THE RELATIONSHIP BETWEEN EMOTION REGULATION AND DIFFERENT TYPES OF INHIBITION

By

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A thesis submitted to the

Graduate School-Camden

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of Master of Arts

Graduate Program in Psychology

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Camden, New Jersey

May 2019

THESIS ABSTRACT

The Relationship between Emotion Regulation and Different Types of Inhibition

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Emotion regulation can be viewed as the process that individuals engage in to alter the intensity, duration, or type of emotion they are experiencing. Two of the ER strategies that have been found to be effective in their ability to reduce negative emotions are reappraisal and distraction. However, the role of individual cognitive factors, particularly inhibition, on the efficacy of these strategies is not thoroughly understood. Thus, the purpose of the current research was to determine the impact of different kinds of inhibition on ER efficacy. Participants completed two cognitive tasks: the Eriksen flanker task measuring inhibitory control of attention and a memory inhibition task measuring cognitive inhibition. Participants also completed an emotion regulation task in which they were asked to view graphic pictures and use either reappraisal or distraction to reduce their negative emotional reactions. Contrary to my hypotheses, there were no significant relationships between performance on the inhibition and emotion regulation tasks. Future research should investigate whether these findings are indicative of methodological limitations or reflect the true nature of the relationship between these variables.

Acknowledgements

I would like to thank my committee members Bill Whitlow and Ira Roseman for their valuable insight and helpful advice with the current research. I would also like to give a special thanks to my advisor Kristin August for her indispensable insight, constant encouragement, and efficacious assistance.

The Relationship between Emotion Regulation and Different Types of Inhibition

Imagine you are in a waiting room preparing for an important interview. You have taken out extensive student loans, lived in a cramped apartment, and interned for almost a year in order to have the opportunity for this job interview. How might you deal with the anxiety, anticipation, excitement, and myriad of other emotions that you inevitably would be experiencing? Some might try to distract themselves by talking to friends on the phone or listening to music. Others might try to change their view of the interview, focusing on the exciting, rather than the anxiety-inducing, aspects of the situation they are in. Why do certain strategies work for some people but not others? What individual differences help to illuminate the success of these different strategies in reducing individuals' anxiety (and other negative emotions) and allowing them to more effectively perform in a high-stakes situation such as a job interview? The purpose of the current research was to investigate whether differences in executive function, particularly differences in inhibition, predict the effectiveness of different emotion regulation strategies. By discerning the impact of inhibition on emotion regulation, I hoped to provide some insight into the role of individual cognitive factors on emotion regulation success.

Emotion Regulation

Emotion regulation (ER) can be viewed as the process that individuals engage in to alter the intensity, duration, or type of emotion they are experiencing, necessitating the activation of the goal to modify or affect one's emotional experience (Gross, 1998; Gross, 2015; Gross, Sheppes, & Urry, 2011). While individuals may engage in ER in order to alter their affect, other goals, such as cognitive or social goals, also may be the motivating force behind emotion regulation (Gross, 2013). For example, Kalokerinos, Tamir, and Kuppens (2017) found that individuals often regulate their negative emotions to help them accomplish tasks, facilitate social relationships, learn, or engage in self-improvement. Alternately, one might regulate one’s emotions in order to recall items on a test.

Although there are many ways in which ER can be classified (e.g. Braunstein, Gross, & Ochsner 2017; Koole, 2010), most research has focused on strategies that individuals actively and consciously engage in to achieve some goal (Braunstein et al., 2017; Gross, 2015). Two of the main types of ER strategies that fall under this category are reappraisal and distraction.

Reappraisal has received a significant amount of attention, particularly due to its effectiveness in regulating emotions and its associations with positive mental and physical health outcomes (Braunstein et al., 2017). Reappraisal is a cognitive ER strategy that involves altering the meaning or self-relevance of a situation so as to influence one’s emotions, although the term is frequently used in the broader sense to refer to changing one’s appraisal of the situation (Gross, 2015). Although much research has focused on reappraisal’s ability to reduce the intensity of emotional responses, it also can be used to increase the intensity of emotions that an individual is experiencing (Ochsner, Silvers, & Buhle, 2012). Furthermore, reappraisal can be implemented in several different ways. For example, some studies have asked participants to change their interpretation of the stimulus in a more positive manner while others have had participants take an objective perspective of the stimulus (Ochsner et al., 2012).

Another ER strategy that researchers often examine is distraction. Distraction is a form of attentional deployment, which involves controlling attention so as to manage one's emotions. More specifically, distraction involves diverting one's attention away from or focusing on different aspects of the emotion-inducing stimulus or situation, either visually or internally with one's thoughts (Gross, 2015), with the latter definition being the most commonly used in the ER literature. Thus, distraction can be both a cognitive and behavioral task. Researchers frequently operationalize this variable by having participants engage in another task during exposure to the emotion-eliciting stimulus or having them try to think of something else. For example, Sheppes and Meiran (2007) instructed participants to think about something neutral, like a flock of birds, while watching a sad documentary.

These strategies have often been compared to one another, both in their efficacy in reducing the intensity of experienced emotion as well as their impact on other cognitive, and even social, processes. One important way in which reappraisal and distraction can be distinguished is by the *intensity* of the emotional stimuli, that is the combined emotional valence and arousal of the stimuli. When given a choice between reappraisal and distraction, individuals will differentially choose one strategy over the other depending on the emotional intensity of the stimuli. If the emotional intensity is high, individuals prefer distraction over reappraisal; if the emotional intensity is low, individuals prefer reappraisal (Sheppes, Scheibe, Suri, & Gross, 2011; Sheppes et al., 2014). Thus, when comparing the efficacy of reappraisal and distraction, considering the emotional intensity is important.

Additionally, reappraisal and distraction differ in their impact on cognitive resources. Sheppes et al. (2008) studied the impact of using reappraisal versus distraction on subsequent performance on the Stroop task (a common task in the cognitive literature used to measure inhibition and self-control). They found that those participants who were assigned to regulate their emotions via reappraisal performed worse on the Stroop task than those who were assigned to regulate their emotions via distraction, suggesting that using reappraisal had depleted more of their cognitive resources and thus negatively affected their performance on the subsequent cognitive task. Likewise, Sheppes, Catran, and Meiran (2009) found that, when comparing the use of reappraisal and distraction late in the emotion-inducing situation, reappraisal led to an increase in skin-conductance level, a physiological reaction associated with effortful self-control (e.g. Wegner & Gold, 1995; Wegner, Shortt, & Blake, 1990). This suggests that reappraisal requires greater cognitive resources and self-control.

Furthermore, reappraisal and distraction differ in their pattern of visual attention. Using eye tracking, Strauss, Ossenfort, and Whearty (2016) found that distraction involved more quickly diverting attention to the non-emotional aspects of the emotion-inducing stimulus while reappraisal involved first focusing attention on the emotion-inducing aspects of the stimulus and then diverting attention to the non-emotional aspects of the stimulus. Thus, there appear to be differences in the allocation of attentional resources when using reappraisal and distraction.

ER and Health

The importance of ER stems from the critical role it plays in physical and mental well-being. Many different mental disorders, including depression, borderline personality disorder, and substance-use disorder are thought to be related to emotional dysregulation and deficient coping abilities (Berking & Wupperman, 2012; Gross, 2013). The strategies used to regulate emotions have distinctive/unique effects on health. For example, reappraisal is positively associated with good mental health and negatively associated with poor mental health (Hu, Zhang, & Wang, 2014). Distraction, when combined with high acceptance of one’s feelings, also appears to be an effective means of promoting positive emotionality and well-being (Wolgast & Lundh, 2017). Likewise, research has suggested that ER plays a key role in physical health as well. For example, controlling for sociodemographic factors, IQ, and health measurements such as child cardiovascular conditions and hematologic conditions, reappraisal significantly predicts lower C-reactive protein levels, a common measure of inflammation and an important factor in many physical health conditions (Appleton, Buka, Loucks, Gilman, & Kubzansky, 2011).

Inhibition

Given the importance of ER in physical and mental well-being, many studies have focused on factors that influence the efficacy and use of different ER strategies. One of the factors that may be related to ER is executive function. Although researchers differ in the precise definition of executive function (Martin & Failows, 2010), it can be broadly defined as top-down cognitive processes that monitor, coordinate, and control attention and behavior. Executive function is associated with the frontal lobes and is typically engaged when automatic, intuitive, or habitual thoughts and behaviors are insufficient to meet the demands at hand (Diamond, 2013; Friedman et al., 2008; Martin & Failows, 2010; Schmeichel & Tang, 2015).

Executive function is typically divided into three related but distinct sub-components: working memory, cognitive flexibility, and inhibition (Diamond, 2013). Although these components share much genetic variance and build off of the functioning of each other, they are generally thought to be distinct from one another (Diamond, 2013; Friedman et al., 2008). Broadly speaking, working memory refers to one's ability to both maintain certain thoughts in one's head as well as manipulate them. Cognitive flexibility refers to the ability to switch between tasks, to shift and update perspectives and goals based on new information, and to be able to view things from different positions (Diamond, 2013).

