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Arousal Reappraisal and Interoceptive Awareness:

How Awareness of Bodily Changes Facilitates Heightened Performance and Ability to Reappraise

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Project title: Arousal Reappraisal and Interoceptive Awareness: How Awareness of Bodily Changes Facilitates Heightened Performance and Ability to Reappraise

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Abstract

The physiological arousal induced by a stressful situation has historically been viewed as bad; however, recent research has challenged this perspective, arguing that stress-related arousal can be beneficial. Arousal reappraisal is a coping technique that encourages individuals to reinterpret their physiological stress response as a means to help improve performance. Conversely, suppression, a common, yet ineffective coping technique, involves the active effort to stop oneself from expressing an emotional behavior. The current research examined the relationship between coping techniques and interoceptive awareness (IA), the degree to which individuals are aware of their own physiological changes. Comparing arousal reappraisal to both suppression and a control condition, the current research measured physiological changes, as well as performance on tasks intended to induce stress, including a timed math subtraction task and a karaoke singing task, to determine whether individuals with high IA would benefit more from arousal reappraisal techniques. Hypothesis One predicted an interaction between the independent variables, with high IA individuals in the control and suppression conditions performing worse than their low IA counterparts and high IA individuals benefiting more from arousal reappraisal techniques than those with low IA. Hypothesis Two predicted a main effect of coping condition for physiological changes, specifically predicting that individuals in the suppression condition would experience increased levels of physiology when compared to individuals in the other conditions. The results of the study did not fully support either hypothesis. The results suggest that arousal reappraisal did not have a significant effect on performance during a stressful task and found IA to have no significant impact on participants' ability to benefit from reappraisal. However, the results did show a non-significant trend towards an interaction between IA and coping condition for performance on the mathematical stress task. This trend supports our prediction that suppression would hinder performance ability and continues to support the importance of the role of IA. Finally, there was a significant difference between baseline physiology and physiology during the two stress tasks, suggesting the tasks were an effective manipulation. However, physiology did not vary between the coping conditions. The results suggest the need for continued research on this topic.

Arousal Reappraisal and Interoceptive Awareness:

How Awareness of Bodily Changes Facilitates Heightened Performance and Ability to Reappraise

Imagine yourself standing at the top of the high dive, looking at the cool water below, or walking up to a podium and looking out to a crowd as you ready yourself to give a speech. Now, imagine yourself stepping up to the plate with two outs in the bottom of the ninth, taking a timed exam for which you are unprepared, or sitting down for an interview at your dream job. How would you respond? Or rather, how would your body respond? If you were ill-prepared for any of the above scenarios, there would certainly be feelings of uncertainty and anxiousness accompanying a more deeply rooted physiological response as you approached the apex of the unfamiliar situation resulting in the all-too-familiar stress response.

The current research focused on the concepts of arousal reappraisal and interoceptive awareness (IA), the degree to which an individual is aware of the changes in his or her physiological state (Craig, 2003). This study measured both physiological changes (heart rate and skin conductance), as well as performance on tasks intended to induce stress, with the goal of determining if individuals who are more aware of the physiological changes that occur during a stressful situation would benefit more from stress reappraisal techniques than those who are less aware of such changes.

The Stress Response

Simply put, stress is defined as an individual's physiological and emotional response to the physical or psychological situations that pose a threat to his or her well-being (Maier, Watkins, & Fleshner, 1994). Stress is a commonality of the human experience, and no one person is immune to its effects. While the stress response may vary from person to person, it creates a change within the body and mind, disrupting the equilibrium that is present during the body's resting state. Stress creates a state of action within the body, a fight-or-flight response if you will, and puts the body into a state of emergency, activating both the sympathetic nervous system (SNS) and the hypothalamo-pituitary-adrenal (HPA) axis system (Maier et al., 1994; Schneiderman, Ironson, Seigel, 2005).

The SNS, the energizing division of the autonomic nervous system, is comprised of motor neurons connected to the central nervous system (CNS) and other bodily systems such as the immune organs, i.e., organs contributing to the body's immune system (Maier et al., 1994). Through the activation of the SNS, a series of catecholamines, a group of amino acids including the neurotransmitters norepinephrine and epinephrine, are released into the bloodstream via the adrenal gland (Maier et al., 1994). Unlike the SNS, which facilitates the much faster fight-or-flight reaction, the HPA axis system is a slower working system that combines the function of three parts of the endocrine system: the adrenal gland, the hypothalamus, and the pituitary gland (Blackburn-Munro & Blackburn-Munro, 2001). The endocrine activity of the HPA axis system works in a series of stages, ultimately resulting in the production of glucocorticoids, hormones associated with the feeling of stress (Baumann & Gauldie, 1994). The HPA axis system is first activated by the hypothalamus. The hypothalamus then produces corticotrophin releasing hormones, which are released at the base of the brain and signal the pituitary gland to produce adrenocorticotrophic hormone, the next hormone in the series. As aforementioned, the final step in the process is the production of glucocorticoids by the adrenal glands, creating a heightened feeling of stress (Baumann & Gauldie, 1994).

The activation of both the SNS and the HPA axis system as the result of a stressor creates a series of events that ultimately produce a palpable biological reaction. There is an increase in heart rate, muscle contraction, and blood flow, as well as an enhancement in sensory perception (e.g., pupil dilation creating better vision clarity and heightening the ability to see long distances) (Maier et al., 1994). Additionally, due to the fact that sweat glands are innervated by the SNS, there is an increase in total skin conductance throughout the body (Wahbeh & Oken, 2013).

If a stressor is short-lived or sudden, then the subsequent reactions are likely to end here; however, if a stressor becomes repetitious or remains persistent, the stressor is likely to have much greater effects on the body. Such long-term exposure to stress results in the persistence of stress hormones within the body and can have detrimental effects on body systems, as well as on one's ability to cope with stress (Schneiderman et al., 2005). In addition to reducing the body's overall ability to interpret stressors, long-term, or chronic stress takes a toll on an individual's immune system, making him or her more susceptible to illness, infection, and disease (Graham, Christian, & Kiecolt-Glaser, 2006; Maier et al., 1994; Suinn, 2001). Additionally, chronic stress can slow the rate at which wounds heal and respond to injury (Marucha, Kiecolt-Glaser, & Favagehi, 1998). Furthermore, the abundance of stress hormones produced by the SNS and HPA axis system during chronic stress can lead to the eventual deterioration of major body tissues, including the heart and the blood vessels (Schneiderman et al., 2005).

