ASSESSING THE RELATION BETWEEN INDIVIDUAL DIFFERENCES IN EXECUTIVE FUNCTIONING AND EMOTION REGULATION STRATEGY CHOICE

by

Sydney E. Park

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Approved by:

_____
Dr. Sara Levens

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Dr. George Demakis

_____
Dr. Laura Armstrong

_____
Dr. Teresa Scheid

ABSTRACT

SYDNEY E. PARK. Assessing the Relation between Individual Differences in Executive Functioning and Emotion Regulation Strategy Choice. (Under the direction of DR. SARA M. LEVENS)

Emotion regulation (ER) is an essential aspect of daily life. Critically, an individual's ability to implement different ER strategies requires varying levels of cognitive control known as executive functions (EFs). Specifically, EFs such as interference resolution and rerouting cognitive resources should influence the ER strategies individuals choose to implement. However, empirical evidence linking individual differences in these EFs to ER choice is lacking. This study aimed to investigate whether individual differences in interference resolution and rerouting ability are associated with differences in ER strategy choice. One hundred twenty-seven participants completed a dual-task version of the recency-probes task followed by an ER choice task. The dual-task version of the recency-probes task assesses one's ability to allocate cognitive resources in low and high load interference conditions. Whereas the ER choice task gives participants a choice to implement one of two common ER strategies, distraction and reappraisal, in response to pictures ranging from low to high negative intensity. Analyses were conducted to determine if performance on conditions of the dual-task recency-probes task was associated with reappraisal choice behavior in response to low, moderate, and high negative intensity photos. Results revealed that interference resolution during the dual-task condition was associated with reappraisal choice proportion in response to moderate and high intensity negative pictures. These findings provide empirical evidence linking executive function ability to reappraisal use.

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LIST OF ABBREVIATIONS

ANOVA	analysis of variance
DUAL-IR TASK	dual-task version of the recency-probes task
EF	executive functioning
ER	emotion regulation
ERC	emotion regulation choice
RCP	reappraisal choice proportion

CHAPTER 1: INTRODUCTION

Emotion regulation (ER) is defined as the process of attending to, processing, and managing a response to an emotional situation (Gross, 2014). This ability is being increasingly investigated in the context of behavioral regulation (Gyurak, Goodkind, Kramer, Miller, & Levenson, 2012) and mental and physical health (Gross & Munoz, 1995; Sagui & Levens, 2016). It is therefore important to examine individual differences in ER strategy choice and the underlying constructs that are theorized to support ER ability and strategy choice. To implement an ER strategy, one must utilize a broad range of cognitive processes, called executive functions (EFs). Previous research has shown that individuals differ in their ability to implement various EFs (Matthews, Gruszka, & Szymura, 2010; Kane & Engle, 2002), and this individual variability in EF should influence how individuals implement ER strategies. Specifically, particular EF strengths should be associated with the selection of ER strategies that align with those strengths. However, empirical evidence supporting the underlying mechanistic link between EF and ER is lacking. This study aims to address this gap and provide empirical support for the association between EF individual differences and ER choice.

Emotion Regulation

To regulate one's emotions, individuals can enact one or more ER strategies (Gross, 1998). For example, say an individual receives bad news, they may choose to ignore it and think about something different or they may decide to think about it in a new way to make their negative emotions easier to manage. Two common strategies illustrated in the examples above are distraction and reappraisal. Distraction involves disengaging from an emotional stimulus and directing attention elsewhere (Gross, 2014).

Reappraisal, on the other hand, involves reframing an emotional stimulus to change its meaning (Gross, 2014). To alter the meaning of an emotional stimulus an individual must engage with the stimulus and modify their initial appraisal so that it aligns with their regulatory goal (Sheppes, 2014). This reframing process can be cognitively taxing, as one must modify a mental representation and resolve the interference between the old and new representation (Sheppes, 2014).

Research has shown that distraction and reappraisal tend to be used in different contexts. As reappraisal is effortful it tends to be used in less intense emotional situations when cognitive resources are available to engage in reframing. On the other hand, distraction, which is less cognitively effortful, has been shown to be used more frequently in response to intense negative stimuli (Sheppes, 2014). Interestingly, although reappraisal is more cognitively demanding in the short term, it is thought to be more adaptive long-term as individuals contextualize their emotional experience in a way that is personally meaningful and aligns with their goals (Gross, 2014). Reappraisal is also a uniquely proactive strategy; once the emotional stimuli have been reframed, the reframing has the capacity to persist beyond the initial situation to be used when faced with related scenarios in the future (Steiberger, Payne, & Kensinger, 2011).

Executive Function and Emotion Regulation

Critically, distraction and reappraisal represent fundamentally different antecedent ER strategies (distraction is a disengagement strategy, while reappraisal is an engagement strategy), and each should therefore be supported by distinct EFs. Distraction involves redirecting cognitive resources from one stimulus to a different, and potentially unrelated

stimulus; therefore, the executive process of rerouting (also known as "set shifting" or "task switching," Miyake et al., 2000) may be particularly relevant.

Reappraisal, on the other hand, involves the modification of an existing representation or conception while sustaining engagement with an emotional stimulus and potentially responding to competing cognitive demands. In the process of reframing an emotional stimulus, conflict can arise between the 'old' (original) appraisal and the 'new' (reframed) appraisal. This conflict requires the EF of interference resolution (Miyake et al., 2000; Persson, Welsh, Jonides, & Reuter-Lorenz, 2007) to resolve conflicting appraisal representations by increasing the 'signal' of salient or task-relevant information over competing less salient or irrelevant information.

To describe this process in greater detail, the ease of modifying or reframing an existing representation to form a new representation should be influenced by how familiar the existing representation is, as well as by recognizing the source of the original encoding or appraisal of the representation. As emotional content is more salient, emotion should heighten the aforementioned familiarity and source elements of a representation. Most of the time familiarity and source elements of a representation are in alignment (i.e., the source of encoding is familiar) but when reappraisal occurs, an individual modifies the meaning of the original source content to form a new representation; however, the old representation is still the most familiar, which can create conflict. This conflict is resolved through interference resolution. Prior research has demonstrated that when familiarity and source recognition conflict, emotional content facilitates interference resolution compared to neutral content (Levens & Phelps, 2008). Levens and Phelps (2008) found that in the context of interference resolution, emotional salience acted as a

contextual anchor that facilitated interference resolution. In this vein, it is possible that emotional interference resolution ability may be related to one's ability to reframe an 'old' appraisal to a 'new' appraisal. In fact, research suggests that when individuals have difficulties with interference resolution, the use of reappraisal is less effective (Pe et al., 2013). This particular EF of interference resolution may therefore be particularly critical for reappraisal.

While we highlight the utility of rerouting for distraction, and interference resolution for reappraisal, recent research suggests the ability to flexibly regulate one's emotions (i.e., choosing a regulatory strategy that fits the context over habitual use of a particular strategy) is advantageous (Bonanno & Burton, 2013). For example, one study conducted in a group of first responders demonstrated that individuals who are able to flexibly regulate their emotions have better emotional outcomes after facing traumatic events (Levy-Gigi et al., 2015). No research to date has been conducted on the association between rerouting and interference resolution in ER choice. However, using a dual-task interference resolution paradigm Levens, Mutahdie, and Gotlib (2009) examined the role of rerouting and interference resolution in the context of ruminative tendencies in a sample of depressed individuals. Results revealed that rumination, which is characterized by habitual negative reframing and an inability to disengage from negative content (Joormann, Dkane, & Gotlib, 2006), was associated with poor performance in a task condition that required concurrent rerouting and interference resolution. Accordingly, the ability to flexibly allocate cognitive resources and resolve interference may be associated with the implementation of ER strategies. Performance on the dual-task interference resolution paradigm used by Levens and colleagues may be

able to associate rerouting and interference resolution capability with ER choice variability.