The focus of this study is on the third category of executive function: inhibition. Inhibition involves controlling one's thoughts, attention, behaviors, and emotions in order to resist inclinations arising from habit or elicited by specific environmental stimuli (Diamond, 2013). For example, inhibition is being used when an individual wants to ignore stressful thoughts while trying to fall asleep or to avoid eating a favorite dessert when an individual is on a diet.

The Relationship between Different Inhibitory Processes

As the definition indicates, inhibition involves different types of control, which research suggests may be separable processes. Of particular interest for the current study, research suggests that there may be differences between inhibitory control of thought, or cognitive inhibition, and inhibitory control of attention. Cognitive inhibition, or controlling unwanted thoughts, is measured in a variety of ways. Researchers have used garden path sentences (Engelhardt, Nigg, Carr, & Ferreira, 2008), which involve inhibiting one's initial interpretation of a sentence to accurately relay the meaning of the sentence (e.g. interpreting the sentence, “while Anna bathed the baby that was small and cute spit up on the bed” involves inhibiting the initial thought that Anna is bathing the baby), as well as a variety of recall tasks in which previously relevant words must be inhibited in order to accurately recall related but distinct words (e.g. Friedman & Miyake, 2004). Inhibitory control of attention involves inhibiting certain stimuli in one’s environment in order to focus one’s attention on a designated stimuli or task. One of the more common measures of this is the Eriksen Flanker Task (Eriksen & Eriksen, 1974), which involves responding based on a central stimulus while ignoring other stimuli in the surrounding environment (e.g. responding to the central arrow in this figure while ignoring the surrounding ones ← ← → ← ←).

There is some evidence to suggest that the different types of inhibition are distinct processes. For example, Friedman and Miyake (2004) conducted a study in which they had participants engage in an array of inhibition tasks and then conducted confirmatory factor analysis to try to distinguish different types of inhibition. They found that resistance to proactive interference (which involves cognitive inhibition) loads onto a separate factor than resistance to distractor interference (which involves attentional control) and prepotent response inhibition, while the latter two loaded onto the same factor. Similarly, Borella et al. (2017) found that individuals with mild cognitive impairment performed worse than controls on a proactive interference task while such deficits were not present when performing response to distractors and prepotent response inhibition tasks.

While these studies do suggest that different forms of inhibition may be separate processes, these findings must be interpreted with caution. Inhibition is measured in a variety of different ways, and there is not a general consensus as to the most accurate or even most valid measurement type (Diamond, 2013). Researchers often use the same task to measure theoretically distinct constructs. For example, the Stroop task is sometimes used as a measure of prepotent response inhibition (e.g. Friedman & Miyake, 2004; Borella et al., 2017) but is also sometimes cited as a measure of interference control (e.g. Votruba & Langenecker, 2013). Furthermore, even though researchers may use the same task to measure certain cognitive constructs (e.g. the stop-signal task for behavioral/motor inhibition), the way in which performance on these tasks is measured differs across studies. Khng and Lee (2014) found that the relationship between the Stroop task and stop-signal task differed depending on the way in which the outcomes associated with engagement in these tasks were measured (error rate, reaction time, etc.). Thus, further research is required to help understand how measurement accounts for differences in the inhibitory processes seen in the literature.

ER and Inhibition

Several studies have looked at the relationship between inhibition and ER, producing mixed results. For example, research has suggested that reappraisal and motor inhibitory control may share a common neural correlate (Tabibnia et al. 2011). This same study also found that performance on the inhibition and reappraisal tasks were moderately correlated. Other research found that higher scores on the stop signal task predicted less strong emotional reactions as a result of an autobiographical mood induction even after controlling for personality differences in emotional reactivity (Tang & Schmeichel, 2014). Some studies, though, have found no relationship between inhibition and ER ability. For example, McRae, Jacobs, Ray, John, and Gross (2012) found no significant relationship between reappraisal ability and performance on the Stroop task. Similarly, Gyurak, Goodkind, Kramer, Miller, and Levenson (2012) found no relationship between performance on the Stroop task and ER when using facial expression and heart rate as the dependent variable.

The present research

Such divergent results in the literature suggest that further research needs to be conducted on the relationship between different inhibitory processes and ER. Although these inconsistent results may reflect actual limitations in the measurements of inhibition, they also may suggest that different types of inhibition are differentially related to ER. In particular, cognitive inhibition may be uniquely related to reappraisal. Since reappraisal involves reinterpreting a situation so as to alter one's emotional response to that situation (Gross, 2015), it seems likely that an essential element of this process is "blocking out" one's initial interpretation of the situation. This is partially supported by research that has shown that reappraisal requires greater cognitive resources and self-control (e.g. Sheppes et al., 2008; Sheppes et al., 2009) compared to distraction. On the other hand, inhibitory control of attention may be uniquely related to distraction. Since distraction involves controlling one's attention so as to alter one's emotional response (Gross, 2015), it seems likely that an essential element of this process is suppressing certain features of the emotion-inducing stimulus or situation to facilitate this process. This idea is supported by research which has found that distraction involves more quickly diverting one's visual attention to the non-emotional aspects of an emotion-inducing stimulus whereas reappraisal involves engaging with the emotion-inducing aspects of the stimulus before diverting attention away from them (Strauss et al., 2016).

Understanding the relationship between different types of inhibition and ER may help to inform our understanding of the role individual differences play in ER success and provide new directions for developing strategies to increase effective ER in those who need it (Gross, 2014). Looking at the relationship between ER and different types of inhibition also may help to establish whether different types of inhibition can be measured and distinguished by the current instruments in the field. If scores on different inhibition measures differentially predict ER success, this would provide support that the instruments in the field can provide valid measurements of different types of inhibition.

Lastly, little research has been done to explore the feasibility of ER research online. Much of the research on ER has exclusively used in-person designs, and, by extension, smaller sample sizes. This study utilized both an online and in-person sample, allowing for comparisons to be made between the two groups and the comparative effectiveness of both methods to be analyzed.

Thus, the purpose of the current study was to investigate the relationship between different types of inhibition and ER strategies. By discerning these relationships, I hoped to come to a better understanding of the differences between cognitive inhibition and inhibitory control of attention, and their relationship to reappraisal and distraction. This research had three primary aims:

1. To identify the relationship between cognitive inhibition and inhibitory control of attention. I hypothesized that performance on each type of inhibition would be correlated but that different types of inhibition would remain distinguishable constructs. Specifically, I hypothesized that the different types of inhibition would only be moderately correlated and

differentially moderate the relationship between ER strategy and subjective reports of negativity.

2. To investigate whether inhibition moderates the effectiveness of ER strategies in reducing subjective reports of negativity. I hypothesized that inhibition would moderate the relationship between ER strategy and negativity reports, such that both ER strategies would be more effective in reducing negativity reports for those who scored higher across both inhibition measures compared to those who scored lower on the inhibition measures.
3. To investigate whether specific types of inhibition moderate the effectiveness of ER strategies in reducing subjective reports of negativity.
    a. Although there is limited research specifically addressing this topic, based on research suggesting that distraction involves a more rapid divergence of attention away from the emotion-inducing aspects of the stimuli in order to develop neutral thoughts (Strauss, et al., 2016), I hypothesized that inhibitory control of attention but not cognitive inhibition would moderate the relationship between distraction and negativity ratings such that distraction would be more effective for those with greater selective attention.
    b. Based on past research showing that reappraisal requires greater cognitive resources (e.g. Sheppes et al., 2008; Sheppes et al., 2009), I hypothesized that cognitive inhibition but not inhibitory control of attention would moderate the relationship between reappraisal and

subjective negativity such that reappraisal would be more effective for those with greater cognitive inhibition.

Method

Participants

A total of 68 students between the ages of 18-25 were recruited for this study from the Human Subjects Pool at Rutgers, Camden. An additional 52 participants from Mechanical Turk (Mturk) between the ages of 18-25 also were recruited to help ensure appropriate levels of power were obtained and to test the validity of ER research online. Given research indicating differential inhibitory abilities amongst those with and without ADHD (Engelhardt et al., 2008), any participant currently diagnosed with ADHD was excluded from the current study. Given the complexity of instructions for both the inhibition and ER tasks and the necessity of comprehension of those instructions in order to attain valid measurement of those constructions, as well as the fact that research suggests culture influences the efficacy of ER strategies (Butler, Lee, & Gross, 2007), individuals outside of the US and those who did not speak English as their primary language were also excluded from the study.

Procedure

This study had a 2 x 2 factorial design with two between-subject levels (ER strategy) and 2 within subject levels (type of inhibition). Specifically, half of the participants used the ER strategy of distraction while the other half used reappraisal. However, all participants completed the cognitive inhibition and inhibitory control of attention measures. The outcome of interest was the level of subjective ratings of negativity (see Table 1). This study was submitted and approved by the Rutgers University IRB.