Stress Appraisal

Another thing to consider is how one interprets, or appraises, the aforementioned scenarios, and while the stress response is fairly common, it is in no way the rule. To fully understand this distinction, one must first have an understanding of the ways in which individuals evaluate their potential stressors. To do this, one must evaluate primary and secondary appraisal, the fundamental pieces of an individual's cognitive appraisal (Lazarus & Folkman, 1984). Primary appraisal accounts for the initial assessment of an environmental stimulus with the goal of determining whether expended consequences will be positive, negative, or neutral. Primary appraisal is categorized in three ways: irrelevant, implying a neutral encounter with the environment, benign-positive, implying a positive environmental outcome, and stressful, which implies some damage has occurred to the individual. The stress response also includes feelings of harm, threat, challenge, and loss. Alongside primary appraisal, secondary appraisal works to evaluate what can be done to manage a stressor in any given situation. More specifically, secondary appraisal is the assessment of whether or not one's resources and coping strategies will be sufficient to overcome a given environmental stimulus (Lazarus & Folkman, 1984). Secondary appraisal takes into account several different factors including the wide variety of coping options an individual can utilize, the likelihood that the coping method chosen will be successful, and the chance that each coping method can be applied effectively and efficiently. Similar to primary appraisal, secondary appraisal considers several different factors and outcomes. The first potential outcome is that the overall threat of the stressor is reduced. This reduction of the perceived threat occurs due to the realization that an individual has the appropriate resources to manage the situation. The second potential outcome of secondary appraisal is the product of perceived negative outcomes and is manifested in the physical and mental perception of stress (Lazarus & Folkman, 1984).

The Biopsychosocial Model of Challenge and Threat

The biopsychosocial model of challenge and threat expands on the preexisting ideas of stress appraisal; however, in this model appraisal is directly linked to an individual's response to a potential stressor, instead of a series of sequential steps (Jamieson, Mendes, & Nock, 2013). Both challenge and threat are experienced during the perception of a stressor and encompass the interworking of both affective and cognitive processes; however, the systems differ fundamentally in both the appraisal and physiological responses they produce (Lazarus & Folkman, 1984). Both responses, challenge and threat, occur during goal-oriented tasks perceived with relative importance to the individual (Blascovich, Mendes, Hunter, & Salomon, 1999). Additionally, they both affectively address positive and negative emotions and cognitively address attention and appraisal (Blascovich et al., 1999).

Challenge occurs when an individual feels that he or she has “sufficient resources” to meet the demands of their present situation (Lazarus & Folkman, 1984). Conversely, threat occurs when an individual feels that he or she has “insufficient resources” given the demands of their present situation. With this in mind then, it is no surprise that individuals experiencing challenge tend to outperform those who feel threatened by their surroundings. This is not to say that threat is a hindrance to performance though, as threatened individuals tend to outperform those who lack any particular motivation to complete the task at hand. Subsequently, it can be said that both challenge and threat act fundamentally as a motivating factor, driving behavior and in many instances enhancing performance (Lazarus & Folkman, 1984).

Another characteristic to consider when looking at the models of challenge and threat is the physiological changes they induce. While it is true that both challenge and threat are associated with SNS activation, they bring about different cardiac and hormonal responses (Blascovich et al., 1999; Jamieson et al., 2013). Challenge is typified by an increase in cardiac efficiency, meaning the ratio of the work done by the heart to the energy used to perform such work is relatively balanced (Jamieson et al., 2013). Additionally, the increase in cardiac performance associated with a challenge response is accompanied by an increase of epinephrine release (Blascovich et al., 1999). Epinephrine is a neurotransmitter released by the adrenal gland that causes vasodilation, expansion of the blood vessels, and a decrease in blood flow resistance.

Alternatively, threat is typified by a decrease in cardiac efficiency, and due to inhibition of the adrenal gland no epinephrine is released, preventing vasodilation from occurring. As a result, blood vessels constrict in anticipation of impending damage and thus a noticeable spike in blood pressure can be observed (Blascovich et al., 1999; Jamieson et al., 2013;).

The model of challenge and threat and their clear cardiovascular markers support and expand upon the ideas of primary and secondary appraisal, again emphasizing the importance of one's own interpretation in the stress response.

Yerkes-Dodson Law

The question of the relationship between physiological arousal and performance has been discussed for years, specifically seeking the ideal level of physiological arousal that should be achieved in order to maximize an individual's performance output. This issue was first discussed by Yerkes and Dodson in 1908, who originally focused their research on physical stimuli in relation to habit formation, observing how long it took mice to learn the distance between two distinct points relative to the number of electric shocks administered by the experimenter (Hanoch & Vitouch, 2004). However, over the years the original Yerkes-Dodson Law (YDL) has transformed. Starting in the early 1950s, psychologists began to raise questions regarding the relationship between emotional arousal and performance. As a result, the YDL was utilized and later adapted to answer these more recent questions (e.g., what is the relationship between level of arousal and performance?). Similar to Yerkes and Dodson's original findings regarding stimulus and habit formation, an inverse 'U' relationship was found between emotional arousal and performance. The updated YDL describes the effects of emotional arousal on performance, explaining that high levels of arousal can have detrimental effects on performance, thus decreasing both an individual's informational processing and decision-making skills (Hanoch & Vitouch, 2004). The parabolic pattern presented with the YDL suggests that peak performance occurs at moments when arousal is moderate, whereas moments with high and low arousal are indicative of low performance outcomes. One common explanation for this pattern is Easterbrook's cue-utilization theory (Hanoch & Vitouch, 2004). The Easterbrook cue-utilization theory relies on the idea of cue recognition, meaning how much an individual can perceive during any given situation. The theory suggests that individuals with moderate arousal are able to perceive a larger array of environmental set cues than those with high arousal, because high arousal can impair information processing skills and limit one's ability to perceive set cues (Hanoch & Vitouch, 2004).

