via self-report after the stimulus task to see if reappraisal or distraction further aided in decreasing their negative experiences. This was a particularly important part of the study because mood is not often added as a variable in many emotion regulation studies. For the study, emotions were elicited using negative and neutral photos from the International Affective Picture System (Bradley et al., 2001; Lang & Bradley, 1997). To measure distraction, the researchers had the participants attempt to memorize six digits while they viewed the emotional stimuli. Reappraisal was measured similarly to previous studies where the participants were asked to think of the negative images in a positive way. ERP measures were recorded during both strategies, and self-report of mood was measured after both strategies were implemented. Results provided the researchers with further evidence that reappraisal aided the regulation processes. The results also indicated that reappraisal helped participants decrease their negative mood more than distraction. In contrast to reappraisal, distraction lowered the emotional response in the amygdala faster and more efficiently than reappraisal did (McRae et al., 2010).

Overall, neuroimaging techniques are important for understanding emotion regulation because they allow for a pinpoint of how regulatory strategies effect the areas of the human brain that create and process emotions. However, functional brain imaging studies lack the ability to detect fine grained temporal changes in response to emotional stimuli from when they are first elicited to when they are regulated. In order to gain a more detailed view of emotion regulation, researchers have incorporated the use of the electroencephalogram (EEG), which provides the fine grain temporal resolution of brain processing needed to add additional insight into the regulatory processes of emotion.

Electroencephalography, Event-Related Potentials and Emotions

In comparison to fMRI, the use of the electroencephalogram (EEG) for studies of emotion regulation yields additional and unique information (Hajcak et al., 2010). EEGs use electrodes placed on the scalp to rapidly record fluctuating and continuous electrical changes in the brain. When a stimulus is presented to an individual, the EEG produces time locked specific events relating to the onset and response towards the stimulus (Hajcak et al., 2010). This response to an event is known as an event-related potential

(ERP). ERPs are distinguished by their timing and response to experimental manipulation (Hajcak et al., 2010). They also reflect synchronous activity of neuron populations which allows for the detection of early and rapid changes in neural processes (Fabiani et al., 2007). With their ability to detect these changes, ERPs are particularly useful in detecting changes in response when emotional stimuli are presented (Sutton et al., 1965). The P300 and latent positive potential (LPP) are the two most commonly utilized brain wave components of the ERP when it comes to detecting changes in response to emotional stimuli.

The P300 is a positive wave that optimally occurs around the midline at parietal recording sites between 300 and 500 ms following a stimulus presentation (Sutton et al., 1965). A consistent finding in past research on emotion showed an increased P300 post-stimulus when emotional pictures were presented compared to neutral pictures (Johnston et al., 1986; Mini, et al., 1996). In addition, Mini et al. (1996) noted that the P300 increases with both negative and positive stimuli. Although it is popular to use the P300 as a point of reference in emotion regulation studies, many researchers have noted the increased positivity that occurs from emotional stimulation extends beyond the traditional P300 range (Codispoti et al., 2007; Cuthbert et al., 2000; Hajcak & Folti, 2008). To examine this sustained positivity, researchers have studied the latent positive potential (LPP) brain wave in emotion research (Hajcak et al., 2010). The latent positive potential is defined by its sustained increase in attention with regard to the ERP (Hajcak et al., 2010). The LPP is a midline ERP that becomes apparent during 300 ms following a stimulus onset and continues for a longer duration than the P300, lasting even several hundred milliseconds (Codispoti et al., 2007). Although a multitude of past research has recorded the LPP with basic emotional imagining responses, it can be, and has been, used to observe more intricate processes such as the process of emotion regulation.

Latent Positive Potential and Emotion Regulation

Latent positive potential sensitivity has been examined considerably in a variety of emotion regulation strategies. For example, Moser and colleagues (2006) reviewed the LPP changes between suppression and enhancement of negative stimuli compared to a neutral trial. In the trials, participants were given instructions to suppress the image they saw by conjuring a different emotion or enhancing their feelings towards the stimuli. Enhancement instructions followed basic rumination strategies where the participants were instructed to keep thinking about their initial feelings towards a stimulus in order to make those feelings stronger. They discovered that the LPP in the suppress condition was considerably smaller, maintaining an average of 5 μV, whereas the enhance condition elicited a much larger LPP around 9 or 10 μV. The research suggested that the LPP is sensitive to emotional regulation upon instruction of the strategy. In addition, Moser et al. (2006) created a foundation for the current methodology of examining the LPP response with emotion regulation, as their instructions for suppression allowed for other researchers to create instructions for reappraisal and distraction.

Similarly, Hajcak and Nieuwenhuis (2006) elicited the LPP with reappraisal by instructing participants to look at unpleasant images in a less negative way (see appendix A for example). They then compared the reappraised responses to responses of unpleasant stimuli that were not reappraised. In this study, the amplitude of the LPP was reported to reduce during the entire duration of 2,000 ms, beginning around 200 ms following the onset of the stimulus. The results were discovered using specific LPP time blocks (200–400 ms, 600–1,000 ms, and 1,200–1,800 ms) that were then compared to the neutral condition and the reappraisal condition. The amplitude in the reappraise condition maintained a lower amplitude around 5 μV than the neutral condition which maintained a higher amplitude throughout all the sections studied (Hajcak & Nieuwenhuis, 2006). Furthermore, the participants self-reported less intense negative feelings during the reappraisal sessions than the neutral condition. The reduction in the LPP also correlated with the self-reported feelings of feeling better after reappraisal (Hajcak & Nieuwenhuis, 2006).

Research of how the LPP changes with instruction was completed by Hajcak and Folti (2008) when they investigated whether the priming of narrative descriptions of negative stimuli helped participants to regulate their emotions before the stimulus was presented. In their findings, the LPP was significantly decreased in the trial where the participants used reappraisal. In the trial where the participants were not primed, reappraisal occurred in the later stage of the emotion regulation process and did not decrease the LPP as much as the primed responses. The data provided further evidence that the reappraisal processes can be manipulated by instructions before stimulus onset.

Similarly, MacNamara, Folti, and Hajcak (2009) reviewed the LPP in response to reappraised images by comparing them to intrinsic (descriptions) and extrinsic (directions) motivation. MacNamara et al. (2009) believed that the LPP would be higher when negative images were attended to intrinsically rather than extrinsically. The LPP for the negative stimuli in both intrinsic and extrinsic conditions peaked at 1,066 ms and 1,688 ms respectively, suggesting that there is a difference in cognitive attention. Furthermore, the researchers uncovered comparable results to Hajcak and Nieuwenhuis

(2006) with an increased LPP when negative pictures were attended to. The researchers also discovered that the LPP decreased with neutral stimuli. The results of this study suggested that the LPP measures differently for motivation style, but overall is influenced in a similar manner to negative and neutral stimuli.

It seems clear that the LPP is influenced by the reappraisal of images no matter how the reappraisal is presented. Reappraisal, however, is not the only emotion regulation strategy that can be employed (Gross, 1998). For example, Thiruchselvam et al. (2011) compared the strategy of distraction with reappraisal and mapped out the LPP patterns in a series of affective picture stimulus trials. The researchers had participants think about the negative stimulus in a more positive way (reappraise) versus thinking about something else completely (distract). The results showed that the LPP decreased with both distraction and reappraisal, however distraction decreased the LPP faster than reappraisal. Distraction activated a response in the LPP around 300 ms and stayed significantly lower (around 5 μV on average) along the duration of the onset of the negative stimuli than reappraisal did. Following from previous studies, reappraisal was found to decrease the LPP around 1,500 ms (decreasing to around 6 μV consistently after 1,500ms) after a Holms correlation was conducted (Thiruchselvam et al., 2011). The results provided evidence that distraction is a way to quickly and effectively stifle emotions. Overall, distraction may not improve negative feelings (Hajcak & Nieuwenhuis, 2006) as well as reappraisal might, but it does aid to quickly decrease stressful responses to negative stimuli.

Overall, previous research has revealed that the LPP is a useful tool when researching emotional regulation as it continuously shows rapid responses in the electrical changes in the brain when emotion regulation is attenuated. For all studies, the LPP was decreased significantly with reappraisal, although it began to form a consistent decrease at a later stage than distraction (<1,000ms) after the stimulus was reviewed. Likewise, the peak of the LPP seemed to change slightly depending on how the stimuli were attended to and how the instructions were given during the study (Hajcak & Folti, 2008; Hajcak & Nieuwenhuis, 2006; MacNamera et al., 2009; Thiruchselvam et al., 2011). Given the fact that the LPP is subject to change depending on instruction, it may be important to assess how lesser examined external variables, such a mood, could influence the emotion regulation process through the examination of the LPP.

Mood Effects

The most specific affective state that lacks assessment in the literature of emotion regulation and individual difference is mood. Mood carries many definitions in affective psychology, but broadly can be conceptualized as transient, fluctuating feelings or enduring affective states (Heuchert & McNair, 2012). The current literature shows that explicit emotion regulation strategies, especially reappraisal, can increase mood over time when practiced consistently (Hajcak & Nieuwenhuis, 2006). However, there are still gaps in understanding the effect of mood on one's ability to regulate emotions. To assess this properly, a foundational understanding of mood and the way it relates to emotion regulation needs to be reviewed.

The study of mood change is one of the key theoretical aspects of psychology (Gross, 1998; Watson, 2000). The affective states that encompass mood include positive affective states, which were defined by Watson, Clark, & Tellegen (1998) as subjective reports of enthusiasm, activeness, and alertness. Negative affective states on the other hand describe low mood states and are generally understood as feelings of adverse emotions such as disgust, sadness, or contempt. Mood effects are commonly studied both before and after an environmental trigger such as changes in weather or changes in a person's diet (Forgas et al., 2009). In addition, more recent literature has examined daily mood states in order to record fluctuating changes in comparison to variables such as mental health, general well-being, and cognitive function (Ortiz & Grof, 2016; Schmid & Mast, 2010).

One category of mood effect research is the study of mood on memory. For example, Forgas et al. (2009), found that when people were in a negative mood, they displayed better recall abilities in a memory task. To manipulate different moods, the researchers set up their study on rainy (negative mood) and sunny (positive mood) days. This study was particularly interesting because it situates mood in the middle of two external factors (type of day). The study further explored the idea mood can shift depending on external factors and because of that, influences how we cognitively perform certain tasks. Mood additionally plays a role in encoding and false memories. Current research that assessed encoding looked at induced mood on a person's tendency to produce false memories (Storebeck & Clore, 2011). By inducing the participants mood with videos, the researchers decided that when negative moods were induced, participants became more focused on their mood rather than the task, which in turn reduced the encoding of false memories. Overall, a clear path can be developed from the relationship between mood and memory, implying that mood can clearly affect some aspects of cognitive function.