Table 1

Conditions for the Experiment

Condition	Between-subject IV	Within subject IV	Dependent Variable
Condition #1	Reappraisal	Inhibitory Control of Attention Cognitive Inhibition	Negative Emotional Response Ratings
Condition #2	Distraction	Inhibitory Control of Attention Cognitive Inhibition	Negative Emotional Response Ratings

Student participants were recruited through the university's online portal system (Experimetrix), which allows students to sign up for studies in return for course credit. Students also were also recruited in-person. A posting for this study was made on Mturk and participants who met the eligibility requirements were be able to sign up. Research has suggested that Mturk participants with high approval ratings and more experience tend to produce the best quality data (e.g. Peer et al., 2014). Thus, in order to participate, all Mturk participants were required to have at least a 95% approval rating and have at least 500 Approved Assignments. Research has also suggested that the quality of data often suffers when participants outside of the US are used, likely due to language and comprehension differences (e.g. Chandler & Shapiro, 2016). Thus, Mturk participants were restricted to US workers who spoke English as their primary language. Studies have also found that the time of day plays an important role in the quality of the data and have suggested that tasks that are more complex and use reaction time measurements be conducted earlier in the day and on weekdays (Arecher et al., 2017; Casey et al., 2017). Hence, the Human Intelligence Tasks (HITs) were only be available Monday and Wednesday from 10AM – 2 PM. Lastly, research has suggested putting a time limit on the research (Kite & Whitley 2013), which may help to minimize Mturk participants working on multiple studies at the same time. Thus, a two-hour limit for study completion was set. All Mturk participants were compensated $8 for their participation. Funding for this project came from the Dean's Graduate Student Scholarship at Rutgers University – Camden.

Participants completed this study on Qualtrics®. All participants filled out a consent form discussing the nature of the experiment. After completing a brief demographics questionnaire asking for age, gender, and race/ethnicity, the participants began either one of the cognitive tasks or the ER task. The order in which the ER and inhibition tasks were presented was counterbalanced. In between each task, participants were presented with a short set of neutral pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) to help prevent carry-over effects. These neutral pictures had a mean emotion valence of 5.12 (on a scale of 1 = *very unpleasant* to 9 = *highly pleasant*) and a mean arousal of 3.44 (on a scale of 1 = *low* to 9 = *high*).

The procedure for the ER task was modified from the design of a study done by Sheppes et al. (2014). Participants were randomly assigned to one of two conditions: reappraisal or distraction. Participants were shown the instructions for their respective ER strategy and told to carefully read and follow the instructions. After reading the instructions, participants completed five practice trials. During the practice trials, *student* participants said what they were doing to feel less negative while viewing the pictures out loud and corrected by a researcher if they were not using the correct strategy. Following the practice trials, participants were once again shown the instructions for their assigned ER strategy and complete 15 more experimental trials. Each trial consisted of a fixation cross presented for 500 ms followed by the picture for 5000 ms. Following each picture, participants were asked the following question: “How negatively does this picture make you feel?” and were prompted to respond on a scale of 1= *not negative at all* to 9 = *very negative*. As a manipulation check on the experimental trials, after every five trials, participants were prompted to briefly describe the strategy they used. If the description of the strategy used by the participants did not match the assigned strategy, the five previous trials were excluded from analyses.

After completing the inhibition and ER tasks, the participants watched a brief clip from the movie *Wall-E*. This clip has been used in a previous study and shown to be rated as both pleasant and relaxing (Bartolini, 2011). Following this, all participants were debriefed.

Measures

All inhibition measures were created using the online toolkit Psytoolkit® (Stoet, 2010; Stoet, 2017). These tests were embedded into the Qualtrics survey, which also contained the pictures and measure for the ER task. The measures used for each of the variables in this study are summarized in Table 2.

Pilot testing. Pilot tests with eight undergraduate students were conducted to help assess the time required to complete the tasks, clarity of the directions, the feasibility of the time cut-offs, and the impact of the tasks on felt emotions. The tasks were altered to incorporate the students' feedback.

Inhibitory Control of Attention. To measure selective attention, participants completed the arrow flanker task. For this task, participants were presented with a series of 5 arrows. Participants were instructed to pay attention to the central arrow and to ignore the flanker arrows. On congruent trials, the flanker arrows faced the same direction as the central arrow (e.g., ←←←←←). On the incongruent trials, the flanker arrows faced the opposite direction (←←→←←). Thus, there were a total of four different conditions presented to participants (left-facing arrows, right-facing arrows, congruent, incongruent). Although many studies also include a neutral condition (e.g. a central arrow surrounded by non-arrow flankers, --→--), performance on this task was only assessed by comparing performance on the congruent and incongruent trials. Thus, the neutral trials were excluded in order to reduce participant burden and the overall length of the experiment.

Each trial started with a fixation cross that appeared in the center of the screen for 200 ms followed by an intermediate blank screen for 300 ms. The target stimuli and their flankers then appeared for 800 ms during which time the participants responded. Although many other studies use a longer response period (e.g. Voelcker-Rehage, Godde, & Staudinger, 2011) or do not limit participants' response times (e.g. Friedman &

Miyake, 2004), this 800 ms limit was used to capture individual differences in accuracy. Hedge et al. (2017) noted that there is often little variation amongst individuals in accuracy on congruent trials, with most participants having extremely high accuracy. Thus, in order to capture individual differences in accuracy for both congruent and incongruent trials, the 800 ms limit was used. The target stimuli were followed by a blank screen for 500 ms. Participants were instructed to react as quickly and as accurately as possible. Participants had 40 practice trials followed by 6 blocks of 40 trials each. During the practice trials, the participants were given feedback based on whether they pressed the correct key and whether or not they completed the response within the 800 ms. Feedback was not be given during the experimental blocks. Each block was comprised of equal amounts of each condition presented to the participants in a random order. Reaction times (RTs) and accuracy were recorded for each participant. In line with prior research (e.g.Willoughby, and Swick, 2011; Voelcker-Rehage, Godde, & Staudinger, 2011) RTs less than 200 ms (suggesting anticipation) or greater than 800 ms (a response omission) were counted as an error. All errors were omitted from the RT analyses. Additionally, all participants with less than 70% accuracy on this task had their data on the task omitted from analyses to ensure that participants were invested in the task (Voelcker-Rehage, Godde, & Staudinger; Schibe et al., 2015). The link to the actual task can be found in Appendix A.

In line with prior research (e.g. Hedge et al., 2017; Schiebe et al., 2015), performance on the flanker task was calculated in two ways:

1) RT cost, which was calculated as [the average RT on incongruent trials] – [the average RT on congruent trials] for each participant

2) Error cost, which was calculated as [the accuracy in congruent trials] – [accuracy in incongruent correct trials]

Although the measures used above are commonly found in the literature, these measures often have conventionally low or just acceptable reliability. Thus, there is a general concern in the field that such measures of inhibition, due to their lack of reliability, may mask the true relationship between variables (e.g. Hedge et al., 2017). In addition, as Liesefeld and Janczyk (2019) point out, participants are often asked in these tasks to respond to the stimuli as quickly and accurately as possible. However, there is no way to determine the approach individual participants may take after reading these instructions. Some participants may attempt to sacrifice speed for optimal accuracy while others may be more focused on responding quickly. Thus, the comparative performance of individual participants may differ depending on whether speed or accuracy is the focus of the analysis, creating problems when interpreting outcomes.

In order to overcome these limitations, some researchers (e.g. Townsend & Ashby, 1983; Vandierendonck, 2017; Woltz & Was, 2006) have proposed measures that integrate both speed and accuracy. Although the use of these integrated measures has not been widely adopted and there is not a general consensus as to the most appropriate integrated measure for use in cognitive tasks (Vandierendonck, 2017), I included an integrated performance measure in the current study to create a more thorough assessment of performance and to provide additional data to address the efficacy of using such integrated measures in experiments. The measure I chose was the linear integrated speed-accuracy score (LISAS). Vandierendonck (2017) demonstrated the efficacy of using LISAS insofar as using this measure approached a normal distribution, was better able to detect effects at various effect size levels, and explained a greater amount of the variance when RT and percent error (PE) were in the same direction (i.e. as RT increased, PE increased) compared to other measures, including integrated measures, of performance.

LISAS is calculated in the following manner: $RT_j + S_{RT}/S_{PE} \times PE_j$ where RT_j is the average correct RT within condition j, S_{RT} and S_{PE} are the participant's RT and PE standard deviation across all conditions, and PE_j is the participant's proportion of errors in condition j. In the case of the flanker task, LISAS for incongruent trials were calculated in the following manner: $RT_{\text{incongruent trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}} \times PE_{\text{incongruent trials.}}$ Likewise, LISAS for congruent trials were calculated in the following manner: $RT_{\text{congruent trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}} \times PE_{\text{congruent trials.}}$ In order to control for individual differences in baseline RT and to mirror the conventional methods for assessing RT performance, the *difference* between the two LISASs [$LISAS_{\text{incongruent}} - LISAS_{\text{congruent}}$] were taken to calculate the final measure of performance, heretofore referred to as LISAS cost.

Cognitive inhibition. To measure cognitive inhibition, participants completed a variation of the memory inhibition (MI) task used by Eich et al. (2016, 2018). In this task, participants were told to pay close attention to the words that appeared on the screen, as they would be tested on them at a later time. Four colored words (two green and two blue) appeared in the center of the white screen for 4500 ms followed by a fixation cross for 1000 ms. After this, participants saw an instruction cue for 1000 ms telling them either to "remember green" or "remember blue" followed again by a fixation cross for 3000 ms. Finally, participants were presented with one of the four words on the original list in black ink or a control word that was not on the list to begin with. This creates three different conditions for this task: 1) the valid condition, in which the word presented is from the original list and is the same color as what the participants were instructed to remember; 2) the lure condition, in which the word presented is from the original list but is *not* the same color as what the participants were instructed to remember; 3) the control condition, in which the word presented is *not* from the original list. Participants were instructed to press the “right arrow” key if the presented word matched the color in the instructions and to press the “left arrow” key if the color of the word did not match the instructions or was not on the original list. Participants had a maximum time of 1500 ms to answer.