Current research supports these original findings, suggesting that there is an optimal level of arousal for all individuals that can maximize their performance levels. Researchers Bray, MacLean, and Hare (2015) put the YDL to the test in a cross-species study. The group hypothesized that problem-solving abilities would be affected and related to temperament within their test group: pet and assistance dogs (Bray et al., 2015). The study applied the ideas of the YDL, still focusing on emotional arousal and performance, however, it bridged the gap between human and non-human animals showing the versatility of the law in question. The study tested two groups of dogs with different training backgrounds. Group one was pet dogs. These dogs were found to have a naturally higher level of baseline arousal. The second group consisted of assistance dogs. These dogs were found to have lower baseline arousal levels likely due to their training history. Each dog was presented with an inhibitory task that required them to retrieve food from across the room. The trick to the task was that the dogs needed to walk around a transparent barrier to reach the food that was easily within their sight, thus increasing the time and distance between them and the reward. Each dog was randomly assigned to either the low or the high arousal condition in which the experimenter systematically varied his or her tone of voice. In the low arousal condition, the experimenter would crouch behind the transparent screen near the reward and call to the dog in a monotone and hushed tone of voice, whereas in the high arousal condition the experimenter used a much louder and more excited tone of voice to call to the dogs. Each trial was timed, recorded, and performance was measured in two ways: time it took for the dog to receive the reward, and arousal (number of tail wags per minute). At the conclusion of the study it was found that assistance dogs, who began the study with naturally lower levels of arousal, ultimately benefit from the increase of arousal, whereas pet dogs were negatively affected by this arousal change (Bray et al., 2015). Their findings not only fit with the original hypothesis, but they aligned with the YDL and supported the expected relationship between arousal and performance.

Interoceptive Awareness

Stress arises out of an individual's physiological and emotional response to his or her surroundings, so it would make sense then that knowledge of one's physiological changes is an important piece in identifying a stressor. Interoceptive awareness (IA), an individual's sensitivity to internal changes and his or her ability to detect various physiological changes, plays a key role in the perception of a stress as a challenge or threat (Craig, 2003).

Consider the James-Lange Theory of emotion. In this cognitive appraisal approach to emotion, the physiological change that is triggered by a situation acts as the necessary predecessor to the actual interpretation of the emotional state (Critchley, Wiens, Rotshtein, Öhman, & Dolan, 2004). In this example, the concept of IA is crucial to the functioning of the emotional appraisal system, as one's awareness of the changes in his or her heart rate or gut reaction, for example, then elicit an emotional response (Critchley et al., 2004). Similarly, in the stress response, physiological arousal again precedes appraisal, with IA playing an integral role in the evaluation process (Kindermann & Werner, 2014a).

If then, IA is a central tool in arousal appraisal, how can it be conceptualized? Being that different people may interpret their physiological states in slightly different ways, IA can be divided into the categories of high and low, a process most commonly done by comparing individual heartbeat estimation (Critchley et al., 2004). To determine these differences, it is common to have participants complete a heartbeat perception task, in which participants are asked to estimate the number of times their heart beats within a given time period (Schandry, 1981). During the task individuals are told to concentrate on his or her bodily sensations, and asked to avoid any physical measures such as pulse (Schandry,1981). Their estimates are later compared to an accurate measure of their heart rate (Schandry, 1981). Individuals who score high on the heartbeat perception task, meaning they have a small error score, are classified as having high IA (Kever, Pollatos, Vermeulen, & Grynberg, 2015; Kindermann & Werner, 2014a; Kindermann & Werner, 2014b; Pollatos, Herbert, Kaufmann, Auer, & Schandry, 2007).

In a 2014 study, Kindermann and Werner set out to learn more about the differences between high IA and low IA individuals, specifically asking questions about how an individual's IA connected to his or her cognitive performance and overall emotional experience while engaging in a mentally stressful task (Kindermann & Werner, 2014b). Using the heartbeat perception task, participants were divided into high and low IA groups and then asked to participate in the Determination Test. The Determination Test acted as the mental stress test and required participants to simultaneously react and respond to visual and auditory stimuli. To assess participants' cognitive performance, a variety of variables were used based on the results of the Determination Test, and to assess emotional experience, the Multidimensional Mood

Questionnaire was used. Additionally, physiological arousal was monitored before, during, and after the stress task. Prior to the study, it was hypothesized that individuals with high IA would perform worse on the cognitive stress task and have a more negative emotional experience; evidence was found to align with these speculations and the hypotheses were supported. As a result, it was found that high IA individuals not only exhibited a keen ability to detect their own heart rate, but showed a greater performance deficit and reported greater decreases in mood during times of stress than individuals with low IA. Additionally, it is interesting to note that while high IA individuals had a better perception of their physiological arousal, their arousal levels were not different than individuals with low IA; both groups showed arousal changes during the stress task at the same level. This suggests that high IA individuals' emotional and cognitive deficits were tied to their ability to perceive changes in arousal rather than a significant difference in their arousal levels (Kindermann & Werner, 2014b).

With this in mind, it is not surprising that individuals with high IA utilize arousal appraisal techniques (e.g., arousal reappraisal, a technique requiring individuals to reinterpret their physiological arousal, and suppression, which is the conscious effort to stop oneself from expressing or feeling a specific emotion) more often than those with low IA to combat this heightened feeling of arousal that they experience in a stressful situation (Kever et al., 2015). After determining a group of individuals' level of IA using the Heartbeat Perception Task, Kever and colleagues (2015) utilized the Emotion Regulation Questionnaire (ERQ) to determine which of two main appraisal techniques, arousal reappraisal or suppression, are used most often by individuals in both high and low IA groups. A positive relationship between IA and the use of arousal reappraisal was hypothesized. Conversely, it was also hypothesized that IA and the use of suppression techniques to combat arousal would yield a negative correlation. At the completion of the study, however, it was found that both arousal reappraisal and suppression show a positive correlation with level of IA. It is possible that, due to a high IA individual's increased awareness of his or her physiological changes, the general use of coping techniques increases and that these individuals utilize both reappraisal and suppression techniques almost equally (Kever et al., 2015).

On the opposite end of the spectrum, individuals who score low on the heartbeat perception task, meaning they have a larger error score, are said to have low IA (Kever et al., 2015; Kindermann & Werner, 2014a; Kindermann & Werner, 2014b; Pollatos et al., 2007;). Unlike the individuals with high IA, individuals with low IA react less negatively to stressors and show significantly fewer performance deficits when tested in a stressful situation (Kever et al., 2015).