Mood can also change the way that we experience emotion. Schmid and Mast (2010), explored the effect of mood on emotion recognition by priming participants towards a certain mood then by giving them a facial emotion recognition task. Their research primed the participants to be in a happy, sad, or neutral mood using movie scenes. The researchers then scored the participants ability to recognize happy and sad facial expressions. Results showed that participants who were primed in a sad mood had the ability to recognize sad faces better than happy faces, while the participants in good moods did not show any discrepancy in either direction. The key takeaway from this study was that sad mood states seem to disrupt a person's ability to recognize information, which further builds upon the knowledge base of how different mood states affect processes in the brain.

The ability to regulate emotions can also be greatly influenced by an individual's mood. For example, Berna et al. (2010) discovered that when participants were introduced to a depressed mood state stimulus, the state disrupted their ability to regulate emotions. The researchers assessed emotion regulation interference by looking at prefrontal cortex activation using an fMRI. The results showed that participants in the depressed mood category showed greater activation of negative appraisal, which in turn interfered with their ability to reappraise or produce positive appraisal. These results compare to the previous studies above, suggesting that sad mood can negatively affect a person's ability to process and understand emotions. These results are also important because this was one of the first instances that emotion recognition was assessed in terms of mood states in a non-clinical population. Before Berna et al. (2010), neuroscience research that focused on mood states only focused on participants with mood disorders or a history of disordered regulatory abilities.

In gathering a detailed understanding of mood states, it is important to look at non-clinical populations. Humans experience a wide range of emotions that can fluctuate at any given moment depending on the external environment (Gross, 1998). Given the literature on induced mood, it seems clear that negative mood states have a greater impact on the ability to normally assess situations and regulate emotions. Induced moods however provide their own set of limitations. When mood states are purposefully curated, the ability to understand their natural occurrence is lost. Although induced mood is beneficial to ensure controlled results, it would be beneficial to understand differences in individual's moods before they start an experiment. These differences may lead to a greater understanding of how occurrences of daily mood influence our emotional capabilities. Although this may increase the external validity of mood states, it does not consider the possibility that individuals show basic differences in their ability to regulate and control their emotions (Gross & John, 2003). In order to fully assess mood effects on emotion regulation strategies however, a comprehensive evaluation of what individual differences are and how they relate to mood effects must be discussed.

Individual Differences in ER Strategies

Generally, the literature is less clear on the benefits of emotion regulation on our daily lives related to how individuals differ in emotion regulation. To assess individual differences, researchers often evaluate self-report measures over long periods of time. The longest recorded self-report analysis of emotion regulation was four years (English et al., 2012). During this longitudinal study, the researchers had participants record their daily feelings as well as their emotion regulation strategy they utilized that day. For this study, the two surveys used for emotion regulation were a suppression and reappraisal survey (Gross & John, 2003). The results indicated that over the course of four years, individuals who engaged in suppression as their regulation strategy tended to report fewer positive relationships with others. They also struggled with close relationships over time. In comparison, people who engaged in reappraisal frequently reported closer friendships overtime. This study aids our current understanding of emotion regulation because it defends the idea that suppression may not lead to many positive outcomes whereas reappraisal and thinking positively can impact a person's life in beneficial ways.

Similarly, subjective experiences and positive impacts of emotion regulation were also assessed by Nezlek and Kuppens (2008). Over three weeks, the researchers demonstrated daily emotion regulation in positive and negative emotions by using self-report measures. Their main goal was to see what benefitted people more in regulating their emotions – reappraisal or suppression. Both reappraisal and suppression tendencies were recorded through measures created by Gross and John (2003). In order to compare the effects of the emotion regulation strategies, the participants were asked to record their self-esteem and psychological adjustment. Their results demonstrated that over the three weeks, reappraisal strategies were linked to higher levels of self-esteem and psychological adjustment, whereas suppression only lead to an increase in negative emotions and a greater difficulty in developing positive thoughts. Not only did this study indicate that emotion regulation occurs daily, but it showed that overtime, with positive reappraisal, humans can boost their self-esteem and their ability to adjust to different situations.

Emotion regulation strategies are also found to mediate responses of anger and aggressive tendencies. For example, in one study, the effects of reappraisal and distraction on rumination were assessed following a situation that stimulated anger (Denson et al., 2012). Individuals recorded subjective negative events that had occurred in their lives. For reappraisal, they were asked to write about the event, but mainly focus on positive outcomes that stemmed from the event or occurred within the event. Finally, for the distraction task, the researchers had the participants write about a completely different situation unrelated to the event. For both situations, levels of anger decreased after the participants engaged in both emotions' regulation strategies. Although this study did not look at individual differences in experience with emotion regulation, it is evident that individual experience utilizing emotion regulation can positively impact our experiences in life.

In addition to reducing anger, differences in emotion regulation abilities across individuals can also influence their success in regulating emotions during a specific stimulus task. Moser et al. (2014) examined whether individual differences impacted distress responses in the partial region of the brain through latent positivity. In comparison to other studies that examined the LPP, the researchers (2014) showed participants distressing images and had them reappraise the distressing images or just watch them normally. They also surveyed the participants on their past knowledge of reappraisal and history with worrying. Participants who had a high history of worrying seemed to have higher amplitudes in their latent positive potentials on average. In contrast, participants who reported a strong history with reappraisal had maintained lowered amplitudes across the latent positive window of 700-1000 ms (out of a 300-2000 ms window). It is clear from this study that not only can a history of practicing reappraisal help quickly relieve stress, but it is also related to individual success in the modulation of the latent positive potential.

With previous knowledge of individual differences and their relationship with emotion regulation strategies, it is important to include them in a full analysis of the external influences on emotion regulation. Moreover, the complexity of emotion regulation may be explained by understanding how daily mood and individual difference affect explicit emotion regulation. The knowledge of which external factors influence emotion regulation has the benefit of expanding ideas of how to best regulate emotions in order to live healthier and more fulfilling lives.

Research Question

The present research evaluated the effect of mood and individual differences on the regulatory process of emotions by using a regulation task with negative and neutral images to assess reappraisal and distraction ability. Specifically, the current study evaluated the average amplitude of the latent positive potential (latent positivity, LPP) brainwave linked to distraction and reappraisal using an ERP analysis. In addition, the current study compared the modulation of the LPP to the self-reported mood of the participants and their individual differences in regulation ability through scores of an emotion regulation questionnaire (Gross & John, 2003).

CHAPTER III

METHOD

Participants

The current study examined the LPP of 25 undergraduate and graduate students (7 males; 18 females) at Central Washington University (CWU). All of the students were recruited via the CWU Sona research system and through the CWU Outlook email system. The Sona system is a Department of Psychology website that allows students to sign up for any ongoing psychology-related research studies. Ages of the participants ranged from 18-51 with the average age of 22 years old. Approximately 68% of the participants identified as White, 16% African American, 12% Hispanic or Latino, and 4% identifying as other. All participants were over the age of 18 and self-reported to be free from any substance use, persistent medication use that may impact EEG recordings, and neurological disorders.

Materials

Equipment

The Compumedics-Neuroscan EEG 32-channel Quik-Cap was utilized along with the SCAN 4 Neuroimaging Suite software for EEG collection and recording. The SCAN 4 software was used to analyze all the brain waves and ERP grand averages for amplitude and latency. All visual stimuli were presented using the Compumedics-Neuroscan STIM^2 software program.

Brief Mood Introspective Scale (BMIS)

Mayer and Gaschke (2013) developed the BMIS to assess current mood states. The BMIS is a 17-item mood adjective scale that contains 16 adjectives (Mayer &

Gaschke, 1988; see appendix B). The survey asked participants to rate how well each adjective described their current mood from (1) *definitely do not feel* to (4) *definitely feel*. In the full BMIS, there is a 17th item that asks participants to rate their overall mood. As the authors noted that it can be omitted and still provide a reliable assessment of current mood, it was omitted from the current analysis. Cronbach's alpha reliabilities range from .76-.83 which are suitable for internal reliability. There are two ways to calculate final scores for the BMIS, but the modern standard suggests that reserve scoring for negative adjectives is the best analysis of current mood state (Mayer & Cavallaro, 2019). Scores range from a high score of 64, indicating highly pleasant mood, to a low score of 16, indicating a highly unpleasant mood. The 4-point scale has a range of 48 and a midpoint score of 40, indicating a relatively pleasant mood with some negative facets noted such as drowsiness, sadness, or stress.

Emotion Regulation Questionnaire (ERQ)

Individual differences in regulation ability were assessed using the Emotion Regulation Questionnaire (Gross & John, 2003). The ERQ is a 10-item survey that measures individuals' tendencies to regulate their emotions in certain ways. Specifically, the ERQ assesses cognitive reappraisal and suppression. For the purpose of this study, the cognitive reappraisal section was the only section utilized. This was in order to assess participants former familiarity with reappraisal, as it is believed that this can influence efficiency during a reappraisal task (Moser et al., 2014). The cognitive reappraisal section of the ERQ consists of six items where respondents answer each item on a 7-point Likert-type scale ranging from (1) *strongly disagree* to (7) *strongly agree*. Reappraisal scores range from 7 (e.g. never reappraises and not familiar) to 42 (e.g. very familiar and often reappraises). A high score indicates that the individual is familiar with reappraisal strategies and uses them often. See appendix C for full scale.

Modified Visual Odd-ball Task

The participants viewed photographs from the International Affective Picture System Database - IAPS (Lang et al., 1997). The IAPS is an archival database of pictures that have been tested for valence and arousal ratings and appropriately placed into categories (neutral, negative, and positive images). Selected pictures from this archive were compiled and shown via the Compumedics-Neuroscan $STIM^2$ software on a computer monitor. The viewing angle for all participants was 61.3 degrees by 38.5 degrees. This was calculated per the standard viewing angle formula: $A = 57.3 \times (r / d)$, with r referring to the size of the stimulus in cm and d referring to the viewing distance in cm. The visual experimental task was based on a visual oddball paradigm and consisted of 112 pictures (84 negative, 28 neutral; see figure D1 in appendix D for example and appendix E for list of picture keys).