To illustrate this task, imagine that participants were presented with the words lamp, sofa, roll, and soap, with lamp and sofa being presented in green ink and roll and soap being presented in blue ink. Following this, participants would be presented with the instructions “remember blue” followed by the word soap. As the word soap was originally in blue ink, the correct response would be for participants to press the “right arrow” key.

All words were four letter neutral nouns. Participants had 9 trials (3 trials per condition) of practice. After each trial, participants received feedback on their performance. Participants then completed four experimental blocks of 30 trials, each block containing 12 valid trials, 9 lure trials, and 9 control trials without feedback. Participants were allowed to rest between each block for as long as they chose. In line with prior research (Eich et al., 2016, 2018), participants RTs that were more than 2 standard deviations from the mean in each condition were excluded. Additionally, participants whose accuracy was not significantly greater than chance were excluded, as this suggests a substantial lack of engagement in the task. A link to the actual task that participants completed can be viewed using the link in Appendix B.

In line with prior research (Eich et al., 2016, 2018), performance on the MI task was calculated in the following two ways:

1) RT cost, which was calculated as [the average RT for the lure condition/the average RT across all conditions] – [the average RT for the control condition/the average RT across all conditions]
2) Error cost, which was calculated as [the accuracy in the lure condition] – [accuracy in the control condition].

In addition, the LISAS was calculated for the MI task in the following manner: $[RT_{\text{lure trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}} \times PE_{\text{lure trials}}] - [RT_{\text{control trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}} \times PE_{\text{control trials}}]$.

Emotion induction task. Negatively valenced pictures from the IAPS (Lang, Bradley, & Cuthbert, 2008) were used to induce emotions. Prior studies have suggested that reappraisal requires greater cognitive resources compared to distraction (Sheppes et al., 2008; Sheppes, Catran, & Meiran, 2009). However, these differences were only evident when emotion intensity was high. Thus, high-intensity pictures from the IAPS were chosen for this study because these seemed more likely to illustrate my hypotheses. All of the pictures from the IAPS were a subset of those used by Sheppes et al. (2012). The pictures used in the ER task had a mean valence of 2.13 and a mean intensity of 5.96. A complete list of the pictures used for this study can be found in Appendix C.

Emotion regulation instructions. The following instructions were used to help participants adopt the ER strategy to which they were randomly assigned. The instructions are based on a slightly modified version of the instructions used by Sheppes et al. (2014).

Reappraisal instructions. "Try your best to feel less negative about the picture by attending to the picture and trying to change the meaning of it. That means you think of something to tell yourself about the picture that helps you feel less negative about it. So, for example, you could tell yourself something about the outcome, so that whatever is going on will soon be resolved or that help is on the way. You could also focus on a detail of the situation that may not be as bad as it first seemed. But we want you to stay focused on the picture and not think of random things that make you feel better, but rather to change something about the picture that helps you to feel less negative about it. Once again, keep focusing on the picture but tell yourself something about the picture that makes you feel less negative about the picture."

Distraction instructions. "Try your best to feel less negative about the picture by thinking of something that is completely unrelated to the picture. There are a few ways you can do this. First, you could imagine your neighborhood or other familiar streets. For instance, if you see a negative picture of a woman who has been burnt, you could think of biking around campus and the different buildings around you. Second, you could imagine yourself doing everyday tasks, such as taking a shower or making coffee in the morning. You could use any one of these ways to distract yourself that you think will work best in making you feel less negative, and you don't have to use the same way to distract all the time. However, it is important that you keep your eyes on the picture and not avert your gaze (look away). Also, when distracting, it's important that you not focus on something that is highly emotional, so we don't want you to think about anything that brings you sadness or extreme happiness."

Emotion regulation performance. Performance on the ER task was calculated as the average negativity ratings across all pictures for each participant. In order to test for the effects of differences in negativity on the relationships of interest, I also calculated the average negativity ratings for those five pictures rated most negative across all participants (average high negativity ratings) as well as the average negativity ratings for the remaining ten pictures (average low negativity ratings). The average high negativity ratings were significantly more negative than the average low negativity ratings, $t(146) = 3.971$, $p < .001$. In order to test for possible order effects on participants' negativity ratings, I also calculated the average negativity ratings for the first seven pictures presented to the participants (average early negativity ratings) as well as the remaining eight pictures (average late negativity ratings). There were no significant differences in negativity between the average early negativity ratings and the average late negativity ratings, $t(146) = .666$, $p = .507$. Negativity ratings were only incorporated into the average if participants implemented the assigned ER strategy correctly. Participants who did not follow directions on at least 10 out of 15 negativity ratings were excluded. These participants were excluded as these negativity ratings served as the primary dependent variable in the study. The cutoff of 10 out of 15 was chosen because participants were only asked about how they were implementing their assigned ER strategy once every five ratings. Failing to implement the assigned ER strategy on the majority of the ER ratings suggests that those participants either misunderstood the instructions they were given or were not paying attention during this portion on the experiment. Either explanation calls into question the validity of their data.

Table 2

Performance Measures for All Tasks

Variables	Measure	Calculation
ER Performance	Average Negativity Ratings	[Sum of Negativity Ratings for Correctly Implemented ER Strategy] / [Number of Pictures for Correctly Implemented ER Strategy]
	Average High Negativity Ratings	[Sum of Negativity Ratings of 5 Most Negative Pictures] / [Number of 5 Most Negative Pictures for Correctly Implemented ER Strategy]
	Average Low Negativity Ratings	[Sum of Negativity Ratings of 10 Least Negative Pictures] / [Number of 10 Least Negative Pictures for Correctly Implemented ER Strategy]
	Average Early Negativity Ratings	[Sum of Negativity Ratings of First 7 Pictures for Correctly Implemented ER Strategy] / [Number of First 7 Pictures for Correctly Implemented ER Strategy]
	Average Late Negativity Ratings	[Sum of Negativity Ratings of Last 8 Pictures for Correctly Implemented ER Strategy] / [Number of Last 8 Pictures for Correctly Implemented ER Strategy]
Flanker Performance	RT Cost	Average $RT_{\text{incongruent trials}}$ – Average $RT_{\text{congruent trials}}$
	Error Cost	$\text{Accuracy}_{\text{congruent trials}}$ – $\text{Accuracy}_{\text{incongruent trials}}$
	LISAS Cost	[$RT_{\text{incongruent trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}}$ x $PE_{\text{incongruent trials}}$] – [$RT_{\text{congruent trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}}$ x $PE_{\text{congruent trials}}$]
MI Performance	RT Cost	[Average correct $RT_{\text{lure condition}}$/Average $RT_{\text{all conditions}}$] – [Average correct $RT_{\text{control condition}}$/ Average $RT_{\text{all conditions}}$]
	Error Cost	$\text{Accuracy}_{\text{lure condition}}$ – $\text{Accuracy}_{\text{control condition}}$
	LISAS Cost	[$RT_{\text{lure trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}}$ x $PE_{\text{lure trials}}$]– [$RT_{\text{control trials}} + S_{\text{RT for all trails}}/S_{\text{PE for all trials}}$ x $PE_{\text{control trials}}$]

Data Analysis

All data were downloaded and analyzed in SPSS version 25.

Results

Participant Exclusions

A total of 68 student participants were recruited for this study. Ten participants were excluded because they did not complete the entire experiment either due to a technical difficulty or because they did not want to view the pictures for the ER task. These participants were excluded because not completing a portion of the experiment resulted in a major reduction of the total amount of time spent on the experimental tasks and thus could compromise the quality of the data. Thirteen participants were excluded because they did not follow directions for the ER task on at least 10 out of the 15 negativity ratings. One participant was excluded because s/he did not fit the age criterion for the given experiment and another was excluded because the PI observed s/he was not paying attention during the course of the experiment. Some participants were excluded for several of the reasons listed above. In total, 21 student participants (30.8%) were excluded from the study

A total of 52 Mturk participants were recruited for this study. Seven participants were excluded because they did not complete the entire experiment. Fifteen participants were excluded because they did not follow directions for the ER task on at least 10 out of the 15 negativity ratings. Three participants were excluded because they did not fit the age requirements for the given experiment and a fourth was excluded because s/he had an identical IP address as another participant, which may suggest that a single individual attempted to participate in the study twice. Some participants were excluded for several of the reasons listed above. In total, 25 Mturk participant (48.1%) were excluded from the study.

In addition to the participants excluded above, several participants had some of their data removed from analyses. One student participant's and one Mturk participant's data was excluded because their accuracy on the Flanker task was below 70%. Twelve student participants and nine Mturk participants had their MI data removed because their accuracy on the task was not significantly greater than chance. Lastly, seven student participants and seven Mturk participants had a portion of their ER data excluded because they did not follow the directions for their assigned ER task.