The Present Study

To assess if complex EF ability, specifically the ability to resolve interference and reroute cognitive resources, is associated with ER choice in a non-clinical population, participants completed a dual-task interference resolution paradigm (Dual-IR task) and an emotion regulation choice (ERC) task. The Dual-IR task (Levens et al., 2009) comprises a recency-probes interference resolution task (Monsell, 1978) and a concurrently performed tracking task. The combination of these two tasks demonstrates one's ability to resolve proactive interference (Baseline Condition), reroute cognitive resources between tasks (Rerouting Condition), resolve interference for task relevant stimuli (Cross-Task Condition), and assess one's ability to concurrently resolve interference and reroute cognitive resources between the recency-probes and tracking tasks (Cross-Task Rerouting Condition).

Next participants completed the ERC task (Sheppes et al., 2014) in which participants chose to either distract or reappraise in response to negative stimuli of low, moderate and high intensity. The ERC task is a behavioral proxy that demonstrates which ER strategies individuals tend to rely on in response to stimuli of varying negative intensity. Broadly, we hypothesized that performance on the Dual-IR task will predict choice behavior on the ERC task.

Our specific hypotheses are three-fold. One, we hypothesized participants would replicate prior findings on both study tasks. Specifically, on the Dual-IR task individuals would resolve interference faster in the Cross-Task and Cross-Task Rerouting Conditions

as opposed to the Baseline and Rerouting Conditions (Levens et al., 2009), In addition, on the ERC task participants would select reappraisal less as the negative intensity of the pictures increased (Sheppes, Scheibe, Suri, & Gross, 2011; Sheppes, 2014; Sheppes et al., 2014). Second, we predict that time to resolve interference in the Cross-Task condition will be associated with reappraisal choice, such that those who resolve cross-task interference faster will choose to reappraise more often than those who take longer to resolve this type of interference. Third, we hypothesized that stronger interference resolution during the Cross-Task Rerouting condition would be associated with ER choice flexibility (i.e., change in reappraisal choice from high to low intensity) such that those who resolve interference and reroute quickly will make less context driven ER choice. Specifically, we propose that if an individual is able to efficiently resolve interference and reroute cognitive resources, then they may have an increased capacity to choose their ER strategy based on their personal goals, rather than what is easiest given the current context or circumstances. Overall our hypotheses suggest that an individual's ER strategy selection is influenced by their EF strengths.

CHAPTER 2: METHODS

Participants

This study recruited 141psychology students (age $M = 20.13$ ($SD = 3.20$); 54% female; 71% white; 9% Hispanic/Latino) from the University of North Carolina at Charlotte. Of the 141 participants, two were excluded for not completing the ERC task, two were excluded because they did not complete the questionnaires, and nine were excluded due to missing data on the Dual-IR task, giving rise to a final sample of 128.

An a priori power analysis was conducted on G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) by task to determine the target sample size. Due to the nature of this study, comparing results across two different tasks, we first conducted power analyses on each individual task using prior literature to determine appropriate effect sizes. All power analyses were set to determine a 95% chance of having an effect ($\alpha = .05$). The first power analysis indicated 32 participants would be necessary to detect a small effect size ($\eta = .2$) (Cohen, 1992) on the Dual IR task. This is consistent with prior literature, which suggests cognitive tasks tend to yield lower effect sizes (Joormann, Nee, Berman, Jonides, & Gotlib, 2011; Levens et al., 2009). The second power analysis indicated 15 participants would be needed to yield a medium effect size ($\eta = .5$) (Cohen, 1992), which is consistent with prior use of the ERC task. We then combined the number of measures in each task to run a third power analysis using a more conservative effect size ($\eta = .1$) (Cohen, 1992) and estimated the correlations between tasks ($r = .2$) to estimate the overall sample size of 126. Recruitment was completed through an online system (SONA Systems). Undergraduate students in psychology courses were able to access the SONA

Systems portal online. Based on a brief study description, participants were able to select participation timeslots. Participants received course research credit for their participation.

Procedure

Upon arrival, a graduate student or trained undergraduate research assistant obtained informed consent (see Appendix A) from the participants. Participants completed a brief demographic questionnaire (see Appendix B), followed by the Positive and Negative Affect Schedule (PANAS; see Appendix C), and the Emotion Regulation Questionnaire (ERQ; see Appendix D) to obtain background information and assess current mood and habitual reappraisal use. Participants also completed additional questionnaires not used in the current analyses, including the Trait Meta Mood Scale (TMMS; see Appendix F), the Center for Epidemiologic Study – Depression Scale (CES-D; see Appendix G), the Generalized Anxiety Disorder 7-item Scale (GAD-7; see Appendix H), and the Mental Health History Checklist (MHHC; see Appendix I). Participants then completed three computerized tasks: the Dual-IR task, and Working Memory Manipulation task (not included in the present study) and the ERC task, each of which took approximately 30 minutes to complete. Participants were offered a short break between each task to reduce fatigue. Lastly, a graduate student or undergraduate research assistant debriefed participants. The entire experimental session took approximately 120 minutes.

Measures

Dual-Task version of the Recency-Probes (Dual-IR) paradigm. The dual-task recency-probes (Dual-IR) paradigm (Levens et al., 2009) modifies the original recency-probes task (Monsell, 1978) to also include a tracking task. The Dual-IR task assesses

rerouting and interference resolution costs in conditions of varying difficulty to provide a more complete picture of how individuals allocate cognitive resources to perform a task and engage in goal pursuit.

Stimuli. Participants viewed 473 words. Three hundred seventy words were from the Affirmative Norms for English Words battery (Bradley & Lang, 1999) and the frequently used words battery (Francis & Kucera, 1982). There were also an additional 103 category words. The ad-hoc categories consisted of items an individual would need in a variety of probable situations (e.g., things to bring on a picnic or things commonly bought at the grocery store; see Appendix E for more examples).

Recency-Probes Subtask. In this task, participants were presented with three words individually, termed as a "target set," for 950ms. Following a fixation cross, presented for 3,000ms, participants observed a single probe word for 1,500ms. Participants then had to indicate whether the probe was one of the words within the current target set by selecting a designated key on the keyboard (i.e., 1 = *yes*; 2 = *no*). For example, a target set could consist of "jacket" "thumb" "forget" and a probe word might be "league." In this case, participants would need to respond "2" for *no* because the probe word was not in the target set.

The Recency-Probes Subtask includes four different trial types (see Figure 1) determined by the recency of the probe word in the preceding target set(s): 1) non-recent no-response trials, 2) non-recent yes-response trials, 3) recent no-response trials, and 4) recent yes-response trials. In non-recent yes response trials (see Figure 1, Trial 4), the probe word was in the current target set (dictating a yes-response) but none of the preceding target sets. In contrast, in non-recent no response trials (see Figure 1, Trial 2)

the probe word was not in the current target set (dictating a no-response) nor was it in any of the preceding target sets. In recent yes response trials (see Figure 1, Trial 5) however, the probe word was in the current target set (dictating a yes-response) *and* the preceding two target sets. Finally, in recent no response trials (see Figure 1, Trial 3), the probe word was *not* in the current target set (dictating a no-response), but it *was* in the preceding two target sets which induces interference between the 'incorrect' familiarity response signal ("I saw that word recently, the response is 'yes'.") and the 'correct' source response signal ("I did not see that word in the target set, the response is 'no'.") As can be seen in Figure 1, Trial 3 "forget" was not presented in the current target set but it was presented in the preceding two trials, which induces interference. The interference in recent no response trials takes additional time to resolve which lengthens response time to these trials. Accordingly, interference resolution ability can be measured by subtracting the average non-recent no response trial reaction times from the average recent no response trial reaction times to create an interference resolution difference score.

Tracking Task. A word-tracking task was interleaved within the recency-probes task to assess a participant's ability to reroute resources between two tasks. For each block of trials, an ad-hoc category was presented before the block began (e.g. "Things to save in case of a fire;" see Appendix E for the full list of categories) and words belonging to this list were strategically interwoven throughout the trials. While completing the recency-probes task participants were instructed to count the number of new category words presented within the target sets (excluding category words presented as the probe word) for each block (see Figure 1). After each block of trials ended, participants were

prompted on the computer to enter the number of category words they counted in the target sets of the block using keys labeled 4 through 14.