The overall experimental task closely followed the design of Thiruchselvam et al. (2011) who developed this specific stimulus task to further understand the relationship between reappraisal and distraction. The pictures were framed within four blocks of 28 images each. The instructions within the four blocks were WATCH AND REAPPRAISE (negative image),WATCH AND DISTRACT (negative image), and WATCH NATURALLY (neutral image or negative image). The word “watch” was added to the instructional cues for clarity and consistency in the regulation task. Additional instructions were also added under the main cues so the participants could seamlessly follow the stimulus task (see appendix C). For the WATCH AND REAPPRAISE trials, participants were instructed to try to feel more positive about an image than their initial reaction (see appendix A). In the WATCH AND DISTRACT trial, participants were asked to think about something completely different from the picture that was shown. During the WATCH NATURALLY instructional cue, the participants were asked to just attend to the image. Both negative images and neutral images in the WATCH NATURALLY trials were included to balance the reappraise and distract trials to keep the participants focused and gather baseline reactions to images. The blocks of 28 images contained 14 WATCH NATURALLY images (7 negative and 7 neutral) and either 14 WATCH AND REAPPRAISE or 14 WATCH AND DISTRACT. The DISTRACT and REAPPRAISE instructional queues were in separate blocks to ensure that participants did not mix up the method of instruction.

Each trial began with a white fixation cross in the center of a black screen for 2s. This was followed by an instruction queue (WATCH AND REAPPRAISE, WATCH AND DISTRACT, or WATCH NATURALLY) for 2s. The instructional queue was followed by an IAPS picture for 5s. The trials within the blocks were randomized for each participant and the blocks were counterbalanced (see figure 2 in Appendix D for example).

Procedure

The participants were seated at a desk with a computer upon their arrival. Once they were seated, the participants were handed the informed consent, a brief demographic questionnaire (see appendix F), and a handedness survey (see appendix G) that asked them about what hand they use for different activities. Each survey packet had a randomly generated number at the top of the packet in order to ensure participant confidentiality. The researcher used the website RANDOM.org to generate a random sequence of numbers. After they were handed the packets, participants were notified that they can leave at any time before the study was complete and that they were allowed to do so without any penalty. When participants completed and signed the documentation, they were given the BMIS and the ERQ to complete. For the questionnaires, the researcher waited in the adjacent lab room to ensure comfort to the participant. Once the participants completed the forms, the researcher returned to the room and fit them with the Compumedics-Neuroscan 32 channel Quik-Cap. When the participant was settled into the cap fitting, the researcher explained to the participant what reappraisal and distraction are and ran them through an example trial and a mock trial on the computer. The example trial consisted of printed images that the researcher handed to the participant to give examples of what they could think about and have them verbally express the reappraisal strategies they could use. The mock trial consisted of an unrecorded session where the participant experienced each of the regulation tasks broken up by the WATCH NATURALLY instructional cue. Each task in the mock trial had two practice images. The examples were pictures from the IAPS that were completely different from those used in the actual trial, which kept the stimulus novel for the participant every time.

After the participants finished the practice trial, they were asked if they have any questions or if they wanted to practice again before continuing with the recorded session. After each block, the participant was given the opportunity to take a short break before continuing with the stimulus task. Once the participants were finished, they were handed a debriefing form and the purpose of the study was explained by the principal investigator.

ERP Data Collection

Electrophysiological data was recorded from 28 electrode sites distributed evenly across the scalp using silver/silver-chloride (Ag/AgCl) electrodes attached to an elastic cap (Neuromedical Supplies Inc.) and a Compumedics-Neuroscan amplifier/stimulator with the Scan 4 Neuroimaging Suite software. Electrical impedance of each electrode was minimized to under 5mΩs, and the system was referenced on the nasion (i.e., the area between the eyebrows, above the nose). Eye blinks were monitored via an electrode positioned at the outer canthus (i.e., corner) of the left eye. Electrodes were aligned in a 10 to 20 system, meaning the distances between adjacent electrodes are either 10 or 20 percent of the total front-back, left-right distance of the skull. Data was recorded continually and epoched into ERPs time locked to the onset of the visually presented experimental stimuli. The stored epoch encompassed 2000 ms (including a 100 ms prestimulus baseline) relative to stimulus onset. A preliminary visual analysis of participant results indicated that past the 1500 ms mark there was no indication any formal latent positivity. Therefore, ERPs were averaged across the Central Zero line (CZ) from 300 to 1500 ms relative to cue onset and for target-locked ERPs from -200 ms to 2000 ms relative to target onset to capture the most important amplitudes of the latent positivity in accordance with past research (Hajcak & Folti, 2008; Moser et al., 2014; Thiruchselvam et al., 2011).

Amplification of the continuous EEG recording was from 0.15 to 70 Hz (1 to 100 Hz for the VEOG channel) and digitized through the Compumedics-Neuroscan acquisition interface system. Continuous analog-to-digital conversion of the EEG and stimulus trigger codes were performed online by the Compumedics-Neuroscan acquisition interface system. Signal averaging was conducted after offline artifact rejection and baseline correction. Individual epochs were examined and rejected whenever electrical activity in either VEOG (Blink) channel or the frontal channels (FP1, FP2) exceeded ±50μV. Successfully averaged ERP waveforms were then digitally bandpass-filtered with a filter slope of -12 dB per octave to remove ambient electrical noise and muscle artifact (e.g., eye blinks).

Experimental Design and Variables

In order to examine the full latent positive responses for the participants, the principal investigator split the latent positivity of the stimulus task into 4-time blocks (300-600, 600-900, 900-1200, 1200-1500). Averaged peak amplitudes were selected via visual inspection, and each participant received an average amplitude for each block. This strategy has been used in previous latent positive research to ensure that the full average overtime can be captured with the equipment (Hajcak & Folti, 2008; Moser et al., 2014; Thiruchselvam et al., 2011). These time blocks also indicated attenuation of the experimental stimulus tasks compared to the neutral control (see Table 1). After this task was completed, the combined averages were entered into planned pairwise comparison *t* tests to see if there were any significant individual changes between the negative control group (WATCH NATURALLY negative images) and reappraisal, the negative control group compared to the distraction task, and reappraisal compared to distraction. These comparisons were useful to examine any initial differences between the two emotion regulation tasks, and to reflect on how this current study matches up to past latent positivity information that has been performed in previous research regarding this subject (Hajcak & Folti, 2008; Moser et al., 2014; Thiruchselvam et al., 2011).

In addition to the time blocks for the overall latent positivity, the participants who reported to be in the most pleasant mood (BMIS scores well above 50) and participants who reported to be in the most unpleasant mood (scores less than 40) were separated from the group for a closer inspection of the relationship of mood on distraction and reappraisal tasks. From there, four pairwise comparison *t* tests were conducted to see if there were any significant differences between reappraisal and distraction along the four time blocks (300-600, 600-900, 900-1200, 1200-1500). In order to compensate for the number of pairwise comparison *t* tests and avoid any statistical error, the p-value for this section was lowered for significance at the 0.01 level.

In order to assess the relationship between mood on reappraisal and distraction, three one-way ANOVAs were performed to see if there were any differences between mood and negative watch, mood and reappraisal, and mood and distraction. ANOVAs were selected over a MANOVA due to the power in the dataset. In addition, a regression analysis was utilized to understand if individual differences (ERQ scores) had any relationship with the participants reported mood and the LPP averages. For the ANOVAs, the independent variable was mood. The three levels of mood were participants in the low affect (negative/unpleasant mood) group, participants in a neutral mood (mostly pleasant with a mix of negative facets), and participants in the high affect (positive/pleasant mood) group. The three dependent variables of the study were the average LPP amplitude of the reappraisal instructional queue trials, the LLP of negative-watch trials, and the LPP amplitude of the distraction instructional queue trials. The neutral images of the WATCH trials were not used for the overall analysis as they just provided a task that broke up the negative images in order for the negative images to remain novel. Tukey's HSD analyses were planned out in advance in the case that any statistical significance was found in the one-way ANOVAs.

The third analysis that was conducted for the current study was a multiple regression analysis that looked at individual difference scores in relationship to the other variables. Individual difference scores were based on the ERQ (Gross & John, 2003). The regression looked at the relationship between the mean scores of individual differences compared to average mood and the average LPP of the regression trials and distraction trials. Individual differences were analyzed as a separate analysis because in many studies, the participants' past knowledge of emotion regulation strategies helped them perform better on emotion regulation tasks. If individual difference was as important as the past literature stated, there was an expectation that a significant relationship between ERQ scores and the other variables would be noted. In this study, there was not enough variation within the gender of the participants to be able to assess differences between them.

Hypotheses

The ERP analysis along with the results of the two surveys were used assess the following hypotheses:

H(1): Positive Mood State and LPP for Reappraisal.

Participants who begin the study in a positive mood state would attenuate the LPP response more efficiently (stability of amplitude around 8 μV would be seen beginning at intervals < 1,000ms) in the modulation for reappraisal.

H(2): Negative Mood State and LPP for Reappraisal.

Participants who reported a negative mood state at the beginning of the experiment would not be able to reappraise as well as participants who were in a positive mood. Reappraisal in the negative mood group was predicted to be similar to the control, attenuating the LPP around 8-10 μV, especially past 1,000ms.

H(3): Mood and Distraction.

Distraction would remain the same regardless of the mood state, attenuating at the onset of the LPP (>300ms) and consistently remaining at a lower amplitude of around 5 μV.

H(4): Mood States versus Individual Differences.

There would not be a significant difference between individual difference scores and the other variables, indicating that prior experience with emotion regulation strategies had minimal effect compared to mood.

CHAPTER III

RESULTS

Latent Positivity Averages

Before the analyses were conducted, the LPP averages were visually examined across the four-time groups to note signs of attenuation differences between the groups. It was apparent that for both reappraisal and negative watch, average amplitude only attenuated for around 300 ms before peaking again around 1200 ms (see Table 1; see Figure 2). Distraction on the other hand attenuated around 900 ms and continued to have a low amplitude through the 1500 ms mark. Although none of these slight differences were significant between the individual time blocks at the .01 level, distraction was slightly different from reappraisal (see Figure 1) and the negative watch instruction cues (see Figure 2). This can be validated further by statistical inspection of the overall latent positive averages from the 300ms time point to the 1500 ms time block.