Excluded participants did not significantly differ from non-excluded participants on any of the outcome measures from the current experiment. Excluded participants were significantly more likely to be non-white, $X^2(1) = 7.118$, $p = .008$, Phi = .246 and were marginally more likely to be male $X^2(1) = 2.754$, $p = .097$, Phi = .153. There were no significant differences in age $t(116) = -1.309$, $p = .193$.

Participant Characteristics

Student and Mturk participant characteristics can be seen in Table 3. Students were significantly more likely to be female, X^2 (1) = 4.778, $p = .029$, Phi = -.254, non-white, $X^2(1) = 5.135$, $p = .023$, Phi = -.263, and younger, $t(72) = -9.337$, $p < .001$, Cohen's $d = -2.33$ than Mturk participants.

Table 3

Participant Demographic Characteristics

	Student Participants				**Mturk Participants**		
		N	**%**		N	%	
Gender	Male	14	29.8		15	55.6	
Race/Ethnicity	Female	33	70.2		12	44.4	
	Black/African American	15	34.0		4	14.8	
	Hispanic	7	13.2		2	7.4	
	White	24	47.2		21	77.8	
	Mixed	1	2.1%		0	0%	
Age			**Mean**	**SD**		**Mean**	**SD**
		47	19.38	1.76	27	23.07	1.39

Descriptive statistics of the different performance measures can be found in Tables 4, 5, and 6. Student participants had marginally lower average negativity ratings compared to Mturk participants $t(72) = -1.829$, $p = .072$, Cohen's $d = -.439$. Given that the size of Cohen's d suggested a medium effect size, I investigated whether these differences held when controlling for the differences in age and gender. To test this, I ran a linear regression entering age and gender in step 1 and participant type (student or Mturk) in step 2. The change in R^2 was .028 and insignificant. Furthermore, when participant type was placed into the regression model with age and gender, it did not significantly predict average negativity ratings, unstandardized B = .891, $p = .146$. Student participants also had significantly lower average high negativity ratings $t(72) = -2.378$, $p = .020$, Cohen's $d = -.569$. I again ran a linear regression entering age and gender in step 1 and participant type (student or Mturk) in step 2. The change in R^2 was .052 and significant ($p = .046$). Furthermore, when participant type was placed into the regression model with age and gender, it still significantly predicted average negativity ratings, unstandardized B = 1.486, $p = .046$. Students also had marginally lower LISAS MI scores compared to Mturk participants, $t(50) = 1.756$, $p = .085$, Cohen's $d = .513$.

Table 4

Descriptive Statistics for Flanker Task

Condition	**Student Participants**			**Mturk Participants**		
Student Participants	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Flanker RT Congruent	46	454.460	66.634	26	443.979	79.088
Flanker RT Incongruent	46	479.052	43.618	26	467.305	52.834
Flanker RT Cost	46	24.592	51.046	26	23.326	48.907
Flanker Accuracy Congruent	46	.987	.021	26	.990	.017

Flanker Accuracy Incongruent	46	.956	.051	26	.953	.037
Flanker Error Cost	46	.031	.044	26	.037	.031
Flanker LISAS Congruent	39	1145.930	2656.369	26	493.938	121.004
Flanker LISAS Incongruent	39	1319.397	2658.899	26	672.714	129.395
Flanker LISAS Cost	39	173.467	96.768	26	178.776	38.572

Table 5

Descriptive Statistics for Emotion Regulation Task

Avg. Negativity Ratings	47	4.284	1.674	27	5.035	1.748
Avg. High Negativity Ratings	47	4.930	1.992	27	6.102	2.123
Avg. Low Negativity Ratings	47	3.951	1.550	27	4.474	1.631
Avg. Early Negativity Ratings	47	4.222	1.634	27	4.839	1.657
Avg. Late Negativity Ratings	47	4.370	1.825	27	5.114	1.911

Table 6

Descriptive Statistics for Memory Inhibition Task

MI RT Valid	35	.961	.057	18	.927	.049
MI RT Lure	35	1.105	.048	18	1.102	.044
MI RT Control	35	.958	.047	18	.988	.046
MI RT Cost	35	.147	.103	18	.114	.073
MI Accuracy Valid	35	.844	.104	18	.878	.121
MI Accuracy Lure	35	.793	.159	18	.908	.089
MI Accuracy Control	35	.931	.158	18	.952	.084
MI Error Cost	35	-.138	.159	18	-.043	.071

MI LISAS Valid	34	1993.613	944.674	18	1718.762	521.323
MI LISAS Lure	34	1583.906	798.815	18	1263.450	455.247
MI LISAS Control	34	1151.473	824.628	18	977.656	444.614
MI LISAS Cost	34	432.433	311.431	18	285.794	295.899

Hypothesis Testing

Hypothesis 1. To test my first hypothesis that the different kinds of inhibition would only be moderately correlated, I ran a Pearson correlation between scores on the flanker task (reflecting measure of inhibitory control of attention) and scores on the MI task (reflecting measure of cognitive inhibition). Because performance on both tasks were measured in multiple different ways, the relationship between each of these measures was tested. As can be seen in Table 7, RT cost performance on the flanker task was positively correlated with error cost and LISAS cost performance on the MI task; all other relationships between the two measures were not significant. Hence, my first hypothesis was partially supported insofar as there was some relationship between the two measures of inhibition.

Table 7

Pearson Correlations between Flanker and MI Performance Scores

	Flanker RT Cost	Flanker Error Cost	Flanker LISAS	MI RT Cost	MI Error Cost	MI LISAS
Flanker RT Cost	1	.209	-.089	-.008	-.294*	.370**
p		.134	.559	.954	.032	.007
N	53	53	45	53	53	52
Flanker Error Cost	.209	1	.320*	-.048	-.083	.026
p	.134		.032	.733	.553	.852
N	53	53	45	53	53	52
Flanker LISAS Cost	-.089	.320*	1	.014	.071	.002

p	.559	.032		.927	.642	.992
N	45	45	45	45	45	44
MI RT Cost	-.008	-.048	.014	1	-.205	.495**
p	.954	.733	.927		.140	.000
N	53	53	45	53	53	52
MI Error Cost	-.294*	-.083	.071	-.205	1	-.745
p	.032	.553	.642	.140		.000
N	53	53	45	53	53	52
MI LISAS Cost	.370**	.026	.002	.495**	-.745**	1
p	.007	.852	.992	.000	.000	
N	52	52	44	52	52	52

*p<.05 **p<.01 ***p<.001

Hypothesis 2. To test the hypothesis that inhibition scores (across both types of inhibition) would moderate the relationship between ER strategies and average negativity ratings, I ran a series of six linear regressions. ER strategy (reappraisal vs distraction) and mean centered summed RT cost (flanker RT cost + MI RT cost) were entered as predictors in the first model to test for the main effects of these variables on average negativity ratings (Table 8, Model 1). These variables, along with the interaction of the two terms (ER strategy X mean centered summed RT cost) were entered as predictors in a second regression (Table 8, Model 2). As can be seen in Table 8, none of the predictors were significant. Four additional regressions were run with the alternate measures of performance on inhibition tasks, summed error cost (Table 9) and summed LISAS cost (Table 10), being substituted for summed RT cost. Again, none of these models were significant. To test to see whether the relationship between the summed inhibition scores and negativity ratings were different depending on the nature of the negativity ratings, I ran a series of Pearson correlations between the combined inhibition scores and all five negativity ratings. As can be seen in Table 11, none of the relationships were significant.

Table 8

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Summed RT Cost, and ER Strategy X Summed RT Cost Predicting Average Negativity Ratings

	Model 1						Model 2					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.359	.501	-.103	-.716	.478	.029	-.361	.503	-.103	-.717	.477	.038
Summed RT Cost	-.001	.004	-.045	-.311	.757		-.014	.016	-.443	-.827	.413	
ER Strategy X Summed RT Cost							.007	.009	.413	.772	.444	

Table 9

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Summed Error Cost, and ER Strategy X Summed Error Cost Scores Predicting Average Negativity Ratings

	Model 3						Model 4					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.386	.498	-.110	-.775	.442	.011	-.388	.504	-.111	-.770	.445	.033
Summed Error Cost	-1.579	1.641	-.137	-.962	.341		-1.531	1.782	-.133	-.859	.395	
ER Strategy X Summed Error Cost							-.271	3.658	-.011	-.074	.941	

Table 10

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Summed LISAS Cost, and ER Strategy X Summed LISAS Cost Predicting Average Negativity Ratings

	Model 5						Model 6					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.391	.551	-.111	-.709	.482	.024	-.378	.557	-.107	-.679	.501	.046
Summed LISAS Cost	.001	.001	.110	.704	.485		.001	.001	.096	.592	.557	
ER Strategy X Summed LISAS Cost							.001	.002	.064	.394	.696	

Table 11

Pearson Correlations between Summed Inhibition Scores and Categories of Negativity Ratings