When the recency probes task and the tracking task are merged, the strategic placement of the ad-hoc category words results in four conditions: Baseline, Rerouting, Cross-Task, and Cross-Task Rerouting.

In the Rerouting Condition, the category words appear as part of the target set (e.g. see “jewelry”, “pet” and “photograph” in Figure 1, Trials 3, 5 & 8, respectively). These trials require the rerouting of cognitive resources because the participant needs to count the category word, add it to their mental list, and then reroute their cognitive resources from the tracking task to the recency-probes task in which they must respond “yes” or “no” to the probe word. This condition functions similar to distraction in that one must engage their attention with the tracking task, then disengage from this task and shift their attention back to the recency-probes task in order to accurately complete the trial, as one may do with an emotional situation.

In the Cross-Task Condition, the category words appear as the probe word (e.g. see “child”, and “heirloom” in Figure 1, Trials 2 & 7, respectively). These trials assess within task interference resolution while also resolving cross-task interference induced (interference between the tracking task and the recency-probes task) because the participants must inhibit counting the category word while responding “yes” or “no” to the trial. Reappraisal during intense emotional contexts may function similarly, as reappraisal during increased emotional intensity requires one to resolve conflict between two competing representations (the recency-probes task) while also resolving interference from other tasks (the tracking task).

In the Cross-Task Rerouting Condition, the preceding 2 conditions are combined—a category word appears in the target set, *and* as the probe word (e.g. see "money" in Figure 1, Trial 4). In these trials the participant needs to reroute cognitive resources from counting the category word in the target set, to resolving cross-task interference while responding to the probe. Responding to these trials requires controlled allocation of cognitive resources across multiple executive functions. This high-interference condition evaluates how well individuals can resolve within-task interference and cross-task interference, and reallocate cognitive resources across two tasks. Prior literature suggests individuals tend to reappraise less and distract more in high cognitive load situations due to the increased cognitive demands reappraisal requires (Sheppes et al., 2014). However, if an individual is able to respond quickly during this high load condition, it may demonstrate greater cognitive control, which may allow them to more flexibly, respond to situations of varying intensity. Faster reaction times in this condition, reflecting greater cognitive control, may facilitate goal directed reappraisal use rather than intensity or context driven reappraisal use.

Finally, in the Baseline condition, no category words appear in the target set, or as the probe word (e.g., Figure 1, Trial 1). Trials in the Baseline condition assess interference resolution capability under no additional cognitive load.

Reaction time (RT) and accuracy for each trial were recorded for use in analyses. Interference resolution difference scores (recent no-response trial RTs – non-recent no response trial RTs) were calculated for each of the above conditions as a measure of interference resolution capability under baseline, rerouting, cross-task, and cross-task rerouting conditions, respectively.

Emotion Regulation Choice (ERC) Task. A modified version of the ERC task (Sheppes et al., 2011) assessed propensity to choose reappraisal or distraction across stimuli of varying negative intensity. In addition to the low and high intensity conditions of the original task (Sheppes et al., 2011), the present study included a moderate intensity condition to better capture choice variance across intensity.

Stimuli. Participants viewed 50 pictures from the International Affective Picture System (IAPS), which included a standardized set of pictures that are designed to evoke an emotional response (Lang, Bradley, & Cuthbert, 2008). Pictures were selected based on normative valence and arousal ratings, which varied from low (n=15; M = 4.35), to moderate (n=20; M = 5.72), to high (n=15; M = 6.63) negative intensity.

Rating Phase. Subjective ratings were obtained for each photo—participants were shown a fixation cross for 1,500ms, followed by a picture for 4,000ms, afterwhich they rated how negative they found the picture to be, using a scale of 1 *("Not negative at all"*) to 9 ("*Very negative*") (see Figure 3).

Experimental choice task. Participants were next instructed in how to implement distraction and reappraisal (order of instruction was counterballanced). After learning both strategies, they were asked to describe each strategy in their own words to ensure comprehension. Subsequently, they completed 6 practice trials (two trials at each intensity level) followed by 50 experimental choice trials. For each trial (practice and experimental), participants viewed a fixation cross presented on the screen for 1,500-1,800ms, which was followed by an IAPS picture for 500ms. Participants then decided which strategy, distraction or reappraisal, they intended to use based on the brief viewing of the picture. Participants then had 2,000ms to prepare their chosen strategy for the

picture they just observed after which the picture was presented again for 5,000ms while they implement their chosen strategy (see Figure 4 for trial sequence). Subsequently, participants rated the impact of the negative picture after using their ER strategy on the previously utilized rating scale (1 = *not negative at all*; 9 = *very negative*) (see Figure 3). On intermittent trials participants were randomly asked to explain how they utilized a strategy for the presented picture.

Covariates

Select questionnaires were included as covariates to control for mood and habitual reappraisal use and are described briefly below.

Positive and Negative Affect Schedule (PANAS). The PANAS required individuals to report their current emotional level. To do so, participants rated how highly they align with the various positive and negative items on a 5-point Likert scale (1 = *very slightly or not at all*; 5 = *extremely*). Within this questionnaire there is both a positive and a negative affect scale, each of which is comprised of 10-items (see Appendix C for the complete form; Watson, Clark, & Tellegen, 1988). Reliability estimates of both the positive affect (α = .89) and negative affect scales (α= .85) are high (Watson et al., 1988).

Emotion Regulation Questionnaire (ERQ). The ERQ is a 10-item questionnaire that assesses how individuals feel they regulate their emotions (see Appendix D for the complete form; Gross & John, 2003). Participants rated each question on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). The scale is broken into two factors: reappraisal (6 questions) and suppression (4 questions). Strong internal consistency was found in each scale (Gross & John, 2003).

Data Analysis

First individual task analyses were conducted followed by combined task analyses to examine the association between performance on each of the four Dual-IR task conditions and ER strategy choice across intensity level on the ERC task.

Individual Task Analyses

Questionnaires/Covariates. Each questionnaire was scored and descriptive statistics and correlations were calculated and presented accordingly.

Dual-Task version of the Recency-Probes Task. Reaction time and response were recorded for each trial. Accuracy rates were calculated for each trial type by dividing the number of correct responses by the total number of trials. A mean reaction time was computed for each trial type by averaging response times to all correct response trials. To measure interference resolution, we calculated an interference resolution difference score (the reaction time difference between recent no response and non-recent no response trials) for each condition. Interference resolution difference scores were the primary independent variable used in analyses. Descriptive statistics were calculated for each condition (see Table 2). To replicate prior task findings (Hypothesis One) of changes in interference resolution as a function of task condition, a two way Cross-Task by Rerouting repeated measures analysis of variance (ANOVA) was conducted on interference resolution difference scores. Paired sample t-tests were conducted to follow-up on any main effects.

Emotion Regulation Choice Task. Subjective ratings from the stimuli rating phase were used to rank order each photo (1 through 50). Next, the 15 lowest ranked negative intensity photos formed the low intensity stimulus set, the 15 highest ranked photos

formed the high intensity set, and the remaining set of 20 stimuli formed the moderate intensity set. Therefore, while every participant viewed low, moderate, and high intensity stimuli based on normative ratings, the photos that comprised those groups were differentially distributed by participant based on each participant's subjective intensity ratings. Given that responses for this task were bi-modal (i.e., participants choose either distraction or reappraisal), ER choice was coded as reappraisal choice proportion. Reappraisal choice proportion was calculated for each subjective intensity level (low, moderate, and high).

To assess whether ERC task performance replicated prior research by Sheppes and colleagues (2014) (Hypothesis One) we conducted a one-way repeated measure ANOVA across intensity. Paired sample t-tests were conducted to follow-up on any main effects. Finally, a Reappraisal Choice Proportion change (RCP Change) score was calculated by subtracting reappraisal use in the low intensity minus reappraisal choice proportion in the high intensity for each individual. Higher scores represent greater context/intensity driven changes in reappraisal use, while lower scores represent less context or intensity driven change. Descriptive statistics are presented in Table 2.