Controlling Arousal

We have already discussed the initial appraisal that is associated with the stress response, primary and secondary appraisal, as have we discussed the biopsychosocial model of challenge and threat. However, the techniques that can be utilized to control and manage arousal are much more expansive than this. The effort one puts into an attempt to manage the psychological and physiological strains that are put on the body during a stressful situation is collectively known as coping, and can further be broken down into specific models and techniques (e.g., optimism, mastery, social support, and self-esteem) (Taylor & Stanton, 2007). While each model of coping varies slightly in execution, they share the common goal to manage, minimize, and accept the pressures which a stressor can introduce. Additionally, these coping mechanisms act as a barrier between stress and its potentially adverse effects (Taylor & Stanton, 2007). This paper focuses on two specific coping models: arousal reappraisal and suppression.

Arousal Reappraisal. While other models of coping, such as problem-focused, emotion-focused, or approach- versus avoidance-oriented coping, certainly hold importance, the focus of this paper is on the cognitive behavioral model of reappraisal. The four major methods of coping previously mentioned all occur after a stressor has already arisen, and determines how an individual interprets and recovers from a stressor. Problem-focused coping aims to directly reduce the stress at hand by targeting its cause and addressing the stressor's external demands (Nes & Segerstrom, 2006). Countering problem-focused coping, emotion-focused coping targets a stressor's internal demands and aims to reduce an individual's emotional response (Nes & Segerstrom, 2006). Approach-oriented and avoidance-oriented coping are also counterstrategies. In approach-oriented coping individuals utilizing this technique accept the stress that is facing them and directly act on its demands (Nes & Segerstrom, 2006; Suls & Fletcher, 1985). On the other end of the spectrum, avoidance-oriented coping is characterized by complete denial or avoidance of the stressor's demand (Nes & Segerstrom, 2006; Suls & Fletcher, 1985).

Unlike the aforementioned coping mechanisms, arousal reappraisal is an antecedent-focused method of coping and thus occurs prior to the activation of any major emotional or behavioral response systems (Kever et al., 2015). Arousal reappraisal techniques encourage individuals to reinterpret their physiological stress response, and instead of viewing these bodily changes as negative, view them as a means to help improve performance (Moore, Vine, Wilson, & Freeman, 2015; Jamieson et al., 2013; Jamieson, Nock, & Mendes, 2012). As a result of such reinterpretations, it has often been found that reappraisal not only yields benefits in performance, but also in total well-being and social functioning (Kever et al., 2015).

In recent years, research regarding the significance of arousal reappraisal has become increasingly prevalent, and a variety of studies have been conducted showing the importance of this cognitive behavioral method. In 2010, Jamieson, Mendes, Blackstock, and Schmader sought to determine if arousal reappraisal methods had any effect on SNS activation levels and performance during a cognitive task. In this study, participants, who were students scheduled to take the GRE within three months of their scheduled lab appointment, had to attend three labs sessions. The first session allowed the researchers to obtain a saliva sample, which would serve as the baseline measure of salivary alpha-amylase (sAA) levels, a value relating to SNS activation. The second session required participants to complete a GRE practice exam and a second saliva sample was taken. This was also the day that participants were randomly assigned to either the reappraisal or control groups. Once divided, each group was given written directions about the practice exam, with the reappraisal condition also receiving a description of how the arousal felt while taking an examination could be beneficial to their performance. The third visit to the lab came one to three months later, after the participants had taken the GRE. This appointment required participants to provide a copy of their GRE scores and complete the GRE experience questionnaire. In conclusion of the study, it was found that participants in the reappraisal condition performed better on the initial practice exam. Additionally, these individuals also showed better performance long term, receiving higher average math scores on the actual GRE then those in the control group. In addition, this performance shown by individuals in the reappraisal condition was found to be related to an increase in sAA and catecholamine levels within the saliva samples, suggesting that reappraisal can lead to large increases in SNS activation. In line with the original research question, these findings suggest that arousal reappraisal can act as a beneficial coping mechanism during moderately stressful scenarios, serving to improve performance, reduce attentional biases, and promote an adaptive physiological response (Jamieson et al., 2010).

Jamieson and colleagues (2012) conducted yet another study centered on the ideas of arousal reappraisal. In this study, the Trier Social Stress Test (TSST) was used, along with physiological measures of cardiovascular response and a test of attentional bias, to answer the question of whether changing appraisal techniques was a sufficient way to adjust an individual's physiological response to stress and decrease his or her attention to emotionally negative stimuli (Jamieson et al., 2012). After being connected to the sensors that would monitor changes in cardiovascular activity, participants were randomly divided into three conditions: reappraisal (told arousal is a benefit), ignore (told it is best to ignore the external source of stress), and no-treatment control (completed a neutral time filling task). Once divided into groups, participants completed the TSST which required them to give a speech in front of two evaluators and a video camera. After the completion of the TSST, an emotional Stroop task, in which participants had to name the colors of the words they were shown, was used to test for attentional biases. As hypothesized, researchers found that the participants in the reappraisal condition showed improvements in cardiovascular functioning in that vessels were less likely to constrict and reduce blood flow in response to a stressor, as well as showing fewer threat-related attention biases in comparison with those in the ignore and control groups. This suggests then that changing appraisal techniques is a suitable way to manipulate the cognitive stress response (Jamieson et al., 2012).

Reappraisal techniques are multifaceted and can take on a variety of forms. Beyond simply asking participants to view their physiological arousal as a benefit to their performance, Brooks (2014) utilized excitement as a reappraisal technique, and she proposed that the anxiety felt during the stress response and excitement were "arousal congruent," meaning the two are characterized by the same high arousal states. Brooks investigated these ideas with a series of experiments, each focusing on a new idea related to reappraisal and performance (Brooks, 2014).

Through a survey, the pilot study tried to determine what people most commonly believed was the best way to cope with performance anxiety (Brooks, 2014). In line with the hypothesis, it was determined that the majority of people believe trying to remain calm is the best ways to cope with increased feelings of anxiety, with very few people, only 7.74%, suggesting that getting excited is the best way to cope with such arousal (Brooks, 2014).