Table 1. Time Blocked Average Amplitudes

	Averages Amplitude (μV)		
Time (ms)	Negative Watch	Reappraise	Distract
300-600	6.56	6.93	6.43
600-900	6.08	6.36	5.72
900-1200	4.13	4.12	4.22
1200-1500	5.17	6.12	4.49

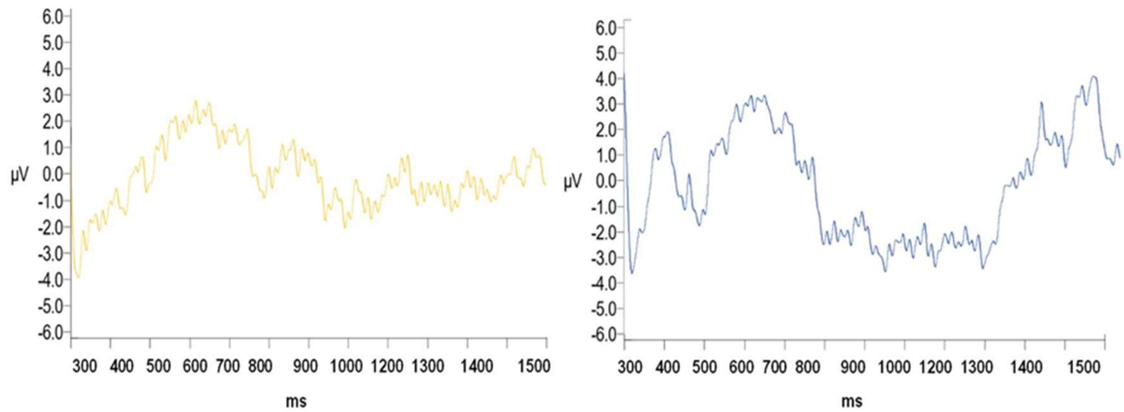

Figure 1. Side by side comparison of the latent positive averages between distract and reappraise instructional cue.

The first analyses of the data evaluated the relationships between the average LPPs across the 1500 ms time interval. Three pairwise t tests were performed for negative watch ($M = 5.47$, $SD = 1.77$) and reappraise ($M = 6.21$, $SD = 1.93$), negative watch and distract ($M = 5.29$, $SD = 2.07$), and distract and reappraise. Results indicated that there was a significant difference between the negative watch and reappraise trials ($t(24) = -2.207$, $p<.05$) and between distract and reappraise ($t(24) = 2.156$, $p<.05$). Further differences can be seen between these two groups with the separation of latent positivity occurring around the 800ms mark (see Figure 1). The negative t value between reappraisal and negative watch indicated that the latent positive averages for the reappraisal task overall were higher than the negative watch task. Likewise, the distraction task seemed to have consistently lower averages than reappraisal. In contrast, there seemed to be no significant effect between distraction and negative watch ($t(24) = -0.75$, $p = 0.4582$) indicating that the images for both instructional groups elicited similar reactions overall as detailed further in the discussion section.

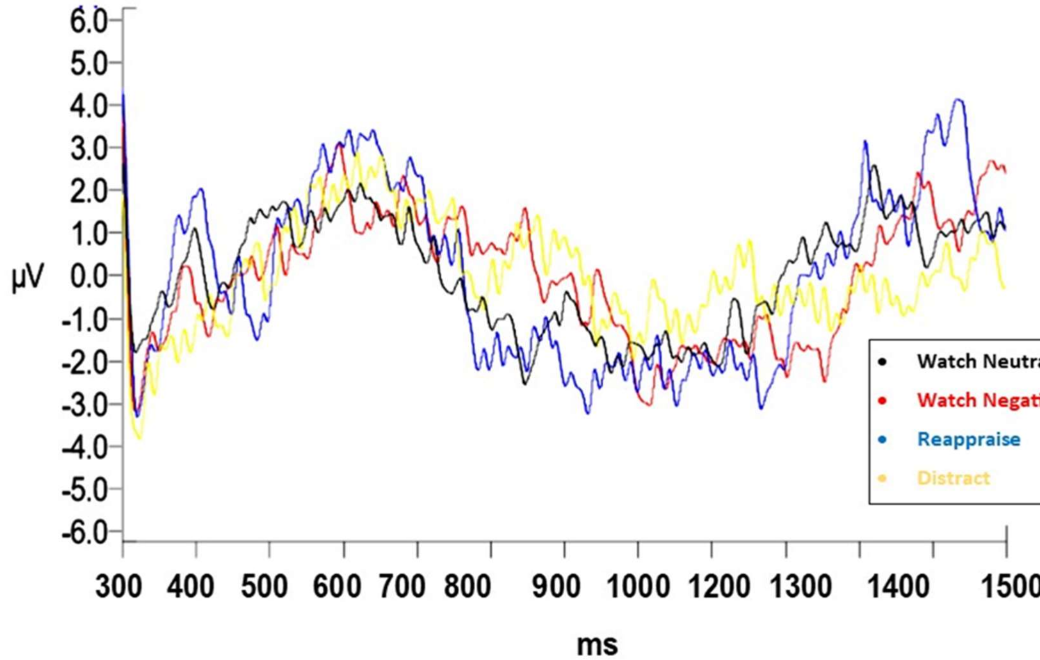

Figure 2. Grand Average Latent Positivity (µV) of Instructional Type.

The second set of analyses selected the participants that were only in the most extreme self-reported mood states. From the 25 participants, four participants reported moods that were lower than 40, suggesting that those participants began the stimulus task in an unpleasant mood. In order to keep the extreme groupings even, the four highest self-reports from the BMIS were selected and their latent positive averages were pulled out to be compared to the negative mood group. Four planned pairwise comparison *t* tests indicated that there were no significant differences between the individuals in the extremely unpleasant mood group versus individuals in the extremely pleasant mood group in any of the latent positive time blocks (see Table 2). Further visual inspection supported the *t*-test analyses, noting no extreme differences in the averaged amplitudes across the four-time blocks. Despite these results, the overall distraction task for both groups seemed to remain at a slightly more stable and low amplitude compared to the reappraisal tasks (see figure 3). Overall, these results may have been a product of the low power involved with only analyzing eight participants for the two extreme groups.

Table 2

Results for Extreme Mood Groups

Time (ms)	*Df*	*t*	*p*
300-600	7	-0.816	0.445
600-900	7	0.754	0.475
900-1200	7	-0.507	0.6273
1200-1500	7	-0.491	0.693

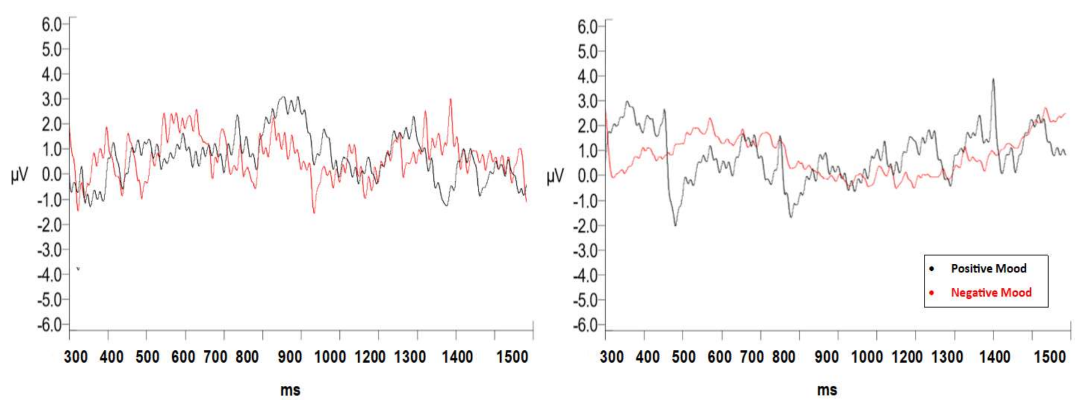

Figure 3. Side by side comparison of the distraction (left) and reappraisal (right) task for the positive and negative mood groups

Table 3

Average Latent Positive Amplitudes of Selected Mood across Four Time Blocks.

	Positive Mood Group		*Negative Mood Group*	
Time	Reappraise	Distract	Reappraise	Distract
300-600	7.505	5.79	6.26	6.12
600-900	5.28	6.65	5.04	5.79
900-1200	6.10	4.04	3.42	4.32
1200-1500	5.58	5.49	5.09	5.17

Overall Mood and Emotion Regulation Tasks

BMIS results indicated that the majority of the twenty-five participants were in a pleasant mood ($M = 46.88$, $SD = 5.47$; see appendix H) with only four participants reporting scores lower than 40. In order to see if mood had any effect on participants ability to efficiently regulate emotions, three one-way ANOVAs were conducted. When compared to the LPP averages, there was no significant effect between mood and negative watch ($F(2, 22) = 1.253$, $p = 0.305$), mood and reappraisal ($F(2, 22) = 0.678$, $p = 0.518$), and mood and distraction ($F(2, 22) = 0.193$, $p = 0.826$; see Table 4). For these analyses, the entire mood group section was examined in contrast to the selected moods above (negative, neutral, and positive mood). A further examination of these results can be found in the discussion section.

Table 4

ANOVA Summaries

BMIS & Negative Watch

Source	*Df*	*SS*	*MS*	*F*	*p*
Mood Groups	22	7.66	3.832	1.253	0.305
Residuals	2	67.30	3.059		

BMIS & Reappraisal

Source	*Df*	*SS*	*MS*	*F*	*p*
Mood Groups	22	5.22	2.611	0.678	0.518
Residuals	2	84.71	3.851		

BMIS & Distraction

Source	*Df*	*SS*	*MS*	*F*	*p*
Mood Groups	22	1.78	.889	0.193	0.305
Residuals	2	101.28	4.604		

Individual Differences

A multiple regression analysis was conducted to see if experience practicing reappraisal had any prediction on mood scores or latent positive averages for reappraisal and distraction. Overall, ERQ scores retained an average of 30.08, indicating that most of the participants were familiar with practicing reappraisal some of the time. These scores, however, maintained a high variation with SD = 5.48, indicating that some participants were extremely familiar with reappraisal and practiced frequently and some were less familiar with the use of reappraisal (see appendix I for visuals). As assessed, individual difference scores did not explain any of the variation in the mood of the participants or their latent positivity averages ($F(3, 21) = 1.334$, $p = .29$, $R^2 = .1601$, $R^2_{Adjusted} = .0401$; see table 5).