Combined Task Analyses

To assess whether faster interference resolution during the Cross-Task condition was associated with greater reappraisal choice proportion across intensity during the ERC task (Hypothesis Two), we conducted a series of linear regressions in which the Cross-Task condition difference scores from the Dual-IR task were entered as a predictor of average reappraisal choice proportion and reappraisal choice proportion at either low, moderate, or high intensity stimuli on the ERC task.

To determine if interference resolution in the Cross-Task Rerouting Condition was associated with reappraisal choice proportion (RCP) change (i.e., change in reappraisal choice from low to high intensity), we conducted a multiple regression analysis with the Cross-Task condition as the predictor and our covariates, habitual reappraisal use and positive and negative mood, entered simultaneously to predict RCP Change (Hypothesis Three).

CHAPTER 3: RESULTS

Demographics and Covariates.

Descriptive statistics and correlations for demographic information, the PANAS, and the ERQ were conducted and are presented in Table 1.

Dual-Task version of the Recency-Probes Task.

To test our first hypothesis predicting replication of prior task findings (faster interference resolution in the Cross-Task and Cross-Task Rerouting Conditions than the Baseline and Rerouting Conditions), we conducted a two way (Cross-Task by Rerouting) repeated measures analysis of variance (ANOVA; see Figure 2). The ANOVA revealed a main effect of Cross-Task interference $F(1, 127) = 32.26$, $p < .01$, $\eta^2 = .20$ and Rerouting, $F(1, 127) = 4.02$, $p = .05$, $\eta^2 = .03$, yet no significant interaction. Paired samples *t*-tests to parse out the main effects revealed that participants resolved interference significantly faster in the cross-task conditions [i.e., Cross-task and Cross-Task Rerouting conditions (M = -13.48 (SD =144.87))] than non-cross-task conditions [i.e. Baseline and Rerouting conditions (M = 74.51 (SD = 127.87))], $t(127)=5.68$, $p<.001$ (see Figure 5). *T*-tests also revealed participants resolved interference significantly faster in non-rerouting conditions [i.e., Baseline and Cross-Task conditions) (M = 15.82 (SD = 144.81))] than rerouting conditions (i.e., Rerouting and Cross-Task-Rerouting conditions) (M = 45.21 (SD =121.60)), $t(127)= -2.00$, $p<.05$). This pattern replicates prior findings by Levens et al. (2009) and suggests that concurrently performed tasks have the capacity to facilitate interference resolution, while rerouting of cognitive resources lengthens response and interference resolution times.

Emotion Regulation Choice Task

Descriptive statistics for reappraisal choice proportion across intensity level (low, moderate, high) are reported in Table 2. To continue to test our first hypothesis, predicting replication of prior task findings (reappraisal use decreases as the negative intensity of the pictures increased), we conducted a one-way repeated measures ANOVA on reappraisal choice proportion across intensity (low, moderate, high), which yielded a main effect of intensity ($F(2, 254)= 90.55$, $p<.001$, $\eta= .42$). Paired sample t-tests conducted to further parse out the differences in reappraisal choice revealed participants used reappraisal more in response to low intensity pictures than moderate intensity pictures, $t(127)=7.69$, $p<.001$, or high intensity pictures, $t(127)=10.95$, $p<.001$. Additionally, participants chose reappraisal more in response to moderate intensity pictures than high intensity pictures, $t(127)=7.89$, $p<.001$ (see Figure 6). This pattern of reappraisal use replicates prior literature (Sheppes et al., 2014) and is posited to be due to the greater amount of cognitive resources required to reappraise—as reappraisal is more effortful, individuals find it easier to reappraise in response to low intensity stimuli, yet harder to reappraise in response to higher intensity stimuli.

Combined Task Analyses

To assess whether faster interference resolution during the Cross-Task condition was associated with greater reappraisal choice proportion across intensity during the ERC task (Hypothesis Two), we conducted a series of multiple regression analyses with the Cross-Task Condition as the predictor and our covariates, habitual reappraisal use and positive and negative mood, entered simultaneously to predict average reappraisal choice

proportion and reappraisal choice proportion at each subjective level of intensity (low, moderate, and high). Findings reveal the Cross-Task condition significantly predicted use of reappraisal for moderate $\beta = -.24$, $t(123) = -2.68$, $p = .01$ and high $\beta = -.18$, $t(123) = -2.00$, $p = .05$, intensity stimuli, as well as average use of reappraisal, $\beta = -.21$, $t(123) = -2.36$, $p = .02$. However, performance in the Cross-Task condition did not predict use of reappraisal for the low intensity pictures, $\beta = -.15$, $t(123) = -1.64$, $p = .10$. These findings indicate that Hypothesis 2 was supported—cross-task interference resolution ability predicts average RCP, which was driven by an association between cross-task interference resolution and RCP at moderate and high intensities.

We also conducted a multiple regression analysis with the Cross-Task Rerouting Condition as the predictor and our covariates, habitual reappraisal use and positive and negative mood, entered simultaneously to predict reappraisal change (i.e., reappraisal choice proportion difference score: low intensity – high intensity) to determine if individuals who demonstrated faster interference resolution in the Cross-Task Rerouting condition demonstrated *less* habit and context driven ER choice (i.e., *less* change in reappraisal choice from low to high intensity). Results suggest reappraisal choice proportion change was not associated with interference resolution on the Cross-Task Rerouting condition $\beta = .03$, $t(123) = .36$, $p = .72$. Therefore, Hypothesis 3 was not supported.

CHAPTER 4: DISCUSSION

This study was designed to assess whether interference resolution under various cognitive load conditions predicted patterns of ER choice in response to negative stimuli of low, moderate, and high intensity. Specifically, we were interested in the relationship between ability to resolve interference and reappraisal use. Past literature suggests these constructs are related, but evidence connecting these underlying processes is limited. To test associations between these processes, participants completed a dual-task recency-probes (Dual-IR) task and an emotion regulation choice (ERC) task. Based on prior literature and the structure of these tasks, we proposed three hypotheses, two of which were supported by the data.

First, we hypothesized that our data would replicate prior findings on both the Dual IR task and the ERC task. Specifically, on the Dual-IR task we predicted individuals would resolve interference faster in the Cross-task and Cross-task Rerouting conditions than the Baseline and Rerouting conditions (Levens et al., 2009). On the Dual-IR task, individuals were able to resolve within task interference more quickly in the Cross-Task and Cross-Task Rerouting conditions than the Baseline and Rerouting conditions. This pattern of findings suggests that concurrently performed tasks have the capacity to facilitate interference resolution for task relevant content, while rerouting of cognitive resources lengthens response and interference resolution times. For example, taking notes on a specific topic while attending a work meeting, lecture, or presentation results in a higher level of engagement with meeting or lecture content. Moreover, the act of more actively engaging with the material improves source memory. Similarly, in the Dual-IR task, the tracking task is like note taking, it takes more cognitive effort and can be a

distraction from the recency-probes task; however, it also increases engagement with the overall task material and improves source memory which facilitates interference resolution. In this manner concurrently performed tasks can influence how events are encoded and representations are formed which may facilitate one's ability to resolve interference.

In regards to replicating prior ERC task findings, we predicted that participants would select reappraisal less as stimulus intensity increased (Sheppes et al., 2011; Sheppes, 2014; Sheppes et al., 2014). Prior studies have demonstrated a pattern of utilizing reappraisal more in response to low intensity stimuli and using reappraisal less (and distraction more) in response to high intensity stimuli (Sheppes et al., 2011; Sheppes, 2014; Sheppes et al., 2014). Sheppes and colleagues attribute this pattern of responding to the increased cognitive resources required to process a highly intense emotional stimulus, whereas distraction requires less cognitive resources and can be more easily implemented when facing highly negative stimuli (Sheppes, 2014). We observed this same pattern as Sheppes and colleagues in the present study, fully supporting our first hypothesis.