In Brooks' first study, participants were required to perform a karaoke song in front of an experimenter, and specifically focused on whether or not reappraisal as excitement was a reasonable arousal reappraisal technique (Brooks, 2014). Before performing the karaoke task, participants were connected to a pulse oximeter, which recorded heart rate, and then were randomly assigned to read an emotional statement, for example "I am [anxious]/[excited]/[calm]/[angry]/[sad]" (Brooks, 2014). Using the pulse oximeter, a significant increase in physiological arousal was recorded after participants were informed of the karaoke task; however there was no further change in arousal after they made their emotional statement. The karaoke task was completed using the "Karaoke Revolution: Glee" video game for the Wii console and the participants performance score was calculated by the game (0% - 100%) based on each participants' volume, pitch, and note duration. After completion of the karaoke task, participants self-reported levels of anxiety and excitement on a Likert scale, as well as completing a self-efficacy measure to see how well participants thought they did. As expected, participants in the excited condition had the highest performance scores and rated themselves highest on levels of excitement and self-efficacy, suggesting that excitement was a sufficient method of arousal reappraisal (Brooks, 2014).

Study two combined the ideas of arousal reappraisal via excitement and via calmness and sought to compare the two strategies directly (Brooks, 2014). Similar to study one, participants were again randomly assigned to read an emotional statement; however, in this study there were only two conditions, calm and excited. The stress task in this study required participants to present a short speech in front of both an experimenter and a video camera, and to increase the pressure of the task, participants were told that their performance would later be judged by a jury of their peers. After completion of the stress task, participants completed the same self-reported measures that were utilized in study one and the video was sent to be analyzed by a panel of raters. Again, in line with the hypothesis, it was found that participants in the excitement condition self-reported higher levels of excitement. These same individuals spoke longer when presenting their speeches and were rated as more competent, confident, and persuasive by the evaluators. Surprisingly, there was no significant difference in self-reported anxiety levels between the calm and excitement groups (Brooks, 2014).

Study three followed the same trend of comparison between excitement, calm, and neutral conditions; however, instead of having participants utilize statements that directly referred to their personal state (“I am [anxious]/[excited]/[calm]/[angry]/[sad]”), to manipulate participant mood and appraisal (Brooks, 2014). The study again utilized the pulse oximeter system to monitor heart rate, and random assignment to sort participants into one of three conditions, in which they were given condition specific directions: calm (“try to remain calm”), excited (“try to get excited”), and neutral (“please wait a few moments”). After reading the appropriate directions for their condition, participants completed a pressurized and challenging math task, after which they self-reported levels of excitement, anxiety, and self-efficacy. While performance on the math test was almost identical for the calm and neutral condition, participants in the excitement condition scored much higher on this task. It was also found that heart rate increased immediately after participants learned about the task they could be completing and remained high throughout the remainder of the task. This suggests that physiological arousal is extremely challenging to manage regardless of the coping technique being utilized (Brooks, 2014).

In her final study, Brooks (2014) tried to explain why utilizing excitement as a reappraisal technique creates a boost in performance. To do this, participants were again randomly assigned to one of two groups, calm or excited, and asked to read a set of simple directions before they completed a cognitively challenging math test (the same test used in study three). In addition to the math test, participants' threat-opportunity mindset was measured through the use of a variety of open-ended (e.g. "describe the math test") and Likert scale measures (e.g., "I view the test more as a challenge than as a threat" or "the IQ test is an opportunity to have fun"). At the conclusion of the study it was again found that participants in the excitement condition performed significantly better on the math test. Additionally, these individuals exhibited higher threat-opportunity levels than the participants in the calm condition (Brooks, 2014).

Not only does Brooks' (2014) work emphasize the significance of reappraisal techniques, but it creates a distinction between the different types of reappraisal techniques. She challenged the idea that trying to calm down was the best way to combat arousal, and instead proposed a new method of arousal reappraisal that transitioned participants' thoughts to an emotion with similar physiological characteristics to the arousal they were already feeling. By completing these experiments, Brooks helped solidify the idea that the way individuals think about, or appraise, a situation plays a significant role in the way they perform and feel during a stressful situation (Brooks, 2014).

Moore and colleagues (2015) proposed a similar question. They wanted to know whether or not arousal reappraisal would have similar cardiovascular and performance benefits during a high stakes, single-trial, motor task (Moore et al., 2015). In the study, participants were randomly assigned to either the arousal reappraisal or the control group, connected to an impedance cardiograph device, and asked to perform six practice golf putts as a baseline measure. Additionally, after their practice, participants were informed that they were in the bottom 30% of those who had already completed the task. Once baseline cardiovascular data had been recorded, participants were informed of the pressurized task, a single golf putt which participants were told would be entered into a competition. Participants were also told the top five performers would win a prize and the bottom five performers would be interviewed. From there, individuals in the reappraisal condition were given instructions that explained how the arousal they would experience as the result of the stress response was an adaptation that evolved to help improve performance. Conversely, individuals in the control condition completed a simple task to control for time differences. After being properly informed about the task at hand, and given their respective instructions, arousal reappraisal or control, individuals completed a single golf putt. The study utilized both performance and physiological measures to determine the validity of the hypothesis, and it was ultimately determined that individuals in the reappraisal condition showed better performance than those in the control group. Additionally, individuals in the arousal reappraisal condition generally interpreted their experienced arousal as a benefit rather than a hinderance. Finally, while the physiological data appeared to show that arousal reappraisal individuals experienced arousal patterns consistent with a challenge state, the difference between groups was not significant (Moore et al., 2015).

Working to connect the two concepts of awareness and coping style, Füstös, Gramann, Herbert, and Pollatos (2012) conducted an experiment that tied together the ideas of both IA and reappraisal. The group hypothesized that individuals more aware of their physiological arousal would benefit more from reappraisal techniques than those less aware of the bodily changes associated with emotion. The study required participants to continuously view images from the International Affective Picture System (IAPS), a collection of positive, negative, and neutral images designed to invoke an emotional response from participants. Instead of distinctly dividing participants into two groups, high IA and low IA, each IA score was taken and assessed as a covariate alongside a variety of variables at the end of the study (e.g., the degree of downregulated arousal and the varying neural activity). Upon entering the lab, participants were informed of the task they would be performing and then properly trained in reappraisal techniques. Training told participants to think about the pictures they were viewing as fake; additionally, it allowed them to practice this reappraisal method to ensure that each participant could utilize it quickly and accurately when presented with unpleasant images. During the main portion of the study participants were connected to an electroencephalogram (EEG) and presented with images, positive, negative, and neutral, from the IAPS. After completion of this task, each participant was asked to complete the Self-Assessment Manikin, a measure used to determine individual level of arousal and overall feeling of pleasantness. The electrophysiological data found that participant use of reappraisal techniques as a means to reduce arousal was effective only for those with high IA. These results suggest that individuals with high IA are more likely to benefit from techniques in reappraisal than the individuals with low IA (Füstös et al., 2012).