	Avg. Negativity Ratings	Avg. High Negativity Ratings	Avg. Low Negativity Ratings	Avg. Early Negativity Ratings	Avg. Late Negativity Ratings	Condition (Reappraisal vs Distraction)	Summed RT Cost	Summed Error Cost	Summed LISAS Cost
Avg. Negativity Ratings	1	.957***	.977***	.946***	.969***	-.129	-.166	-.151	.111
p		.000	.000	.000	.000	.357	.235	.281	.475
N	53	53	53	53	53	53	53	53	44
Avg. High Negativity Ratings	.957***	1	.876***	.890***	.937***	-.174	-.082	-.132	.065
p	.000		.000	.000	.000	.213	.558	.347	.677
N	53	53	53	53	53	53	53	53	44
Avg. Low Negativity Ratings	.977***	.876***	1	.938***	.938***	-.108	-.216	-.162	.129
p	.000	.000		.000	.000	.443	.120	.248	.405
N	53	53	53	53	53	53	53	53	44
Avg. Early Negativity Ratings	.946***	.890***	.938***	1	.849***	-.198	-.208	-.087	.116
p	.000	.000	.000		.000	.156	.136	.536	.451
N	53	53	53	53	53	53	53	53	44
Avg. Late Negativity Ratings	.969***	.937***	.938***	.849***	1	-.080	-.140	-.192	.081
p	.000	.000	.000	.000		.569	.317	.169	.600
N	53	53	53	53	53	53	53	53	44
Condition (Reappraisal vs Distraction)	-.129	-.174	-.108	-.198	-.080	1	.088	-.049	-.032
p	.357	.213	.443	.156	.569		.532	.728	.837
N	53	53	53	53	53	53	53	53	44
Summed RT Cost	-.166	-.082	-.216	-.208	-.140	.088	1	.334*	.415**
p	.235	.558	.120	.136	.317	.532		.014	.005
N	53	53	53	53	53	53	53	53	44
Summed Error Cost	-.151	-.132	-.162	-.087	-.192	-.049	.334*	1	.673**
p	.281	.347	.248	.536	.169	.728	.014		.000
N	53	53	53	53	53	53	53	53	44
Summed LISAS Cost	.111	.065	.129	.116	.081	-.032	.415**	.673**	1
p	.475	.677	.405	.451	.600	.837	.005	.000	
N	44	44	44	44	44	44	44	44	44

**p*<.05 ***p*<.01 ***p<.001

Hypothesis 3a. To test the hypothesis that that inhibitory control of attention but not cognitive inhibition would moderate the relationship between distraction and negativity ratings, I again ran a series of six linear regression. ER strategy (reappraisal vs distraction) and mean centered flanker RT cost were entered as predictors in the first model to test for the main effects of these variables on average negativity ratings (Table 12, Model 7). These variables, along with the interaction of the two terms (ER strategy X mean centered flanker RT cost) were entered as predictors (Table 12, Model 8) in a second regression model. As can be seen in Table 12, none of the predictors were significant. Four additional regressions were run with the alternate measures of performance on inhibition tasks, flanker error cost (Table 13) and flanker LISAS cost (Table 14), being substituted for flanker RT cost. Again, none of these models were significant. To test to see whether the relationship between the flanker inhibition scores and negativity ratings were different depending on the nature of the negativity ratings, I ran a series of Pearson correlations between the flanker inhibition scores and all five negativity ratings. As can be seen in Table 15, none of the relationships were significant.

Table 12

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Flanker RT Cost, and ER Strategy X Flanker RT Cost Predicting Average Negativity Ratings

	Model 7						Model 8					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	.044	.415	.013	.106	.916	.028	.045	.418	.013	.108	.915	.039
Flanker RT Cost	-.001	.004	-.027	-.227	.821		-.009	.015	-.248	-.562	.576	
ER Strategy X Flanker RT Cost							.005	.009	.229	.520	.604	

Table 13

Linear regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Flanker Error Cost, and ER Strategy X Flanker RT Cost Predicting Average Negativity Ratings

	Model 9						Model 10					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	.032	.415	.009	.078	.938	.025	.029	.418	.008	.069	.946	.039
Flanker Error Cost	-2.745	5.190	-.064	-.529	.599		-8.251	22.577	-.191	-.365	.716	
ER Strategy X Flanker Error Cost							3.112	12.411	.131	.251	.803	

Table 14

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered Flanker LISAS, and ER Strategy X Flanker LISAS Predicting Average Negativity Ratings

	Model 11						Model 12					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	.070	.433	.021	.162	.872	.025	.062	.436	.018	.143	.887	.037
Flanker LISAS Cost	.002	.003	.082	.649	.519		-.008	.018	-.364	-.440	.661	
ER Strategy X Flanker LISAS Cost							.005	.009	.452	.546	.587	

Table 15

Pearson Correlations between Flanker Inhibition Scores and Categories of Negativity Ratings

	Avg. Negativity Ratings	Avg. High Negativity Ratings	Avg. Low Negativity Ratings	Avg. Early Negativity Ratings	Avg. Late Negativity Ratings	Condition (Reappraisal vs Distraction)	Summed RT Cost	Summed Error Cost	Summed LISAS Cost
Avg. Negativity Ratings	1	.955***	.972***	.950***	.966***	.012	-.027	-.064	.082
p		.000	.000	.000	.000	.917	.821	.593	.518
N	72	72	72	72	72	72	72	72	65
Avg. High Negativity Ratings	.955***	1	.864***	.897***	.924***	-.040	.013	-.031	.038
p	.000		.000	.000	.000	.741	.913	.795	.766
N	72	72	72	72	72	72	72	72	65
Avg. Low Negativity Ratings	.972***	.864***	1	.938***	.935***	.037	-.057	-.063	.136
p	.000	.000		.000	.000	.758	.634	.600	.280
N	72	72	72	72	72	72	72	72	65
Avg. Early Negativity Ratings	.950***	.897***	.938***	1	.849***	-.029	-.034	-.025	.108
p	.000	.000	.000		.000	.807	.779	.836	.393
N	72	72	72	72	72	72	72	72	65
Avg. Late Negativity Ratings	.966***	.924***	.935***	.849***	1	.043	-.037	-.081	.061
p	.000	.000	.000	.000		.719	.755	.501	.630
N	72	72	72	72	72	72	72	72	65
Condition (Reappraisal vs Distraction)	.012	-.040	.037	-.029	.043	1	.010	-.048	-.022
p	.917	.741	.758	.807	.719		.932	.687	.859
N	72	72	72	72	72	72	72	72	65
Flanker RT Cost	-.027	.013	-.057	-.034	-.037	.010	1	.130	-.019
p	.821	.913	.634	.779	.755	.932		.275	.879
N	72	72	72	72	72	72	72	72	65
Flanker Error Cost	-.064	-.031	-.063	-.025	-.081	-.048	.130	1	.404
p	.593	.795	.600	.836	.501	.687	.275		.001
N	72	72	72	72	72	72	72	72	65
Flanker LISAS Cost	.082	.038	.136	.108	.061	-.022	-.019	.404	1
p	.518	.766	.280	.393	.630	.859	.879	.001	
N	65	65	65	65	65	65	65	65	65

*$p<.05$ **$p<.01$ ***$p<.001$

Hypothesis 3b. To test the hypothesis that cognitive inhibition but not inhibitory control of attention would moderate the relationship between reappraisal and average negativity ratings, I ran a series of six linear regressions. ER strategy (reappraisal vs distraction) and mean centered MI RT cost were entered as predictors in the first model to test for the main effects of these variables on average negativity ratings (Table 16, Model 13). These variables, along with the interaction of the two terms (ER strategy X mean centered MI RT cost) were entered as predictors in a second model ratings (Table 16, Model 14). Two additional regressions were run with the alternate measures of performance on the MI task, MI error cost (Table 17) and MI LISAS (Table 18), being substituted for MI RT cost. Again, none of these models were significant. To test to see whether the relationship between the flanker inhibition scores and negativity ratings were different depending on the nature of the negativity ratings, I ran a series of Pearson correlations between the flanker inhibition scores and all five negativity ratings. As can be seen in Table 19, none of the relationships were significant.

Table 16

Linear Regressions with ER Strategy (Reappraisal vs Distraction), Mean Centered MI RT Cost, and ER Strategy X MI RT Cost Predicting Average Negativity Ratings

	Model 13						Model 14					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.452	.487	-.130	-.930	.357	.015	-.454	.490	-.130	-.927	.358	.029
MI RT Cost	1.545	2.588	.083	.597	.553		7.780	10.837	.420	.718	.476	
ER Strategy X MI RT Cost							-3.564	6.013	-.347	-.593	.556	

Table 17

Linear Regressions with ER strategy (Reappraisal vs Distraction), Mean Centered MI Error Cost, and ER Strategy X MI RT Cost Predicting Average Negativity Ratings

	Model 15						Model 16					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.471	.484	-.135	-.973	.335	.002	-.476	.483	-.137	-.984	.330	.001
MI RT Cost	1.751	1.726	.141	1.014	.315		7.546	5.859	.607	1.288	.204	
ER Strategy X MI RT Cost							-3.635	3.512	-.488	-1.035	.306	

Table 18

Linear Regressions with ER strategy (Reappraisal vs Distraction), Mean Centered MI LISAS, and ER Strategy X MI LISAS Predicting Average Negativity Ratings

	Model 17						Model 88					
Predictor Variables	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**	**B**	**SE B**	**β**	**t**	**p**	**Adjusted R^2**
ER Strategy	-.455	.497	-.129	-.914	.365	.022	-.454	.502	-.129	-.905	.370	.040
MI LISAS Cost	.000	.001	.036	.251	.803		-.001	.003	-.158	-.334	.740	
ER Strategy X MI LISAS Cost							.001	.002	.203	.430	.669	