Table 5

Multiple Regression Analysis

Predictors	B	SE	β	p	R^2	$R^2_{Adjusted}$	F	p
1					0.161	0.041	1.334	0.29
LPP R	1.101	0.685	2.08	0.050				
LPP D	-0.239	0.599	-0.401	0.693				
Mood	0.086	0.12	0.402	0.692				

CHAPTER IV

DISCUSSION

Overall, the current study validates past research that cites a difference between distraction and reappraisal (Hajcak & Folti, 2008; Hajcak & Nieuwenhuis, 2006; MacNamera et al., 2009; Thiruchselvam et al., 2011). The significance along the two tasks supports the theory that distraction may be a faster and more efficient emotion regulation strategy (see Appendix I). From the analysis, reappraisal seemed to be a strategy that may increase cognitive function as it employs heightened thinking techniques. Not only did the reappraisal task consistently have higher amplitudes than the distraction task (see figure 1), but it fluctuated inconsistently throughout the 300-1500-time block. Unlike past studies, the negative value of the paired *t* test indicated that reappraisal on average maintained a higher amplitude than the control instructional cue of negative watch. This is contrary to past studies, as they have indicated that reappraisal can maintain a lowered amplitude across the latent positive potential compared to just attending to negative images (Hajcak & Folti, 2008; Hajcak & Nieuwenhuis, 2006; MacNamera et al., 2009; Ortiz & Grof, 2016; Thiruchselvam et al., 2011).

The reappraisal task in the current study may have differed from past findings due to the intensity of the images that the participants experienced. This may have also been the explanation for the results of the distraction task and the negative control. If the images were too similar, the negative control would have not elicited a stronger reaction to see a significant difference (see limitations for more). Since the distraction task was separated by the watch task, participants may also have been utilizing the strategy during the negative watch images. Regardless, distraction can still be considered an efficient way to regulate emotional responses to negative stimuli, as it still contrasted from the reappraisal instructional que.

The Relationships of Mood, ER Strategies, and Individual Differences

The overall mood score of the participants was on average rated as very pleasant with scores well above 40. The lack of varying mood reports may speak to the reason why the ANOVA results failed to reach significance. These findings can be explained and assessed further in terms of the hypotheses of the current study.

H(1): Positive Mood State and LPP for Reappraisal.

The first hypothesis assumed that participants who began the study in a positive mood state, would attenuate the LPP response faster (stability of amplitude around 8 μV would be seen beginning at intervals < 1,000ms) in the modulation for reappraisal. The amplitude assumption of this hypothesis was based off of past research that indicated an average higher amplitude for reappraisal (Hajcak & Folti, 2008; Hajcak & Nieuwenhuis, 2006; Moser et al., 2014; Thiruchselvam et al., 2011). The current study discovered that the

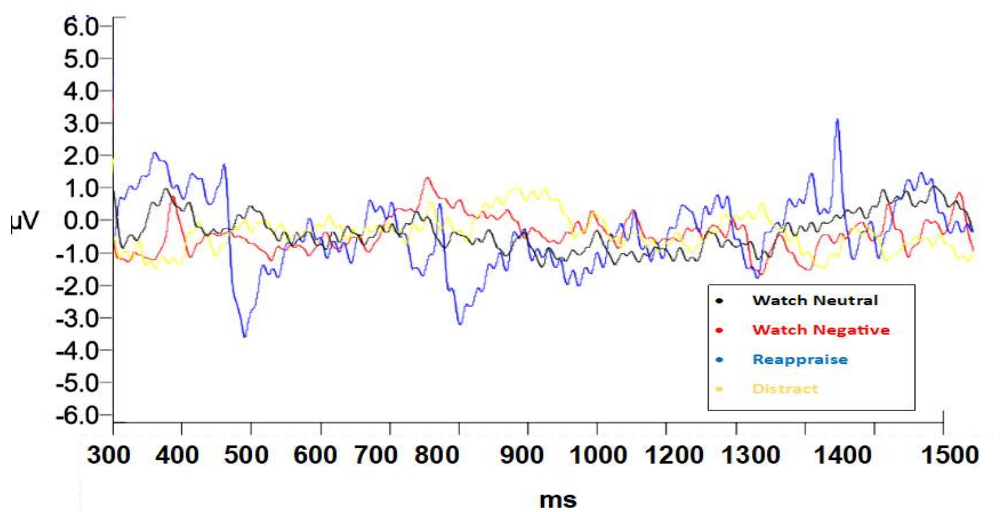

Figure 4. Grand average amplitudes in the positive mood groups across all conditions.

reappraisal task elicited and maintained a lower amplitude of around 6 μV past the 300ms mark. This however spiked again at the 1200ms mark which is a possible indication that reappraisal did not attenuate the latent positive potential efficiently. These findings can be further validated by considering the highest scores on the BMIS (extremely pleasant mood) in figures 3 and 4. Although these participants all reported scores above 40 for the BMIS, their reappraisal tasks did not attenuate consistently for the entire time block.

Reappraisal did however seem to have lowered amplitudes for the 900-1200 block compared to the other time blocks, which may indicate that reappraisal still begins to attenuate around 1,000ms although this was not defended by any statistical outcomes. Overall, it was not conclusive as to whether or not participants in a positive mood attenuated the reappraisal response more efficiently.

H(2): Negative Mood State and LPP for Reappraisal.

Hypothesis two stated that participants who reported a negative mood state at the beginning of the experiment would not be able to reappraise as well as participants who are in a positive mood. Additionally, reappraisal in the negative mood was also predicted to be similar to the control, attenuating the LPP around 8-10 μV, especially past 1,000ms. Results were similar to the positive mood group, with reappraisal reactions averaging consistently at 5-6 μV over the duration of the latent positive time block (see figure 5). Furthermore, although there were no significant differences to indicate that participants in the negative mood group struggled with reappraisal, the task still appeared to attenuate past the 1,000ms mark. This facilitated the claim that reappraisal may be a more difficult emotion regulation task to perform compared to other emotion regulation strategies (Gross & John, 2003; Thiruchselvam et al., 2011).

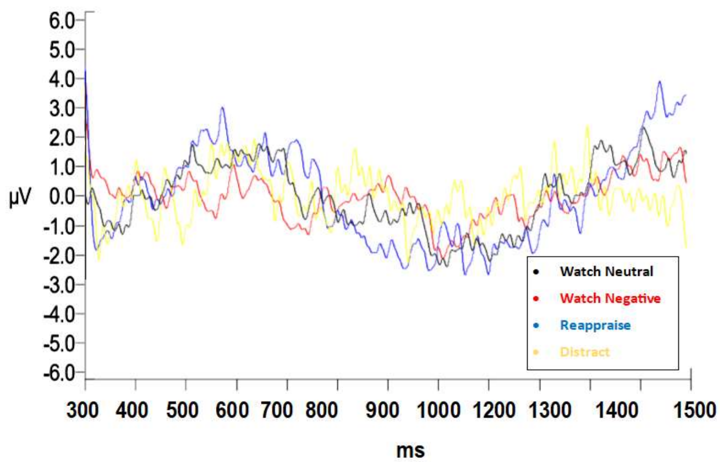

Figure 5. Grand average amplitudes in the negative mood

H(3): Mood and Distraction.

The third hypothesis assumed that distraction would remain the same regardless of mood state, attenuating at the onset of the LPP and consistently remaining at a lower amplitude of around 5 µV. The results of the current study showed that no matter what the grouping was, distraction did have a lowered amplitude of around 5 µV (see figure 1 and 2). This can be further validated by the significant difference found between the overall LPP activity for reappraisal and distraction for the twenty-five participants. Although it cannot be verified whether or not current mood had any relationship to distraction, it can be noted that distraction seemed to attenuate the LPP consistently throughout the time block of interest. Distraction, therefore, may be a useful emotion regulation strategy to deploy when in need of a faster way to regulate a negative situation.

H(4): Mood States versus Individual Differences

The last hypothesis for the current study stated that there would not be a significant difference between individual difference scores and the other variables, indicating that prior experience with emotion regulation strategies has minimal effect compared to mood. The average score on the Emotion Regulation Questionnaire indicated that the majority of the 25 participants were familiar with reappraisal. The distribution of the scores also indicated that there were no participants that did not use reappraisal strategies in some way in their day to day lives. The regression analysis seemed to validate this hypothesis, indicating that ERQ scores could not predict averaged reappraisal ability or mood (see appendix J). Since mood effects also indicated minimal significance, it could not be determined which external variable had more influence on the emotion regulation tasks. One interesting outcome of this regression analysis however is that the low adjusted R^2 value seemed to indicate that with more power behind the model future researchers may be able to view the relationships more clearly. Likewise, more variation in scores could have adjusted the relationships to see how ERQ scores interact with mood and emotion regulation ability when individuals are very familiar with reappraisal versus individuals who are not very familiar with reappraisal. This regression, however, may suggest that past history with emotion regulation does not have any bearing on the success of an individual's ability to reappraise and that the brain will always employ some sort of regulation when processing a negative stimulus.

Overall, there may have not been enough participants in extreme moods to note any significant difference between the groups. Despite the mood responses from participants, distraction continuously maintained a lowered amplitude when compared to reappraisal. In addition, reappraisal was less stable overtime with its averaged amplitude increasing again after the 1200 ms mark. This suggests that reappraisal may be more difficult to examine in an ERP analysis in comparison to distraction. It also suggests that reappraisal could be more difficult to employ quickly, as the participants only had five seconds to reappraise the images. Lastly, the results indicated that individual differences may not have as much as an influence on emotion regulation strategies as previously research would suggest (Denson et al., 2012; English et al., 2012; Gross & John, 2003; Moser et al., 2014) .

Limitations and Future Directions

It is important to examine the key limitations of the present study. First, in previous studies, participants usually had at least a day of practice before they reappraised images during a stimulus task (Thiruchselvam et al., 2011). This contrasts from the current study, as time constraints only allowed for the participants to practice the same day of their stimulus task recordings. Although the participants were told they could practice as many times as they wanted, none of the twenty-five participants felt they needed to practice more than once. A stricter approach to emotion regulation practice could be employed in the future to keep the method similar to previous research.