Suppression. In contrast to arousal reappraisal, suppression is a response-focused strategy of coping, meaning it is not utilized until an emotional or stress response is already underway (John & Gross, 2004; Kever et al., 2015). Suppression is the conscious effort to stop oneself from expressing a certain emotional behavior once already in an emotional state. Though suppression is a relatively common coping mechanism, it has been shown to have less than beneficial effects, often causing a decrease in social functioning, a sense of self-discrepancy, and a decline in the total well-being of the individual (John & Gross, 2004; Kever et al., 2015).

In a study of suppression, Gross and Levenson (1997) randomly assigned participants to watch a sad, neutral, or amusing film. Participants were also randomly assigned to one of two coping conditions, suppression or no suppression. This study focused solely on the effectiveness of suppression as a coping mechanism, and aimed to see if the results of its use varied based on the type of emotional stimulus. At the conclusion of the study, researchers found for all three film conditions, participants in the suppression condition exhibited decreased expressive behavior. Additionally, there was a decrease in self-reported amusement scores for participants in the suppression condition who selected to watch the sad and amusing films. It was also found that watching the neutral film had no effect on the participants' physiological response; however, watching both the sad and the amusing films had significant effects on the individuals within the suppression condition, and led to a clear increase in heartrate and other sympathetic responses (Gross & Levenson, 1997). The results of this study confirm the adverse qualities associated with suppression, and illustrate its broad effects on an individual's psychological and physiological well-being.

In a similar study Gross (1998) again focused on suppression and sought to compare the difference in effectiveness of two different coping mechanisms, one antecedent-focused and one response-focused. In his study participants were randomly assigned to one of three conditions: arousal reappraisal, suppression, or control. Each group was shown a series of short film clips intended to provoke negative emotions and were asked to call upon their assigned coping strategy to manage these emotions. At the completion of the study researchers found that even though individuals assigned to the suppression condition showed far fewer signs of emotional distress, when prompted by a questionnaire at the end of the study, these individuals were feeling just as much negative emotion as the other groups within the study. Additionally, it was found that the individuals within the suppression condition showed signs of greater physiological arousal (e.g., elevated heart rate). On the other end of the spectrum, participants in the arousal reappraisal condition, who utilized the antecedent-focused model of coping, showed decreases in their expression of negative emotions without the adverse effects of increased physiological arousal (Gross, 1998).

Both of these studies not only outline the nature of suppression, but they also highlight its potential adverse side effects (e.g., hindered social functioning, self-discrepancy). Another key idea that these studies emphasized was suppression's expansive nature and its effect on both positive and negative emotions (John & Gross, 2004). If faced with a negative situation, individuals who utilize suppression still maintain the full emotional impact of the situation; they simply hide their experience from others. Conversely, those faced with a positive situation who choose to utilize suppression not only hide their true emotion, but also they dampen their overall experience. Finally, since suppression is a response-focused strategy and is not initiated until the experience has already begun, it requires much more cognitive effort to be utilized. Contrary to arousal reappraisal, which requires very few cognitive resources, individuals utilizing suppression must actively manage each of their emotions and responses to properly disguise them. This cognitive demand is one of the main reasons that suppression can create detrimental social effects as well as performance deficits (John & Gross, 2004).

Current Research

As has been illustrated, stress can manifest in a multitude of different ways. But even with this multifaceted nature, the arousal experienced as a result of a stressor is almost universally seen as bad. Current research in the field of cognitive behavioral psychology, however, poses a different perspective, arguing that the physiological arousal accompanied by the stress response increases one's ability to manage the stress at hand, ultimately improving task performance (Jamieson et al., 2013). Arousal reappraisal, an antecedent-focused coping mechanism, works through the reinterpretation of one's physiological arousal as the result of a stressor. Arousal reappraisal encourages individuals to view this physiological arousal not as negative, but instead as a means to facilitate and improve one's performance (Jamieson et al., 2012; Jamieson et al., 2013; Kever et al., 2015; Moor et al., 2015). Connected to physiological arousal, IA describes the degree to which an individual experiences and is aware of his or her bodily changes (e.g., heart rate) (Craig, 2003). While there have been a variety of studies addressing these two concepts independently, few studies have addressed the relationship between the effectiveness of arousal reappraisal and one's level of IA.

The present study addressed the relationship between these two variables, IA and appraisal techniques, seeking to determine if individuals with high IA would benefit more from arousal reappraisal techniques than those with low IA. More specifically, after being divided into groups, participants completed the Heartbeat Perception Task to determine their level of IA and were then asked to complete two stress tasks: a mathematical stress task and a karaoke stress task. During the study, an Electrocardiogram (EKG) and galvanic skin response (GSR) were used to monitor heart rate and skin conductance, and participants were scored on their performance during each of the stress tasks.

Hypotheses

Based on previous research on both interoceptive awareness and the cognitive behavioral model of arousal reappraisal, the following predictions were made:

Hypothesis 1: An interaction was predicted for performance scores. It has been established in previous research that suppression is a largely ineffective coping mechanism, often associated with adverse cognitive effects (Gross & Levenson, 1997; Gross, 1998). Additionally, it has been found possible that, due to an increased awareness of their physiological arousal, high IA individuals show a greater performance deficit during stressful situations when compared to low IA individuals (Kindermann & Werner, 2014b). Based on previous research, we predicted that individuals with high IA within the control and suppression conditions will perform worse than those with low IA within these groups (Kindermann & Werner, 2014b). Conversely, based on studies showing the relationship between arousal reappraisal techniques and IA, we predicted that individuals with high IA in the arousal reappraisal condition would benefit more from this coping technique than the individuals with low IA (Füstös et al., 2012). Thus, if the use of the arousal reappraisal technique leads to an increased ability to manage their physiological arousal, we also predicted that this would reduce the performance gap between high IA and low IA participants, making the performance scores of the high IA individuals much more comparable to the scores of the low IA individuals. Finally, we predicted that individuals in the suppression condition would have the lowest performance scores, individuals in the control condition would have moderate performance scores, and individuals in the arousal reappraisal condition would have the highest performance scores.