Table 19

Pearson Correlations between MI Inhibition Scores and Categories of Negativity Ratings

	Avg. Negativity Ratings	Avg. High Negativity Ratings	Avg. Low Negativity Ratings	Avg. Early Negativity Ratings	Avg. Late Negativity Ratings	Condition (Reappraisal vs Distraction)	Flanker RT Cost	Flanker Error Cost	Flanker LISAS Cost
Avg. Negativity Ratings	1	.957	.977	.946	.969	-.129	.082	.135	.032
p		.000	.000	.000	.000	.357	.559	.335	.820
N	53	53	53	53	53	53	53	53	52
Avg. High Negativity Ratings	.957	1	.876	.890	.937	-.174	.086	.131	.002
p	.000		.000	.000	.000	.213	.540	.349	.988
N	53	53	53	53	53	53	53	53	52
Avg. Low Negativity Ratings	.977	.876	1	.938	.938	-.108	.064	.143	.041
p	.000	.000		.000	.000	.443	.651	.306	.773
N	53	53	53	53	53	53	53	53	52

Avg. Early Negativity Ratings	.946	.890	.938	1	.849	-.198	.085	.082	.030
p	.000	.000	.000		.000	.156	.545	.561	.835
N	53	53	53	53	53	53	53	53	52
Avg. Late Negativity Ratings	.969	.937	.938	.849	1	-.080	.071	.175	.014
p	.000	.000	.000	.000		.569	.613	.211	.921
N	53	53	53	53	53	53	53	53	52
Condition (Reappraisal vs Distraction)	-.129	-.174	-.108	-.198	-.080	1	.010	.043	.025
MI RT Cost	.357	.213	.443	.156	.569		.945	.760	.861
p	53	53	53	53	53	53	53	53	52
N	.082	.086	.064	.085	.071	.010	1	-.205	.495
MI Error Cost	.559	.540	.651	.545	.613	.945		.140	.000
p	53	53	53	53	53	53	53	53	52
N	.135	.131	.143	.082	.175	.043	-.205	1	-.745
MI LISAS Cost	.335	.349	.306	.561	.211	.760	.140		.000
p	53	53	53	53	53	53	53	53	52
N	.032	.002	.041	.030	.014	.025	.495	-.745	1

**p*<.05 ***p*<.01 ***p<.001

To test for the potential effects of burnout on participant performance, I ran a series of t-tests with a portion of the participants comparing performance on all measures when the ER task was first vs second or third, the MI task was first vs second or third, and the flanker task was first vs second or third. None of these analyses were significant.

Lastly, this study also sought to determine the efficacy of conducting ER research online. To determine this feasibility, I conducted a Chi-square analysis to compare the proportion of student participants excluded for not implementing their assigned ER strategy to the proportion of Mturk participants excluded for not implementing their assigned ER strategy. There was a marginal difference between the two groups, $X^2(1) = 1.190$, $p = .275$, Phi = .100, with students being marginally more likely to implement the strategy correctly compared to Mturk participants.

Discussion

The purpose of the current study was to investigate whether differences in inhibition predicted the effectiveness of reappraisal and distraction in reducing subjective reports of emotional negativity, with the goal of providing insight into the role of these factors on ER success. Two young adult samples – one with college students in person and one with Mturk participants online – were used to test the study the hypotheses.

Overall, the results of the current study failed to support most of my hypotheses. Specifically, although there was a positive correlation between performance on the flanker and MI task, this relationship was only found between flanker RT cost and MI error cost and MI LISAS. Furthermore, the combined inhibition scores failed to moderate the relationship between ER strategies and negativity ratings. Additionally, performance on the MI task did not moderate the relationship between reappraisal and negativity ratings nor did performance on the flanker task moderate the relationship between distraction and negativity ratings.

The lack of support for the study hypotheses could be due to multiple different factors. First, a large proportion of my sample (30.8% of student participants and 48.1% of Mturk participants) had to have their data excluded due to not completing portions of the tasks. Furthermore, several more participants had at least a portion of their data excluded because of their poor performance on these tasks. These exclusions represent a marked difference from other research in this area. For example, Sheppes et al., (2014), who used nearly identical instructions and training procedures for the emotion regulation task, reported not having to exclude any participants across their different experiments.

Likewise, Eich et al., (2016, 2018), who measured MI in the same manner, did not report having to exclude any participants.

The increased exclusions in the current study, compared to those found in similar research in the field, may be due to subtle differences in the methods used in the research. For example, Sheppes et al. (2014) did not ask participants to state the strategy they were using after their initial training as I did in the current experiment. Thus, it is possible that participants who are able to correctly implement their assigned ER strategy in the training may not necessarily be able to maintain such an orientation throughout the entirety of the session. For example, one participant, after viewing the third set of pictures stated that, “It was hard to think of something to change my view on the picture.” Another participant stated, “A handful [of pictures] I tried to imagine them happening in more positive situations, while the more negative ones I tried to ignore to be honest.” Other participants did not find all of the pictures especially negative. For example, referring to one of the pictures, a participant stated, “There wasn't really anything to make me upset because there wasn't really anything to take from it.” Hence, the large number of exclusions in the current study may have been due to the fact that I asked participants to state the strategy they were using throughout the experimental sessions as opposed to only at the beginning of the experiment like other studies have done that looked at the efficacy of ER strategies to reduce subjective negativity.

Furthermore, the current study consisted of multiple different tasks, each with specific and somewhat complex instructions, which may have led to carryover effects or burnout on the part of the participants. On the other hand, the studies conducted by Sheppes et al. (2014) consisted of the ER task in isolation. Thus, the differences in the length and/or complexity of the experiments may have contributed to the discrepancy in the participant exclusions and performance on the ER task.

The differences between the current study and studies conducted by Eich et al. (2016, 2018) may also have been due, in part, to differences in the methodology and participant characteristics. In their studies, Eich et al. (2016, 2018) did not provide the exact instructions or training procedures that they used with their participants for the MI task nor did they explicate how those instructions and trainings were given to the participants (e.g. whether they were displayed on a computer monitor or dictated by the experimenter). Hence, for the current experiment, I created the instructions myself based on my understanding of the task. The disparity between the instructions used by Eich et al. (2016, 2018) and those used in the current study may have helped to account for the differences. This supposition is further supported by the fact that average accuracy of the participants on the MI task in the studies by Eich et al., (2016, 2018) was above 90% while the accuracy of participants in the current study, even after excluding those who did not perform significantly greater than chance, was around 80%. Additionally, in the experiments conducted by Eich et al. (2016, 2018), participants completed between 8-16 practice trials whereas participants in my study only completed 9 practice trials. Lastly, the participants in the studies conducted by Eich et al., (2016, 2018) were significantly older than those used in the current study. The youngest participant in their experiment was 24, with the average age for their "young" experimental group being 31.39 (SD = 5.34). On the other hand, the average age in the current study was 20.73 (SD = 2.42). Given the fact that Eich et al. (2016) found differences in performance on the MI task as a function of age, these differences may have been important.

Finally, the studies conducted by both Eich et al. (2016, 2018) and Sheppes et al. (2014) were conducted exclusively in-person while all of the Mturk participants completed this study online. This modification in the settings between the experiments might also help explain the differences, although it is worth noting that no significant differences were found between the student and Mturk participants on the performance measures.

Alternately, the results of the current study may suggest that there is not, in fact, any relationship between performance on the flanker and MI tasks and ER efficacy. Both McRae et al. (2012) and Gyurak et al. (2012) failed to find any relationship between performance on an inhibition RT measure, the Stroop task, and ER. McRae et al. (2012) interpreted their findings as suggestive that different types of cognitive abilities may be uniquely related to ER strategies. Gyurak et al. (2012) also noted that measures of executive function, even those purportedly measuring the same construct (e.g. working memory), may require different abilities depending on the nature and complexity of the given task, and thus their relationship to ER may be task specific. Consequently, the results of the current study may not have been due to methodological limitations but may in fact reflect a true null relationship between the specific types and operationalizations of the inhibition and ER strategies examined.

In addition to these measurement considerations, it is possible that inhibition is related more closely to habitual or implicit ER as opposed to deliberate or explicit ER. Gyurak et al. (2011) suggest that individuals may engage in a certain amount of ER automatically and without deliberate thought. Controlling one’s thoughts or visual attention, while not automatic, nonetheless occurs within a matter of milliseconds and may be more akin to habitual ER processes as opposed to deliberate ones. This supposition has some indirect support in the literature. Tang and Schmeichel (2014), who found a positive relationship between ER and inhibition, did not ask participants to explicitly regulate their emotions but rather simply measured participants' overall negative emotional responding, likely tapping into participants' habitual and unconscious ER.

Limitations

The findings for the current study should be interpreted within the context of limitations. One limitation of the current study was the operationalization of the variables. Prior research, which has examined the relationship between inhibition and ER efficacy, has often used different measurements than those used in the current study. For example, both Tabibnia et al. (2011) and Tang and Schmeichel (2014), who found a positive relationship between inhibition and ER efficacy, used the stop signal task to measure inhibition. Given research that suggests that different types of inhibition may be distinct processes (e.g. Borella et al., 2017; Friedman and Miyake, 2004), the use of the flanker task and the MI task in the current research may account for the discrepancies between the studies. Similarly, Tabibnia et al. (2011) used a difference score (i.e. negativity ratings at baseline – negativity ratings while engaging in reappraisal) to measure ER efficacy while Tang and Schmeichel (2014) simply measured participants' negative emotional responding to stimuli without explicitly asking participants to regulate their emotions. Again, these methodological differences may play a key role in determining the relationship between these variables.