Another limitation to the current study was the distribution of reported mood. Although it is thought that mood can be reliably self-reported in real time (Mayer & Gaschke, 2013), it may be too nuanced to only have self-report as a measure. A closer inspection on participant reports uncovered that many participants varied in their responses from *slightly feel* to *slightly do not feel* which skewed their mood scores towards a pleasant or neutral mood state. Current literature on mood does seem to support the idea that mood exists on a continuum, yet during their analyses, the other researchers split mood into two levels, excluding a possibility for a neutral mood state (Mayer & Gaschke, 2013; Ortiz & Grof, 2016; Watson, 2000). Splitting mood into two levels of positive and negative seemed to be beneficial in the examination of relating clear variants of mood to other variables such as sleep, general well-being, and mental health assessments (Ortiz & Grof, 2016; Watson, 2000). However, the limitation of this strategy is that in many self-report measures, there are response options for *neutral* or *slightly feel* which are potential roadblocks to analyzing mood on two levels. For studies that elicit smaller sample sizes, additional mood measures may need to be implemented to encompass the overall state of the participants.

In order to accomplish this, eliciting mood through the means of a sad video, song, or reading prompt may further develop the relationship between mood and emotion regulation strategies. Although this would diminish the external validity slightly, it may be necessary for a more concrete examination on the relationship between mood and emotion regulation. If self-report is used over an elicitation strategy, it may be beneficial to implement multiple self-report measures in order to encompass all aspects of daily mood and prevent too many neutral responses from participants.

The Emotion Regulation Questionnaire (Gross & John, 2003) uncovered a similar limitation in terms of variation of self-report. Many of the participants were familiar with reappraisal, so the analyses in the current study did not provide much variation in terms of individual differences relating to efficiency in the distraction and reappraisal tasks. This lack of variation could be avoided in future research by increasing sample size or selecting participants that score low on the ERQ to participant in the study. Having a range of individual differences may uncover a pattern that is similar to what has been developed in the literature so far (Gross & John, 2003; Koole & Rothermund, 2011; McRae et al., 2010).

Latent positivity and affective images.

The final limitation of this study was the selection of the images for the stimulus task. The results for the distraction task indicated that there was no difference between distraction and the negative watch control task. There are many reasons to why this could have occurred. First, there could have been overlap between individuals distracting themselves continuously throughout the blocks that contained the distraction task instead of switching to the negative watch task (i.e. just attenuating to the image as it appeared). This can be corroborated by past research that maintains the LPP is subject to change depending on how the instructions are presented (Hajcak & Folti, 2008; Hajcak & Nieuwenhuis, 2006; MacNamera et al., 2009; Thiruchselvam et al., 2011). The current study had instructional cues that may have been too similar and therefore may have made it too difficult for the participants to efficiently switch between tasks. Furthermore, given how powerful distraction strategies can be, it may be difficult to switch from distraction to another task within a short window of time. Separating the distraction and negative watch conditions in the future may be beneficial to ensure that the participants are correctly following instructions.

Another consideration may be that the negative images did not have a strong enough valance to elicit emotional arousal. Evaluation of past research indicates that the pictures selected from the IAPS for those studies had lower valances and higher arousals than the pictures that were selected for the current study. For example, some key violent photographs in the IAPS archive were selected for the Thiruchselvam et al. (2011) and for the Moser et al. (2014) study, with some having valance ratings lower than a 3 (indicating extremely unpleasantness; Lang & Bradley, 1997). Although not all of the pictures had lower valance ratings than the images selected for the present study, the differences were notable enough that the Thiruchselvam et al. (2011) team and other past researchers may have been able to elicit stronger reactions due to the use of more disturbing novel images. In order to protect participant welfare, the images in the current study had to be carefully selected and examined to make sure that even though they were negative, they would not elicit a long-lasting fear response. Because of this, many of the negative photos depicting disturbing imagery in the IAPS archive were disregarded and the more trivial negative images were utilized.

The utilization of trivial negative images may have produced too many similarities between the tasks as a whole. Given how graphic the images were in the previous studies, it seems that in order to evaluate changes in the latent positive potential appropriately, extremely adverse stimuli may need to be utilized. Inconsistency in the negative image category may have created subtle negative responses in the participants, which made it more difficult to see any electrophysiological changes overall. Future analysis of image intensity related to latent positivity may be a beneficial addition to understanding amplitude differences of negative reactions. In addition to the valance discrepancies, the images may have not been adequately shuffled between tasks. Overall, ensuring that very different images are next to each other may be a key process for setting up an affective stimulus task in the future to ensure a novel reaction to each stimulus. Finally, having the negative-watch control in a separate block than distraction may provide a beneficial change in the stimulus results as it would provide concrete certainty that the tasks are not overlapping.

Conclusion

Emotion regulation is a fundamental aspect of human behavior and emotion processing (Panksepp, 2004). The present study examined the relationship between the neural markers of reappraisal and distraction, self-reported mood, and individual differences in experience utilizing reappraisal. Although there was no conclusive evidence to support that mood related to changes in the latent positivity of the two regulatory tasks, results did suggest that distraction employed a lower amplitude than reappraisal altogether. This indicated that reappraisal may be beneficial as a longer term, practiced emotion regulation strategy. In addition, it may not be beneficial to study the short-term changes of reappraisal in future studies. Despite these findings, distraction and reappraisal are important strategies to employ when wanting to control the type of emotions that one feels or the intensity of those emotions (Gross, 1998). Although reappraisal occurs at a slower process than distraction, the long-term effects of reappraisal have still been shown to benefit overall wellbeing (Berna et al., 2010; Forgas et al., 2009; Gross & John, 2003).

Moreover, the stimuli used for the present study may have not been intense enough to elicit the reactions required for proper analysis of the latent positive potential. Finally, further analysis suggests that gathering more varying information on individuals' history using different emotion regulation strategies would provide a well-rounded look on its strategic relationship to latent positivity. In addition, the self-reporting of daily mood seemed to be more nuanced than initially expected with participants reporting mostly pleasant facets with only slight negative feelings such as stress, sadness, or drowsiness. This highlights the fact that it may be important to edit these methods and control for mood in order to examine if mood may potentially influence an individuals' ability to regulate emotions successfully. Overall, future research on the neural markers of emotion regulation are warranted to aid in the understanding of the neurological underpinnings of emotion processing and their possible implications for general well-being.

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APPENDIXES

APPENDIX A

Emotion Regulation Strategies

The following is a scenario that would require the use of an explicit emotion regulation strategy:

It is a dark weekday night and you are walking home from the train stop. Although it is a short walk home, you are finding that it feels longer, due to the clouds covering the usually bright moon. As you keep walking you pass a fence and a dog starts to jump up on the fence and bark at you. You step back, frightened. You have three choices of explicit emotion regulation that you can use.

1. Reappraisal: If you choose to use reappraisal, you may keep walking and think about the dog in a more positive way. Maybe the dog is a kind dog and was just protecting its home. You also may have scared the dog more than it scared you. Telling yourself that the dog is actually a kind and gentle dog recreates the negative situation into a positive situation (reappraisal) and you can quickly calm down as you keep walking.
2. Distraction: If you choose to utilize distraction, you may begin to instantly think about the ice cream you have waiting for you at home. By thinking about something completely unrelated to the dog, you can quickly distract yourself from the situation and calm down.
3. Suppression*: If you were to utilize suppression, you may just keep walking fast away from the dog and try to push away any feelings or thoughts you have at all. You are still focusing on the dog but trying to dull your feelings as you walk. This

will effectively calm you down and you may even forget that you ever had the encounter. Using suppression, however, may negatively affect your relationship with all dogs in the future and you might not even understand why.

*Suppression was added as an example in order to understand the three most popular emotion regulation strategies. It will **not** be used in the study.

APPENDIX B

Brief Mood Introspection Scale

Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988)

Instructions: Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

1 (definitely do not feel) 2 (do not feel) 3 (slightly feel) 4 (definitely feel)

1. Lively
2. Drowsy
3. Happy
4. Grouchy
5. Sad
6. Peppy
7. Tired
8. Nervous
9. Caring
10. Calm
11. Content
12. Loving
13. Gloomy
14. Fed up
15. Jittery
16. Active

*Question 17 of the BMIS is not used for this study

APPENDIX C

Emotion Regulation Questionnaire

Emotion Regulation Questionnaire (ERQ; Gross & John 2003)

Instructions: We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways.

For each item, please answer from 1 (Strongly Disagree) to 7 (Strongly agree)/

1. When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.
2. I keep my emotions to myself.
3. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.
4. When I am feeling positive emotions, I am careful not to express them.
5. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.
6. I control my emotions by not expressing them.
7. When I want to feel more positive emotion, I change the way I'm thinking about the situation.
8. I control my emotions by changing the way I think about the situation I'm in.
9. When I am feeling negative emotions, I make sure not to express them.
10. When I want to feel less negative emotion, I change the way I'm thinking about the situation.

APPENDIX D

Important Figures

Figure D1. IAPS Stimuli Examples

All photographs were obtained from the International Affective Picture System (Lang et al. 1997). These photographs are examples of the kinds of pictures that the participants were shown during the modified visual odd-ball task. Pictures in section A of the above example are negative stimuli and pictures in section B are neutral stimuli. For all four trials, the participant received different negative pictures and neutral pictures to keep the images novel to obtain the best results.