Hypothesis 2: A main effect for condition and time of recording were predicted regarding physiological arousal. An effect of time was predicted due to the fact that heart rate and skin conductance were expected to increase during the stress tasks. As for condition, due to the nature of arousal reappraisal as an antecedent-focused method of coping, meaning it originates prior to the introduction of any major emotional or behavior response systems, and the fact that arousal reappraisal requires very few cognitive resources, we predicted that participants in the control and arousal reappraisal conditions would present with similar levels of physiological arousal (John & Gross, 2004; Moore et al., 2015). Conversely, since it has been found that suppression can lead to increased physiological arousal, due to the fact that it requires more active cognitive processing, we predicted that participants in the suppression condition would have the highest physiological arousal levels (John & Gross, 2004). Additionally, while arousal levels would vary between conditions, within each condition (control, suppression, and arousal reappraisal), arousal levels were predicted to be the same between the high IA and low IA groups based on the study conducted by Kindermann and Werner (2014b), which found that there were no significant differences in physiological arousal between high IA and low IA individuals despite their difference in performance scores.

A visual representation of these hypotheses can be seen in *Figure 1.*

Method

Participants

Participants (N = 82) included male (*n* = 25) and female (*n* = 57) college age students from the College of St. Benedict and St. John's University, two small, Catholic, liberal arts institutions in central Minnesota. Additionally, the sample represented each cohort, first-year (*n* = 57), sophomore (*n* = 16), junior (*n* = 3), and senior (*n* = 5); however, first years were overrepresented in this sample. Participants were recruited from Introductory Psychology courses and each received a small amount of credit for their participation; they were randomly assigned to one of three conditions: arousal reappraisal (*n* = 27), suppression (*n* =26), or control (*n* = 29). During the session, each participant completed the Heartbeat Perception Task to determine his or her IA score. A median split was used (0.71025) and participants were labeled as either high IA (*n* = 39) or low IA (*n* = 39).

Within the arousal reappraisal condition, 11 participants were labeled low IA and 14 were labeled high IA. Additionally, 8 participants within this condition were male and 17 were female, and 72% were first-year students. Within the suppression condition, 12 were labeled low IA and 13 were labeled high IA, 6 were male and 19 were female, and 84% of these participants were first-year students. Finally, within the control condition 16 participants were labeled low IA and 12 were labeled high IA, 10 were male and 18 were female, and 57% of these participants were first-year students. Participants ranged in age from 18-23, and there was no significant age difference between the groups.

Four other participants were excluded from the analysis because they had been informed about the nature of the stress tasks by previous participants. An additional five participants were excluded from the analysis of karaoke performance due to equipment failure.

Materials and Design

Participants completed the Heartbeat Perception Task and a variety of surveys, including the ERQ and the State-Trait Anxiety Inventory (STAI). Additionally, participants completed two stress tasks: a mathematical stress task and a karaoke stress task. Following the stress tasks, participants also completed a self-efficacy measure and a manipulation check. The ERQ was administered during the pre-screen questionnaire that all Introductory Psychology students took at the beginning of the semester as a means to speed up the process on the day of testing.

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). The ERQ was used to determine the extent to which participants naturally use the coping techniques of arousal reappraisal and suppression when faced with a stressor. The measure consists of 10 items, six relating to the use of reappraisal (e.g., "When I am faced with a stressful situation, I make myself *think about it in* a way that helps me stay calm" or "I control my emotions by *changing the way I think* about the situation I'm in") and four relating to the use of suppression (e.g., "I keep my emotions to myself" or "I control my emotions by *not expressing them*"). Each of these measures required participants to rate how strongly they agreed or disagreed with the presented statements, and each involved a different aspect of emotional regulation. (See Appendix A)

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983; Spielberger, 1989). The 40-item self-report questionnaire was designed to measure both state and trait anxiety. In the current study, form Y, the most widely used form of the STAI, was administered. Form Y includes 20 items which evaluated state anxiety (e.g. "I feel at ease"), and another 20 items designed to assess trait anxiety (e.g. "I lack self-confidence"). High scores on the STAI indicate higher anxiety levels and can be evaluated collectively or broken down to look at either state or trait anxiety more thoroughly (Spielberger et al., 1983; Spielberger, 1989). Participants completed the Trait Anxiety Inventory at the beginning of their session and participants completed the State Anxiety Inventory at the end of the study. The separation of these two sections was to eliminate potential biases that could have been formed had the State and Trait section of the measure been taken simultaneously.

Procedure. Upon arrival to the lab for their individual appointment, participants were randomly assigned to one of three conditions: 1) arousal reappraisal, in which participants were informed of the benefits of their arousal, 2) suppression, in which participants were told to hide any arousal they may experience from the researcher, or 3) control, in which participants completed a time-filling task as opposed to receiving any specific coping instructions. To avoid suspicion or the possibility of participants discovering the true purpose of the study, participants were informed that the study was designed to investigate individual differences in how people respond to a variety of stressful situations. Participants were fully debriefed upon completion of the study.

Once assigned to a condition, participants completed the Trait Anxiety Inventory. Following the completion of this questionnaire, participants were connected to the heart rate and skin conductance monitors and allowed to rest for five minutes so as to become acclimated with the equipment. During this five-minute rest period, participants were given the book *St. John's in Pictures* to look through as a means to pass the time and maintain a consistent resting environment (Crouser, 1994). Prior to completion of the Heartbeat Perception task, and after the five-minute rest period, baseline measures of heart rate and skin conductance were recorded for three minutes. To record these measures, Electrocardiogram (EKG) and galvanic skin response (GSR) equipment were utilized. After baseline physiology was recorded, participants completed the Heartbeat Perception task to determine their individual level of IA. Following completion of the Heartbeat Perception task, participants proceeded to complete two stress tasks, which are outlined below. Before each stress task, participants were told to practice their assigned appraisal technique. The order in which the stress tasks were administered was counterbalanced so as to reduce potential confounds that could have been produced by task order. After completing the sequence of stress tasks, the State Anxiety portion of the STAI was completed along with a manipulation check.

Heartbeat Perception Task. The Heartbeat Perception Task followed the methodology outlined by Schandry (1981) and is further described below.