Another limitation of the current study was the fact that carryover effects might have impacted performance on the other measures in the experiment. Prior research has suggested that emotional reactions can influence performance on cognitive tasks. For example, Cohen, Henik, and Moyal (2012) found that negative emotional stimuli reduced performance on the flanker task. However, this explanation seems unlikely, as participant performance did not significantly change depending on the task which they completed first.

A third limitation of the current study is that participants were instructed to implement the ER strategies at the *outset* of the ER task. Prior research (e.g. Richards, 2004; Sheppes et al. 2008; Sheppes et al. 2009) found that the differential impact of reappraisal and distraction on cognitive resources was only found when participants implemented their assigned ER strategy *after* they had been exposed to the stimuli for some time. Implementing an ER strategy after some exposure to the stimuli represents a greater challenge as it requires the individual to alter their emotions in the midst of the emotional experience itself. Accordingly, it is possible that the relationship between ER efficacy and inhibition were not found in the current research because the ER task was not sufficiently challenging to require inhibitory resources.

Future Directions and Conclusions

In light of these limitations, future research should look more closely at the relationship between inhibition and ER efficacy, comparing different operationalizations of both constructs. As the literature currently stands, the evidence of a relationship between these variables is limited and somewhat contradictory, perhaps in part due to the vastly different measurements which researchers use (Schmeichel & Tang, 2015). In order to efficiently investigate these relationships, it may be necessary to conduct a series of experiments holding one experimental measure constant while interchanging the other with a variety of measurements from the literature. For example, it might be efficacious to use the same ER task while alternating the inhibition task. In this way, researchers might be able to more firmly establish the true nature of the relationship between ER and inhibition.

It might be equally important to consider investigating the relationship between performance on the flanker task, MI task, and ER task in isolation. As noted previously, it is possible that the relationship between these variables was masked due to carryover effects and/or participant burnout. Using only two of these measures in the same experimental session or measuring these variables on separate days, might help to explore these possibilities.

The results of the study also suggest that it may be important for ER researchers to more universally consider taking steps to ensure that participants are implementing their assigned ER strategy throughout the entire experimental session. Although some researchers assess whether participants are implementing their assigned ER strategies correctly throughout the experimental session (e.g. Sheppes & Meiran, 2007, whose debriefing procedure consisted of probing participants for the strategies they used during the ER task), others do not (e.g. Bigman et al., 2014). It may also be of interest to look to see if there is a relationship between correctly implementing ER strategies and other factors such as personality and cognitive ability. For example, those with a proclivity towards higher emotional reactivity (e.g. individuals high in neuroticism) may find it harder to focus their efforts on implementing a somewhat complicated strategy such as reappraisal.

Additionally, the current research provides some evidence to suggest that ER research may be conducted online. Although there were marginally more Mturk participants excluded for not correctly implementing their assigned ER strategy compared to student participants, the Phi coefficient was quite small, suggesting that the differences between the two groups was small or even unsubstantial. Additionally, although Mturk participants had marginally higher average negativity ratings compared to students, these differences became insignificant when controlling for age and gender differences. However, it is important to note that student participant did have significantly lower high negativity ratings, on average. Thus, future researchers should make comparisons between in-person and online samples for ER tasks to provide further research on the capacity of this medium to produce meaningful data and diversify the samples used in the ER literature.

Overall, the results of this study failed to find any support for the hypotheses that inhibitory control of attention and cognitive inhibition are related to ER efficacy. Limitations in the study design and differences from other research in the literature may partially account for the current findings. However, this research should also be considered as potentially indicative of the true nature of the relationship between these variables. Even though some published literature on this topic suggests a relationship between ER and inhibition, studies that fail to find significant effects (like my own) are not typically published (i.e., a file drawer problem) thus contributing to our lack of true understanding of the nature of these associations. Hence, future research should build off of the current study to explore these relationships more fully.

Appendices

Appendix A

Link to the Inhibition of Attention Task

https://www.psytoolkit.org/cgi-bin/psy2.5.1/survey?s=hOveP

Appendix B

Link to cognitive inhibition task.

https://www.psytoolkit.org/cgi-bin/psy2.5.1/survey?s=XYZ8S

Appendix C

IAPS Images for Study

The codes of the IAPS images used are as follows:

2101, 2205, 3310, 3051, 3110. 3150, 3170, 3180, 3230, 3350, 3530, 6212, 6350, 6415, 9040, 9252, 9253, 9265, 9400, 9921

Part of the agreement with the researchers to use this picture set stipulated that these pictures not be publicized or shared with anyone outside of the lab using them. Hence, I have not attached the pictures to this appendix. For the negative pictures, a variety of content was used including images of threat, sadness, fear, disgust, injury, and mutilation.

Appendix D

Responses to Committee Comments

1. Dr. Whitlow requested that the average RT, error rate, and LISAS scores be presented in a table in addition to the RT cost, error cost, and LISAS cost scores. These values can be found in Tables 4 and 6.
2. Dr. Roseman suggested that I look at the relationship between inhibition and different types of negativity ratings. In particular, he suggested that I look at the relationship between the negativity ratings on the five most negative pictures and performance on the inhibition tasks. In order to address this suggestion, I calculated the average negativity rating of each picture across all the participants and identified five with the highest average rating. I then calculated the average negativity rating of those five pictures (high negativity ratings) and the remaining ten pictures (low negativity ratings). These values can be found in Table 5. I ran a series of Pearson correlations looking at the relationship between these two different types of negativity ratings and all six performance measures for the inhibition tasks. These can be seen in Tables 15 and 19. As evidenced by these tables, no significant relationships were found. He also suggested I divide the negativity ratings into early and late ratings and compare the relationship between these two categories of ratings and performance on the inhibition tasks. In order to address this suggestion, I calculated the average negativity ratings for the first 7 pictures (early negativity ratings) as well as the average negativity ratings for the remaining eight pictures (late negativity ratings). These values can be found in Table 5. I ran a series of Pearson correlations looking at the relationship between

these two different types of negativity ratings and all six performance measures for the inhibition tasks. These can be seen in Tables 15 and 19. As evidenced by these tables, no significant relationships were found. Furthermore, I compared the student and Mturk participants on each of these negativity ratings and found that students had significantly lower high negativity ratings, on average. This analysis is presented on page 29 and incorporated into the Discussion section on page 47.

3. Dr. Whitlow suggested that I run a 2-level Chi-square of race/ethnicity between the student and Mturk subjects given the low number of Hispanic and African American individuals in the Mturk sample. To address this suggestion, I used a binary race/ethnicity identification, White vs non-White, and ran a 2 level Chi-square analysis between the student and Mturk subjects. This analysis can be seen on page 28 of this thesis.
4. Dr. Roseman suggested that I incorporate the explanations of past researchers who also failed to find a relationship between inhibition and ER into my Discussion section. To address this comment, I incorporated the authors' explanations into one of the paragraphs in the Discussion section (see pages 43-44).
5. Dr. Whitlow pointed out that some of the adjusted R^2 values in the regression analyses were negative. To address this suggestion, I changed all of the R^2 values so that they were positive. These corrections can be seen in Tables 8, 9, 10, 12, 13, 14, 16, 17, and 18.

6. Dr. Whitlow pointed out that the Vandierendonck (2017) article was not included in the References. As can be seen in the new References section, this article was added.
7. Dr. Whitlow suggested that I provide more background on the use of measures integrating speed and accuracy in the cognitive literature. Several paragraphs providing this background were added on pages 19-20.
8. Dr. Whitlow pointed out that there were discrepancies in the number of participants that I claimed were excluded from the study and the number of participants I stated were included in the analyses. In order to address this comment, I reviewed the participants' data and adjusted the number of participants included in the final analyses (see pages 27-28). All analyses were redone with the adjusted participant number as can be seen throughout the Results section of this document. None of the main outcomes of the study changed as a result of this adjustment.
9. Dr. Roseman noted that the example given for the memory inhibition task was inaccurate. This example was altered so that it was accurate (see page 21).
10. Dr. Roseman noted that *p*-values were not given in the Tables throughout the Results section. In order to address this comment, I added *p*-values in all of the Tables (see Results section of this document).
11. Dr. Whitlow suggested that I provide a more thorough explanation of my reasoning for the relationship between specific types of inhibition and emotion regulation strategies. A paragraph was added explaining this reasoning (see page 9).

12. Dr. Roseman suggested that I provide more conceptual reasoning for the non-significant results of the current study. To address this comment, I added a paragraph providing a possible conceptual explanation for the current findings (see page 43-44).
13. Dr. Roseman suggested that I run analyses to see if burnout effects were present in the participants' data. To address this, I ran a series of *t*-tests with a portion of the participants comparing performance on all measures when the ER task was first vs second or third, the MI task was first vs second or third, and the flanker task was first vs second or third. The results of these analyses are mentioned in the Results section on page 39 as well as incorporated into the Discussion on page 45.

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