In regards to our second hypothesis, we predicted that time to resolve interference in the Cross-Task condition would be associated with reappraisal choice, such that those who resolve cross-task interference faster would choose to reappraise more often than those who take longer to resolve this type of interference. The basis for this hypothesis is the cognitive processes required for reappraisal. Reappraisal requires the resolution of two competing representations—when faced with an emotional situation, individuals must resolve conflict or interference between the original and more familiar

representation and the new, altered (or reframed) representation (Gross, 2014; Sheppes, 2014). As resolving conflict or interference between the original and new representation is central to reappraisal, we posited that faster interference of task-relevant content during the Cross-Task condition would be associated with greater reappraisal use. Our results supported this hypothesis as we observed a negative association between interference resolution in the Cross-Task condition and mean reappraisal choice, such that lower interference difference scores (faster interference resolution) predicted more frequent reappraisal choice. This finding supports prior research, which found that individuals with poorer interference resolution skills were less effective at implementing ER strategies, including reappraisal (Pe et al., 2013).

Interestingly, the negative association between Cross-Task interference scores and reappraisal choice was selective—we observed it in response to moderate and high intensity negative photos, but not to low intensity photos. This pattern of findings suggests that interference resolution ability may be more relevant in contexts in which cognitive resources are more limited or strained (such as trying to reappraise moderate and high intensity negative photos) but less relevant in situations in which resources are less strained (i.e. reappraising low intensity negative photos). Another possibility is that reappraisal in response to low intensity negative pictures may be more automatic or habitual, whereas reappraisal in response to higher intensity photos is more effortful and deliberate.

Finally, in our third hypothesis, we predicted that individuals who demonstrated faster interference resolution in the high load Cross-Task Rerouting condition would demonstrate less context driven regulatory choice behavior on the ERC task compared to

those who did not resolve interference in this condition as quickly. We postulate that those who can quickly resolve cross task and within task interference and rapidly reroute cognitive resources would demonstrate high multi-executive function capacity and be less affected by changes in stimulus intensity and context and therefore have a greater capacity to select a strategy based on their goals, as opposed to stimulus context. Therefore, we predicted an association between Reappraisal Choice Proportion change score and time to resolve interference in the high load Cross-Task Rerouting condition. This hypothesis was not supported; we found no association between Reappraisal Choice Proportion change scores and Cross-Task Rerouting condition performance. It may be that elements of task design contributed to this null finding. It is important to note, however, that participants were not asked about their goals or instructed to change their emotional responses based on specific or personally relevant goals. As such, participants may be performing in accordance with what is cognitively easiest, (i.e., using reappraisal more with low intensity pictures and less as the intensity increases [Sheppes, 2014]) and not with respect to one's goals. Future research should assess participants' regulatory goals to further clarify the association between multi-executive function capacity and reappraisal choice across intensity.

Although the last hypothesis was not supported, our finding that individuals who are able to resolve interference faster tend to utilize reappraisal more in moderate and high intensity situations suggests that interference resolution may be an important EF for implementing reappraisal. Moreover, our findings support recent research highlighting the role of individual differences in understanding regulatory behavior. Therefore, strengthening an individual's ability to resolve interference may improve one's ability to

utilize reappraisal more effectively as they would be more able to implement reappraisal in a larger range of scenarios. As prior literature indicates, successful use of reappraisal can be applied beyond the original situation to similar scenarios (Steiberger et al., 2011). This pattern of findings also suggests that individuals with high interference resolution ability may be more able to select a strategy that aligns with their goals rather than adjusting their regulatory strategy when intensity increases. Therefore, increasing one's ability to utilize reappraisal in higher intensity situations may allow for more adaptive and broader application of the strategy to improve emotion regulation and coping abilities.

The findings also have implications beyond the ER literature. For example, results from the current study support prior research, which has found that stronger EFs are linked with more adaptive, planned coping strategies, whereas weaker EFs are more associated with avoidant coping techniques (Krpan, Levine, Stuss, & Dawson, 2007). The present study demonstrates that faster interference resolution ability was associated with greater reappraisal use, which is often considered a more "adaptive" strategy (Cohen, Henik, & Moyal, 2012; Sheppes, 2014). Additionally, our results indicate that individuals with slower interference resolution ability implement reappraisal less, which is consistent with the coping styles and regulatory abilities of individuals with EF and ER deficits. For instance, prior research demonstrates that EF and ER difficulties are common in individuals with neurologic or medical disorders/injuries, such as traumatic brain injury (TBI) and stroke, and in individuals with mental health disorders, such as schizophrenia and these populations typically display a maladaptive or avoidant coping style (Kegel, Dux, & Macko, 2014; Kpran et al., 2007; Wilder-Willis, Shear, Steffen, & Borkin, 2002).

Increasing knowledge about how EF and ER play a role in various types of coping and self-regulation may provide more insight into the processes of these disorders and diseases, which may lead to greater treatment types. Therefore, it may be particularly important to better understand the EF-ER relationship and how it relates to coping within these types of populations.

Limitations

While the results of this study contribute significantly to the EF and ER literature, particularly in the areas of individual differences and EF mechanisms underlying reappraisal choice, there are a number of notable limitations. The sample, while non-clinical by design, was a convenience sample comprised of undergraduate students from a public university; therefore the generalizability of the results to the broader population may be limited and future research should seek to replicate these findings in a community and clinical sample. Furthermore, as the sample is comprised of individuals who are enrolled in public university participants likely have average to above average levels of intelligence and cognitive abilities, which may not be representative of other populations, particularly at risk populations with lower cognitive capabilities. Individuals with lower cognitive abilities may demonstrate a unique association between EF ability and ER strategy choice, as compared to those in the present study. Additionally, aspects both EF and ER abilities continue to develop until individuals are in reach young adulthood (McRae et al., 2012; Zelazo & Muller, 2010). Therefore, our data may be highlighting a relationship that is developmental in nature and these results may not be generalizable to adults with fully matured EF and ER abilities or to children with less developed EF and ER abilities.

Future Directions

In addition to the future directions discussed above, the findings of the present study also highlight a number of interesting future directions. In the present study, we focused on two specific EFs, but other EFs (i.e., updating) and cognitive factors (i.e., intelligence level) may also be impact one's regulatory choices. Future research should explore the differential impacts of other EFs on reappraisal choice, as well as the impact of EFs on other ER strategies, such as suppression. Further exploration into the associations between EFs and ER will result in a more nuanced understanding of these constructs and their relation to each other. More specifically, ER and EF are influential in interpersonal relationships, academic achievement, occupational functioning, mood regulation, coping skills and mental health (Nyklicek et al., 2011; Izard et al., 2011; Gross & Munoz, 1995; Diamond, 2013; Goldstein et al., 2014; Riley et al., 2006; Combs et al., 2015), outlining this link further could be particularly beneficial for the treatment of mental illness and other clinical interventions.

Future results should also explore the clinical relevance of the present findings. While this task was designed to assess the relation between EF and ER in a non-clinical sample, the targeted empirical association could be present in clinical samples that report difficulties in these domains. Our results suggest that people who struggle to resolve interference and reroute cognitive resources may choose ER strategies differently than those with more of these EF capabilities. Preliminary research suggests that disorders characterized by EF deficits (i.e., ADHD, schizophrenia, mood disorders; Barkley, 1997; Pe et al., 2013; Suchy, 2009) may also have ER problems, and that people with disorders of ER (i.e., depression, anxiety, posttraumatic stress disorder; American Psychiatric

Association, 2013; Joormann & Quinn, 2014) may also have difficulties with EFs (Guimond, Padani, Lutz, Eack, Thermenos, & Keshavan, 2017; Joormann, 2010; Joormann & D'Avanzato, 2010; Levens et al., 2009). Therefore, administration of the present tasks in clinical populations may elucidate unique disorder specific associations that could clarify disease etiology.

Conclusion

In conclusion, the partial support of our hypotheses begins to provide empirical evidence for the underlying relationship between EFs capabilities and ER choice. Specifically, findings suggest that being able to resolve task relevant interference more quickly may allow for reappraisal use in higher intensity situations that would typically be more cognitively demanding. This increased ability to implement reappraisal may allow individuals to more adaptively respond to emotional situations, allowing for better mental health overall. The present findings expand upon existing research by demonstrating an association between task relevant interference resolution and ER choice. Overall, this study provides a more nuanced look at the potential role of interference resolution in reappraisal choice in a non-clinical sample. Furthermore the findings suggest intriguing avenues of future research, particularly in the domain of emotion dysregulation and mental health disorders where greater insight into the association between EF capabilities and emotion regulation choice may identify treatment avenues to increase adaptive functioning and avoid maladaptive ER choice patterns.