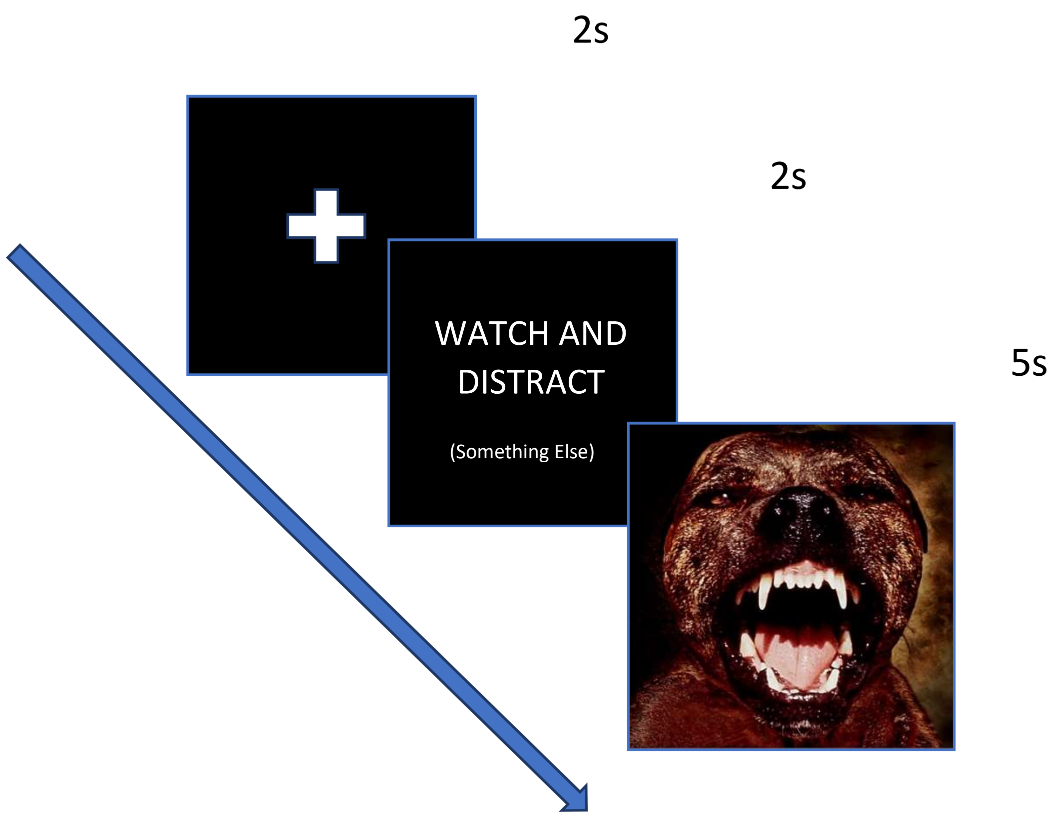


Figure D2. Trial Sequence

Each trial began with a white fixation plus sign in the center of a black screen for 2s. This was followed by an instruction queue (WATCH AND REAPPRAISE, WATCH AND DISTACT, WATCH NATURALLY) for 2s. Each instructional cue also had an additional cue to remind the participants of what to do. For WATCH AND REAPPRAISE, the addition was "something positive", the WATCH AND DISTRACT addition was "something else", and the WATCH NATURALLY was "just observe". The instructional queue was followed by an IAPS picture for 5s where the recording took place. The trials within the blocks were randomized with each participant and the blocks will be counterbalanced. The blue outline of the boxes appears in this example as a way to separate the induvial boxes.

APPENDIX E

IAPS Image Keys

Each of the following number sequences corresponds to which negative image in the IAPS archive was used for the stimulus task. Images were selected based off of their valance and arousal ratings and were heavily vetted by the researcher and Human Subjects Review Committee at Central Washington University to ensure patient safety.

1302	1220	2590
1931	1930	2695
2100	1304	9220
2010	1275	9290
2271	2039	9295
2280	2455	9342
2339	2456	9360
2491	2694	9470
2457	2691	9621
2520	2700	983
2772	6020	9480
2770	6190	9266
2681	9180	9941
2682	9186	9912
2753	9291	9560
2745.2	9270	9010
3310	9390	9001
5961	9440	1200
6000	9471	1110
6010	9610	1525
6241	963	2301
6220	9922	2120
6837	9927	2688
6840	9600	2692
3216	9090	6200
1271	9120	6940
1080	9000	9927

APPENDIX F

Lab Issued Demographic Survey

Brain Dynamics & Cognitive Neuroscience Lab

Central Washington University

Participant History Questionnaire

1. What is your age? ___________

2. What is your biological sex?
   - ❑ Male
   - ❑ Female
   - ❑ Prefer not to answer

3. What is your race/ethnicity? ____

4. Have you ever had a concussion, stroke, seizure, or any other traumatic brain injury?
   - ❑ Yes
   - ❑ No

   If yes, please explain the injury and when this occurred.

   ____
   ____

5. Do you have a vision impairment that cannot be corrected for with lenses or glasses?
   - ❑ Yes
   - ❑ No

6. Do you have a hearing impairment that cannot be corrected for with a cochlear implant or hearing aids?
   - ❑ Yes
   - ❑ No

7. Have you taken any pharmaceutical or nonpharmaceutical drugs within the past two weeks?
   - ❑ Yes
   - ❑ No

   If yes, please specify.

   ____

APPENDIX G

Lab Issued Handedness Survey

Brain Dynamics & Cognitive Neuroscience Lab

Central Washington University

Hand Preference Questionnaire

Please indicate which hand you use for each of the following activities by circling:
R for right **L** for left or **E** for either

Which hand orientation would you use:

To write a letter clearly?	R	L	E
To throw a ball to hit a target?	R	L	E
To hold a racket in tennis, squash, or badminton?	R	L	E
To hold a match while striking it?	R	L	E
To cut with scissors?	R	L	E
To guide the thread through the eye of a needle?	R	L	E
At the top of the broom while sweeping?	R	L	E
At the top of the shovel when moving sand?	R	L	E
To deal a deck of cards?	R	L	E
To hammer a nail into wood?	R	L	E
To hold a toothbrush while cleaning your teeth?	R	L	E
To unscrew the lid of a jar?	R	L	E
To play your most practiced instrument?	R	L	E
To hold a pick while playing guitar?	R	L	E

If you use the RIGHT HAND for all these actions, are there any one-handed actions for which you use the left hand? Please list:

If you use the LEFT HAND for all of these actions, are there any one-handed actions for which you use the right hand? Please list:

Were you born one of TWINS? _________ or TRIPLETS? _________

If yes, please indicate the hand preference of your twin or triplets.
____

If you have children, please indicate the hand preference of your:

First Child __________ This child's other parent ___________

Second Child __________ This child's other parent ___________

Third Child __________ This child's other parent ___________

APPENDIX H

ERQ and BMIS Distributions

The following Histograms are the survey result distributions for the ERQ and BMIS

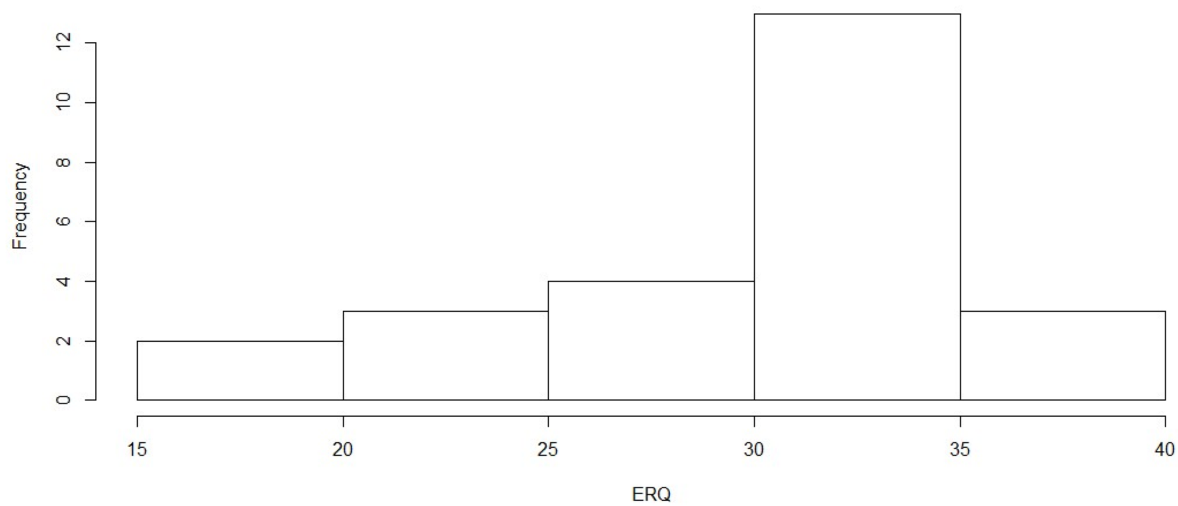


Figure H1. Histogram of ERQ Raw Scores

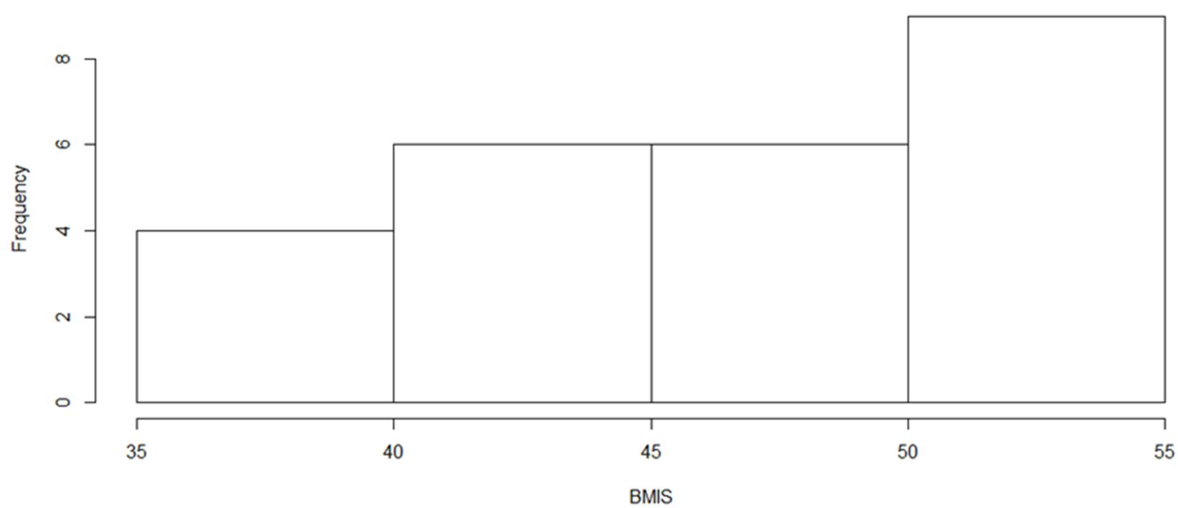


Figure H2. Histogram of BMIS Raw Scores

APPENDIX I

Visual Activity for Emotion Regulation Tasks

These visuals provide snapshots of each latent positive time block (300-600, 600-900, 900-1200, 1200-1500) of the distraction task and reappraisal task in terms of active areas of the brain. Red areas indicate higher activity. Note: these averages do not fully represent average brain activity due to the age and function of the electrodes. They are provided to add perspective to the overall differences between distraction and reappraisal.