Table 1.
Descriptive Statistics and Zero-Order Correlations Among Demographics and Study Variables

Variable	*M (SD)/%*	1.	2.	3.	4.	5.	6.	7.
1. Age	20.13 (*3.20*)	--						
2. Gender % Female	54%	-.01	--					
3. Race % White	71%	.10	-.00	--				
4. Ethnicity % Hispanic/Latino	9%	.02	-.02	-.46**	--			
5. PANAS Negative	18.98 (6.58)	.15	.03	.13	.02	--		
6. PANAS Positive	29.70 (9.34)	.04	-.20*	-.02	.11	.04	--	
7. ERQ	30.06 (6.02)	-.07	-.03	.11	-.03	-.15	.20*	--

Note. N = 128, **p*>.*05;* ***p*>.*01;* PANAS – Positive and Negative Affect Scale; ERQ = Emotion Regulation Questionnaire, reappraisal.

Table 2.
Partial correlation between RCP and interference resolution scores

Variable	*M (SD)*	1	2	3	4	5	6	7	8
1.Baseline[1]	49.57 (201.94)	--							
2. Rerouting[1]	99.45 (151.54)	.03	--						
3. Cross-Task[1]	-17.94 (205.71)	.01	.16	--					
4. Cross-Task Rerouting[1]	-9.03 (192.06)	.22*	-.01	.05	--				
5. RCP Low	.70 (.26)	.01	-.09	-.15	.08	--			
6. RCP Medium	.59 (.25)	.01	-.07	-.24**	.11	.81**	--		
7. RCP High	.46 (.26)	.07	-.03	-.18*	.09	.55**	.73**	--	
8. Average RCP	.58 (.23)	.10	-.07	-.21*	.10	.88**	.95**	.85**	--

Note. N = 128; **p>.05; **p>.01;* + = trend; [1] = difference score. Dual-IR task conditions include: baseline, rerouting, cross-task, and cross-task rerouting. Analyses were conducted controlling for habitual reappraisal use (ERQ) and both positive and negative mood (PANAS). RCP low, medium, and high is referring to the picture intensity of the ERC task.

Example Trial sequence (ITI = 5000 ms)				Interference Resolution Trial Type	Dual Task Conditions
Trial	Target set: 950ms	Delay: 3000ms	Probe:		
1.	jacket thumb forget	+	league	Non-recent No Response	Baseline
2.	forget beard apple	+	child	Non-recent No Response	Cross-Task
3.	jewelry blue agreed	+	forget	Recent No Response	Rerouting
4.	face money blue	+	money	Non-Recent Yes Response	Cross-Task Rerouting
5.	forget blue pet	+	blue	Recent Yes Response	Rerouting
6.	nail lunch tree	+	tree	Non-Recent Yes Response	Baseline
7.	jacket blue lunch	+	heirloom	Non-Recent No Response	Cross-Task
8.	photograph flower pen	+	lunch	Recent No Response	Rerouting

Figure 1. Example trial sequence for the Dual-IR task. Trial types for the recency-probes task and conditions for the inclusion of the tracking task are noted. Interference resolution ability was calculated by subtracting reaction time for the non-recent no response trials (i.e., within-task interference; example trials 1, 2, and 7) from the recent no response trials (i.e., non-interference; example trials 3 and 8) for each condition. Ad hoc category: Things to save in case of a fire; total count is four words (see trials 3, 4, 5, and 8).

		Cross-Task	
		Not present	Present
Rerouting	Not present	Baseline	Cross-task
	Present	Rerouting	Cross-task Rerouting

Figure 2. Trial conditions presented as the two by two cross-task and rerouting recency-probes dual-task design.

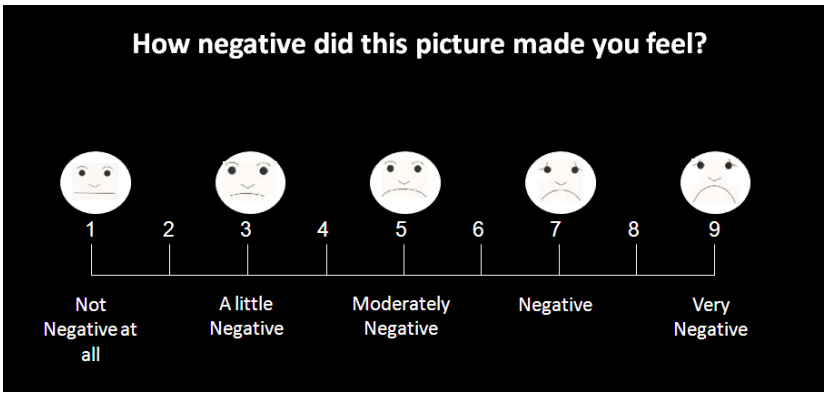

Figure 3. ERC task rating scale presented after each trial.

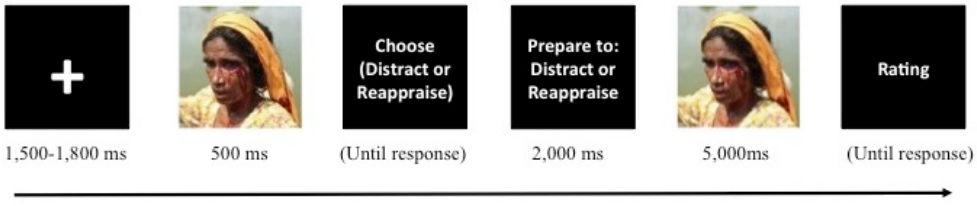

Figure 4. ERC task choice phase trial structure.

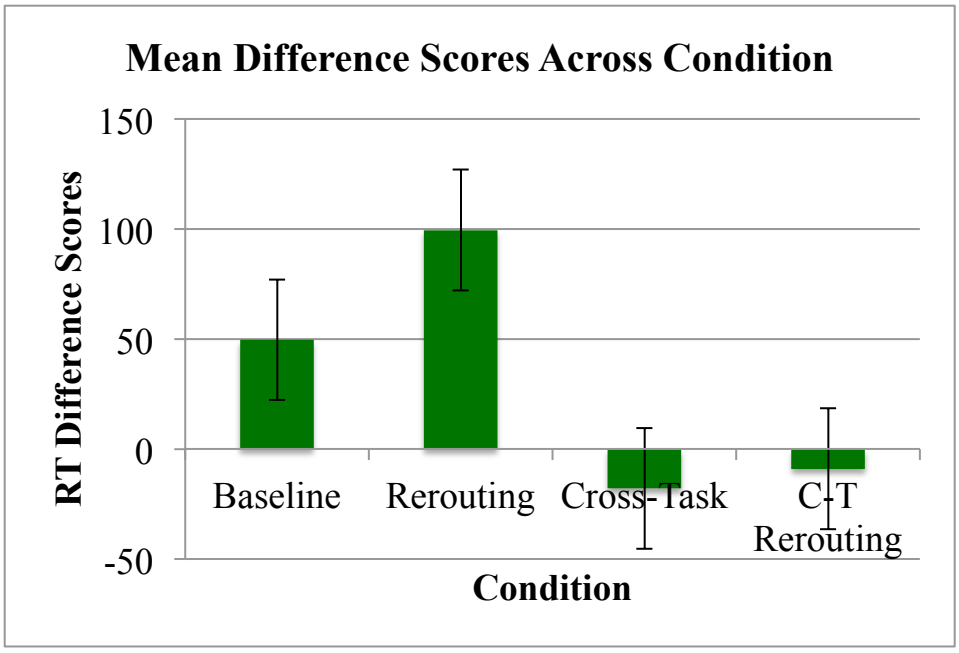

Figure 5. Mean interference resolution difference scores across each condition of the Dual-IR task.

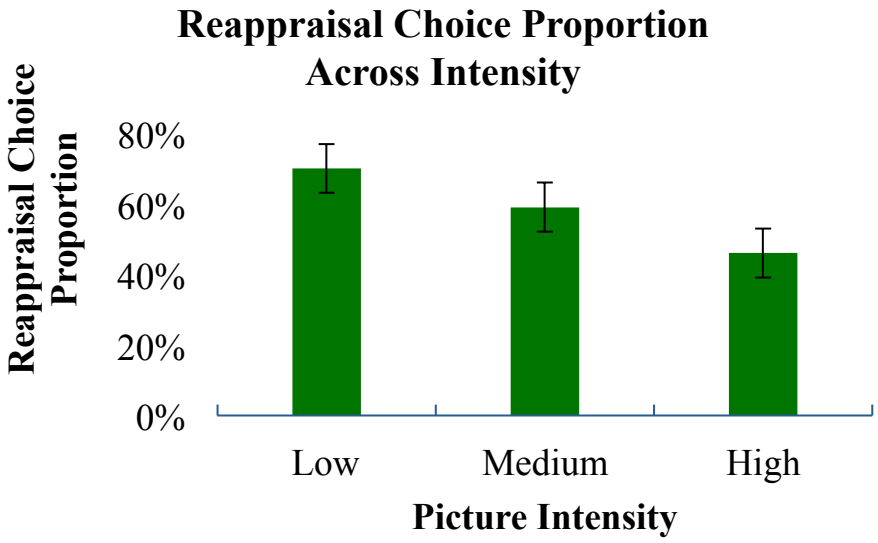

Figure 6. Reappraisal choice proportion across intensity on the ERC task.

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APPENDIX A: INFORMED CONSENT FORM

Thank you for your interest in participating! As part of the study, you will be asked to complete a variety of questionnaires and complete two computerized tasks. The questionnaires will include basic background questions as well as questions about your mood and mental health. This study will take approximately 1 hour and 30 minutes to complete.

To participate, you must be fluent in English and 18 years or older.

You are a volunteer. The decision to participate in this study is completely up to you. If you decide to be in the study, you may stop at any time. You will not be treated any differently if you decide not to participate in the study or if you stop once you have started.

There are no risks, side effects or discomforts associated with this study. Some of the information collected in the questionnaires may be sensitive; however, no personally identifying information will be collected and as such, your responses on this survey are anonymous.

You will receive extra credit for your participation via SONA Systems.

PRINCIPAL INVESTIGATOR:
Sara M. Levens, PhD
Assistant Professor of Psychology
Dept. of Psychology, Colvard 4033
9201 University City Blvd. Charlotte, NC 28223
Phone: 704-687-1965
slevens@uncc.edu

DOCTORAL RESEARCHER:
Sydney Park
spark68@uncc.edu

About Research Participant's Voluntary Consent to Participate in Research:

To voluntarily agree to take part in this study, you must sign on the line below. If you choose to take part in this study, you may withdraw at any time. You are not giving up any of your legal rights by signing this form. Your signature below indicates that you have read or had read to you this entire consent form, including the risks and benefits, and have had all of your questions answered, and that you are 16 years of age or older.

ID # : _____

Printed Name of Participant

_____

Signature of Participant Date

_____

Principal Investigator, Graduate Student or RA
I have given this research participant information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.

Printed Name of Person Obtaining Consent Study Role

_____

Signature of Person Obtaining Consent Date

_____

APPENDIX B: DEMOGRAPHIC QUESTIONNAIRE

1. How old are you in years? _____

2. Date of Birth: _____

3. Please select. Are you: "Male" or "Female" or "Other"

4. Are you Hispanic or Latino? Yes No Don't know/Not sure

5. Which one of the groups below would you say best represents your race?:
   - White
   - Black
   - Asian
   - Native Hawaiian/Pacific Islander
   - Native American
   - Other _____
   - Don't know/Not sure

6. What is your marital status?
   - Single
   - Married
   - Common law marriage
   - In a relationship
   - Separated
   - Divorced
   - Widowed

7. Which one best describes your religious beliefs?
   - Christian-Catholic
   - Christian-Protestant
   - Jewish
   - Muslim
   - Buddhist
   - Hindu
   - Agnostic
   - Atheist
   - Not affiliated
   - Other _____
   - Don't know/Not sure

8. What is the highest level of education you have completed?
   - Graduate or professional training
   - College
   - Some college

High school diploma
Some high school
Junior high school
Less than 7 years
I prefer not to answer

9. Which of the following categories best describes your pre-tax household income in the last year?

Less than 10,000
10,000 to 24,999
25,000 to 49,999
50,000 to 74, 999
75,000 to 99,999
More than 100,000
I prefer not to answer

10. What is your current occupation status?

Employed
Unemployed
Retired

If you are employed, please list your current occupation: _____

APPENDIX C: POSITIVE AND NEGATIVE AFFECT SCHEDULE (PANAS)

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063-1070.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt like this today. Use the following scale to record your answers.

1 **=** Very slightly or not at all
2 = A little
3 = Moderately
4 = Quite a bit
5 = Extremely

Interested _____	Irritable _____
Distressed _____	Alert _____
Excited _____	Ashamed _____
Upset _____	Inspired _____
Strong _____	Nervous _____
Guilty _____	Determined _____
Scared _____	Attentive _____
Hostile _____	Jittery _____
Enthusiastic _____	Active _____
Proud _____	Afraid _____

Scoring: To score this scale first have a look yourself and see if you can decide which of the 20 questions are positive and which are negative. Check your own judgment with the list below. Then add your scores for the 10 positive words and separately for the 10 negative words. Now you have your positive and negative scores. The scores generated will vary along the scale of 10 – 50, with lower scores indicating low (positive or negative) affect and higher scores indicating high (positive or negative) affect.

The 10 items for **POSITIVE (PA)** affect are:
attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong and active.

The 10 items for **NEGATIVE (NA)** affect are*:*
distressed, upset, hostile, irritable, scared, afraid, ashamed, guilty and nervous, jittery.

APPENDIX D: EMOTION REGULATION QUESTIONNAIRE (ERQ)

Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85*, 348-362.

Description:
The Emotion Regulation Questionnaire is designed to assess individual differences in the habitual use of two emotion regulation strategies: cognitive reappraisal and expressive suppression.

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 using the following scale:

1	2	3	4	5	6	7
strongly disagree			neutral			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.

Note: Do not change item order, as items 1 and 3 at the beginning of the questionnaire define the terms "positive emotion" and "negative emotion".

Scoring (no reversals); Reappraisal Items: 1, 3, 5, 7, 8, 10; Suppression Items: 2, 4, 6, 9

APPENDIX E: AD HOC CATEGORIES FROM THE DUAL-TASK VERSION OF THE RECENCY-PROBES TASK

1. *For Practice Trials*: Items needed to bake a pie: Fruit, Bowl, Oven, Spoon, Sugar
2. Things to save in case of fire: Photograph, Child, Jewelry, Pets, Heirloom, Money
3. Things to bring on a picnic: Blanket, Sandwich, Frisbee, Bread, Basket, Cookies, Drinks, Soda, Plates, Napkins
4. Items needed for a new pet dog: Bed, Food, Bowl, Collar, Treat, Brush, Toys, Ball
5. Activities or ways to lose weight: Medication, Diet, Aerobics, Operation, Exercise, Weights, Yoga, Bike
6. Things commonly bought at the grocery store: Milk, Bread, Eggs, Butter, Juice, Cheese, Toothpaste
7. Things to pack in your suitcase for a trip: Money, Jacket, Socks, Hairbrush, Shirts, Toothbrush
8. Things you need to travel around Europe: Tickets, Suitcase, Passport, Guidebook, Wallet, Clothes, Shoes, Bus, Train
9. Things to buy for a new baby: Blanket, Milk, Clothing, Crib, Bonnet, Bib, Diapers, Bottle
10. Things necessary for your new office: Copier, Staples, Paper, Desk, Pens, Fax, Computer, Pencil
11. Things needed to remodel your home: Tools, Budget, Carpenter, Paint, Contractor, Wood
12. Items to bring to the beach: Swimsuit, Towel, Sun-screen, Shovel, Sunglasses, Bucket, Cooler, Food, Drinks, Sandals
13. Items needed for a meeting, presentation, or interview: Suit, Resume, Notepad, Research, References, Pen
14. Things to bring camping: Lantern, Tent, Matches, Knife, Coat, Pillow, Flashlight, Chairs
15. Things needed to write a paper: Computer, Dictionary, Reference, Paper, Library, Journal, Book

APPENDIX F: TRAIT META MOOD SCALE (TMMS)

Salovey, P., Mayer, J. D., Goldman, S. L., Turvey, C., & Palfai, T. P. (1995). Emotional attention, clarity, and repair: Exploring emotional intelligence using the Trait-Meta Mood Scale. In J. W. Pennebaker (Ed.), *Emotion, disclosure and health* (pp. 125-154). Washington, D.C.: American Psychological Association.