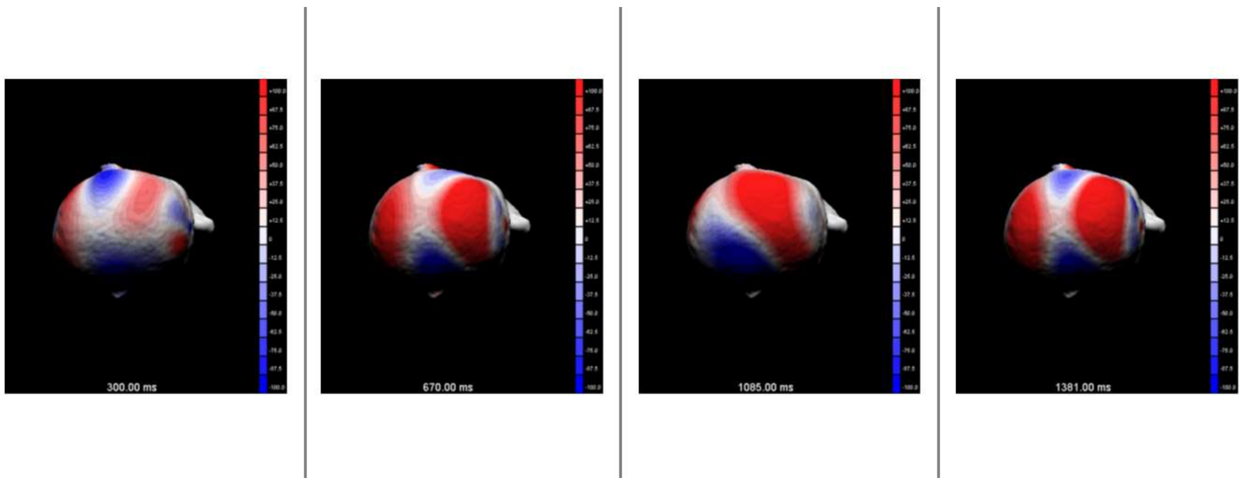


Figure I1. Average Brain Activity for the Reappraisal Time Blocks

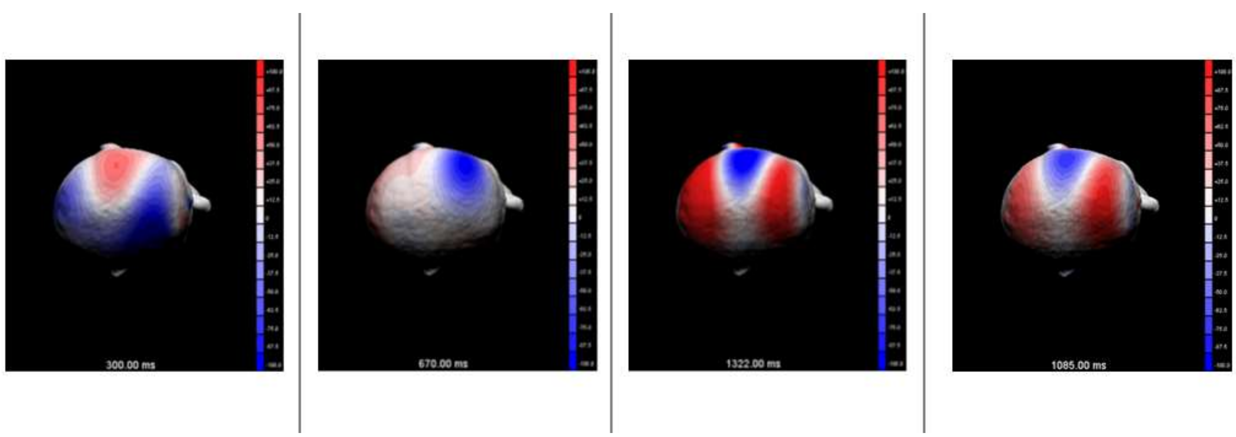


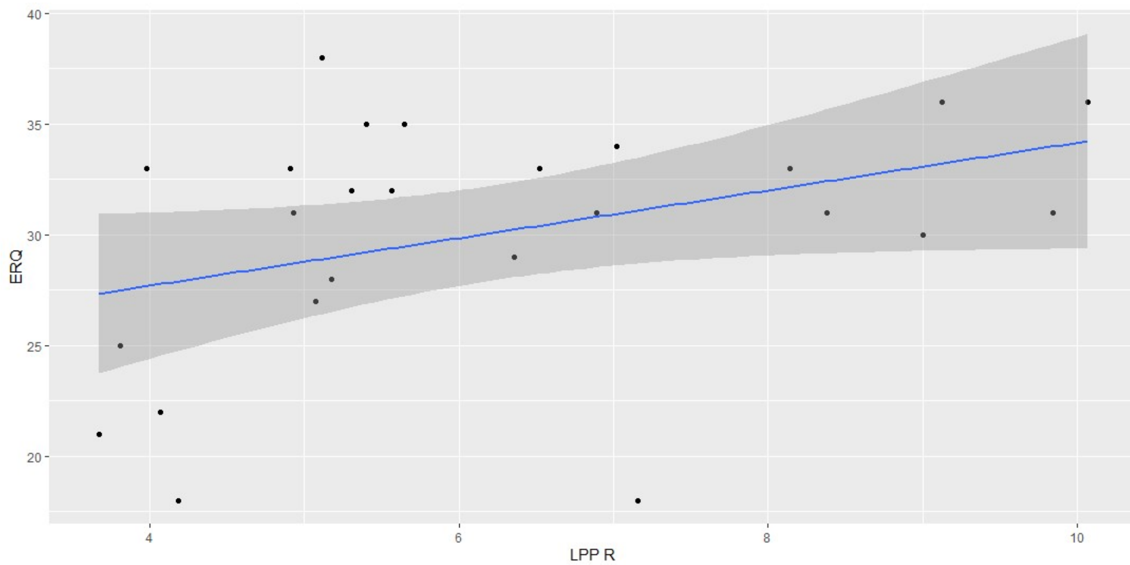
Figure I2. Average Brain Activity for the Distraction Time Blocks

APPENDIX J

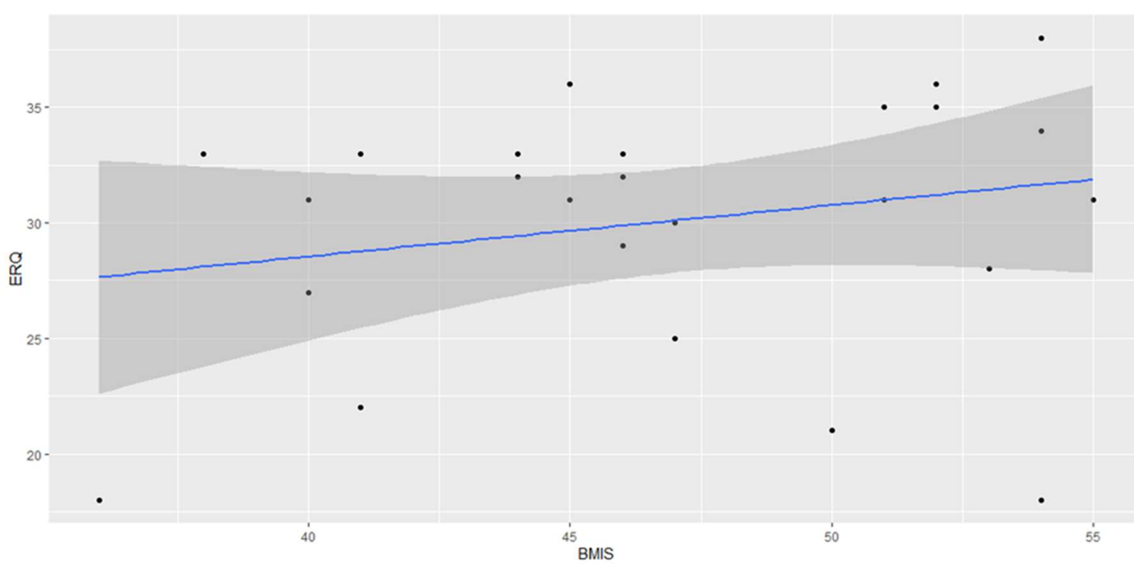
ERQ Regression Lines

The following three regression lines visually represent the weak relationships between ERQ, the regulation strategies, and Mood.

A



B



C

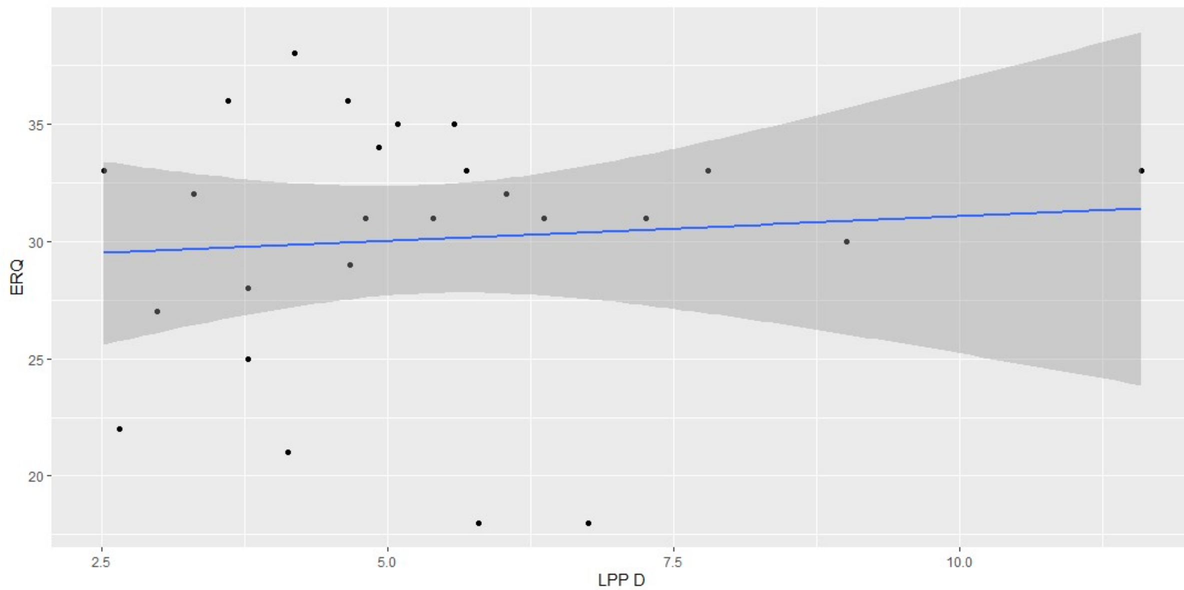


Figure J1. ERQ Regression Lines