Instructions: Please read each statement and decide whether or not you agree with it.

5 = Strongly agree
4 = Somewhat agree
3 = Neither agree nor disagree
2 = Somewhat disagree
1 = Strongly disagree

_____ 1. The variety of human feelings makes life more interesting.

_____ 2. I try to think good thoughts no matter how badly I feel. [Repair]

_____ 3. I don't have much energy when I am happy.

_____ 4. People would be better off if they felt less and thought more. [Attention (R)]

_____ 5. I usually don't have much energy when I'm sad.

_____ 6. When I'm angry, I usually let myself feel that way.

_____ 7. I don't think it's worth paying attention to your emotions or moods. [Attention (R)]

_____ 8. I don't usually care much about what I'm feeling [Attention (R)]

_____ 9. Sometimes I can't tell what my feelings are. [Clarity (R)]

_____ 10. If I find myself getting mad, I try to calm myself down.

_____ 11. I have lots of energy when I feel sad.

_____12. I am rarely confused about how I feel. [Clarity]

_____ 13. I think about my mood constantly.

_____ 14. I don't let my feelings interfere with what I am thinking.

_____ 15. Feelings give direction to life. [Attention]

_____ 16. Although I am sometimes sad, I have a mostly optimistic out look. [Repair]

_____ 17. When I am upset I realize that the "good things in life" are illusions. [Repair (R)]

_____ 18. I believe in acting from the heart. [Attention]

_____ 19. I can never tell how I feel. [Clarity (R)]

_____ 20. When I am happy I realize how foolish most of my worries are.

_____ 21. I believe it's healthy to feel whatever emotion you feel.

_____ 22. The best way for me to handle my feelings is to experience them to the fullest. [Attention]

_____ 23. When I become upset I remind myself of all the pleasures in life. [Repair]

_____ 24. My belief and opinions always seem to change depending on how I feel. [Clarity (R)]

_____ 25. I usually have lots of energy when I'm happy.

_____ 26. I am often aware of my feelings on a matter. [Clarity]

_____ 27. When I'm depressed, I can't help but think of bad thoughts.

_____ 28. I am usually confused about how I feel. [Clarity (R)]

_____ 29. One should never be guided by emotions. [Attention (R)]

_____ 30. If I'm in too good a mood, I remind myself of reality to bring myself down.

_____ 31. I never give into my emotions. [Attention (R)]

_____ 32. Although I am sometimes happy, I have a mostly pessimistic outlook. [Repair (R)]

_____ 33. I feel at ease about my emotions. [Clarity]

_____ 34. It's important to block out some feelings in order to preserve your sanity.

_____ 35. I pay a lot of attention to how I feel. [Attention]

_____ 36. When I'm in a good mood, I'm optimistic about the future.

_____ 37. I can't make sense out of my feelings. [Clarity (R)]

_____ 38. I don't pay much attention to my feelings. [Attention (R)]

_____ 39. Whenever I'm in a bad mood, I'm pessimistic about the future.

_____ 40. I never worry about being in too good a mood.

_____ 41. I often think about my feelings. [Attention]

_____ 42. I am usually very clear about my feelings. [Clarity]

_____ 43. No matter how badly I feel, I try to think about pleasant things. [Repair]

_____ 44. Feelings are a weakness humans have. [Attention (R)]

_____ 45. I usually know my feelings about a matter. [Clarity]

_____ 46. It is usually a waste of time to think about your emotions. [Attention (R)]

_____ 47. When I am happy I sometimes remind myself of everything that could go wrong.

_____ 48. I almost always know exactly how I am feeling. [Clarity]

APPENDIX G: CENTER FOR EPIDEMIOLOGIC STUDY – DEPRESSION SCALE (CES-D)

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385-401. doi:10.1177/014662167700100306

During the past week…	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	All of the time 5-7 days)
1. I was bothered by things that usually don't bother me.				
2. I did not feel like eating; my appetite was poor.				
3. I felt that I could not shake off the blues even with help from my family.				
4. I felt that I was just as good as other people.				
5. I had trouble keeping my mind on what I was doing.				
6. I felt depressed.				
7. I felt that everything I did was an effort.				
8. I felt hopeful about the future.				
9. I thought my life had been a failure.				
10. I felt fearful.				
11. My sleep was restless.				
12. I was happy.				
13. I talked less than usual.				
14. I felt lonely.				
15. People were unfriendly.				
16. I enjoyed life.				
17. I had crying spells.				
18. I felt sad.				
19. I felt that people disliked me.				
20. I could not "get going."				

Scoring:
Directions: Do not score if missing more than 4 responses. 1) For each item, look up your response and corresponding score (0-3). 2) Fill in the score for each item under the last column labeled "Score." 3) Calculate your Total Score by adding up all 20 scores.

During the past week…	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasi on-ally or a moder ate amoun t of time (3-4 days)	All of the time (5-7 days)	Score
1. I was bothered by things that usually don't bother me.	0	1	2	3	
2. I did not feel like eating; my appetite was poor.	0	1	2	3	
3. I felt that I could not shake off the blues even with help from my family.	0	1	2	3	
4. I felt that I was just as good as other people.	3	2	1	0	
5. I had trouble keeping y mind on what I was doing.	0	1	2	3	
6. I felt depressed.	0	1	2	3	
7. I felt that everything I did was an effort.	0	1	2	3	
8. I felt hopeful about the future.	3	2	1	0	
9. I thought my life had been a failure.	0	1	2	3	
10. I felt fearful.	0	1	2	3	
11. My sleep was restless.	0	1	2	3	
12. I was happy.	3	2	1	0	
13. I talked less than usual.	0	1	2	3	
14. I felt lonely.	0	1	2	3	
15. People were unfriendly.	0	1	2	3	
16. I enjoyed life.	3	2	1	0	
17. I had crying spells.	0	1	2	3	
18. I felt sad.	0	1	2	3	
19. I felt that people disliked me.	0	1	2	3	
20. I could not "get going."	0	1	2	3	
				Total Score:	

Scoring Results: Total Score of 16 or higher is considered depressed.

APPENDIX H: GENERALIZED ANXIETY DISORDER 7-ITEM SCALE (GAD-7)

Generalized Anxiety Disorder 7-item (GAD-7) scale

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
Add the score for each column	+	+	+	
Total Score *(add your column scores)* =				

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all _____
Somewhat difficult _____
Very difficult _____
Extremely difficult _____

Source: Spitzer RL, Kroenke K, Williams JBW, Lowe B. A brief measure for assessing generalized anxiety disorder. *Arch Inern Med.* 2006;166:1092-1097.

APPENDIX I: MENTAL HEALTH HISTORY CHECKLIST (MHHC)

Has a medical doctor or psychologist ever diagnosed you as suffering from any of the following conditions?

Diagnosis	No	Yes
Anxiety disorders (e.g., anxiety disorders, panic disorders, phobias, etc.)	0	1
Eating disorders (e.g., bulimia, anorexia)	0	1
Depression (e.g., major depression, dysthymia, etc.)	0	1
Posttraumatic Stress Disorder (PTSD)	0	1
Learning disability	0	1
Attention-Deficit/Hyperactivity Disorder (ADHD/ADD)	0	1
Behavior Disorder (e.g., Conduct disorder, oppositional defiant disorder)	0	1
An alcohol or substance abuse problem/disorder	0	1
Other condition. Specify _____	0	1