The Heartbeat Perception Task required participants to estimate their heartbeat by counting and concentrating on their bodily experience (Schandry, 1981). The counting, or perception, task was performed four times, each intermittently broken up by a period of rest, and participants were instructed to avoid any physical manipulation (e.g., taking his or her pulse) that may help distinguish individual heartbeats (Kever et al., 2015). Starting with a 60-second rest period, the four perception periods, each varying in length (15, 25, 35, and 45 seconds), were counterbalanced and alternatingly broken up by the remaining periods of rest lasting 30, 30, 30, and 60 seconds. The beginning and end of each perception period was stated by the researcher and the participant was unaware of the length of each counting period. At the end of each perception period, the participant was instructed to verbally report his or her estimated number of heartbeats (Schandry, 1981).

During the Heartbeat Perception task, participants' heart rate and skin conductance were measured using the Biopac Electrocardiogram (EKG) and galvanic skin response (GSR) modules. This allowed for comparison between the participants' estimated heartbeats and the physiologically recorded heartbeats that occurred during each perception period. The accuracy of participant estimations was calculated as an error score using the following equation: $\frac{1}{4} \sum (1 - (|\text{recorded heartbeats} - \text{counted heartbeats}|) / \text{recorded heartbeats})$ (Kever et al., 2015).

Consistent with previous research, a median split was used to distinguish between high IA and low IA individuals (Kindermann & Werner, 2014a; Kindermann & Werner, 2014b; Montoya, Schandry & Müller, 1993; Pollatos, Kirsch, & Schandry, 2005). Our median split led us to use 0.71025 as a cut-off (rather than the previously published 0.85) to determine whether participants were classified as high or low IA (Kindermann & Werner, 2014a; Kindermann & Werner, 2014b).

Mathematical Stress Task. This task required participants to utilize basic subtraction skills as they verbally counted backwards from 998 in increments of three (Bristow, Jih, Slabich, & Gunn, 2016). Participants subtracted in this manner for two minutes, however, they were not told how long the task would last. Additionally, during the subtraction period the experimenter monitored participant performance and continuously prompted the participant saying, "Go faster," "You're going too slow," and "No, that's not right; go back." The task lasted two minutes. While heart rate and skin conductance were continually monitored throughout the duration of the task, the primary dependent variables for the mathematical stress test were the number of correct values stated within the allotted two minutes and the number of errors made. Following the previous task, whether it be the heartbeat perception task or the karaoke stress test, participants were given a short two-minute resting period before being informed of the math test and given a brief description.

After being told about the math test, participants were then read detailed directions outlining the task, as well as specific group-appropriate directions. The detailed mathematical stress task directions were as follows:

> "In a few minutes, you will complete a simple math test. The task requires that you count backwards, and out loud, from 998 in increments of three. Do so as quickly and as accurately as you can as you will be scored based on your performance and compared with the others in the study."

Once aware of the logistics of the math task, participant's heart rate and skin conductance were recorded.

As for the group-appropriate directions, the participants in the arousal reappraisal condition were read the following set of instructions, which have been adapted from Jamieson and colleagues (2012) and Moore and colleagues (2015):

> "In stressful situations, like presentations or performances for example, it is normal for one's body to react in a very specific way, increasing arousal (e.g., faster heart rate and breathing, and a rush of adrenaline) and feelings of discomfort or fear. During your upcoming task, consider the fact that the changes in arousal you may experience are not harmful, but instead have evolved as a way to manage the stressful situations one may encounter in their life. Additionally, consider the fact that recent research has shown that the physiological response you may experience helps improve performance during a stressful situation and makes you more likely to succeed. Such arousal evolved as a trait

to help our ancestors survive, and it ensured that oxygen was delivered to the correct body systems during times of stress. With this in mind, during the upcoming math test, reinterpret any arousal changes you may experience and consider them as beneficial to your performance. Remind yourself that though you may feel more aroused, these bodily changes could likely be helping you have a successful performance.

It will be just a moment until I get the math test set up. In the meantime, please sit quietly with your eyes closed and evaluate your feelings in the way that was just suggested. I will inform you when the task is ready."

Similar to the arousal reappraisal condition, participants in the suppression condition were read a set of instructions that prompted them to evaluate, or appraise, the upcoming task. The suppression instructions were adapted from Hofmann, Heering, Sawyer, and Asnaani (2009) and were read as follows:

"In stressful situations, like presentations or performances for example, it is normal for one's body to react in a very specific way, increasing arousal (e.g., faster heartrate and breathing, and a rush of adrenaline) and feelings of discomfort or fear. That being said, during the upcoming task try not to let your increased arousal show in any way and try to make it so no one would be able to tell if you are feeling any increase in arousal.

It will be just a moment until I get the math test set up. In the meantime, please sit quietly with your eyes closed and evaluate your feelings in the way that was just suggested. I will inform you when the task is ready."

In contrast to the previous two conditions, the control group was read a set of neutral instructions in addition to the detailed math test instructions that prompted them to complete a non-demanding cognitive task to account for time. The task asked participants to think about the United States presidents for one-minute after they had been read the directions (adapted from Moore et al., 2015). The directions for the control group read as follows:

> "It will be just a moment until I have the math test set up. In the meantime, try to create a list of the United States Presidents on the paper provided. I will inform you when the task is ready."

After participants had been read their respective set of directions, the arousal reappraisal and suppression groups rested for one-minute so as to process the appraisal techniques they had just been assigned, and the control group completed their assigned cognitive task for the allotted time of one-minute. To track changes in arousal, both heart rate and skin conductance were monitored throughout the entirety of the test. A self-efficacy measure was also completed following the mathematical stress task to assess participants' self-reported levels of excitement and enjoyment as well as a rating of how well they thought they had performed on the task.

Karaoke Stress Task. The procedure for the karaoke stress task was modified from Brooks' (2014) study regarding the validity of excitement as an arousal reappraisal method. In this task, participants were required to sing "Don't Stop Believin'" on the "Karaoke Revolution: Glee" system for the Nintendo Wii videogame console. Additionally, to increase the pressure of the task, a video camera was present in the room and directed at the participants as they performed; however, no video was actually recorded, though it appeared as though the camera was started. Heart rate and skin conductance were continually monitored throughout the duration of the task to track arousal states. Participants' singing performance was automatically evaluated by the game's scoring and voice recognition software upon completion of the song. At the completion of the task, the computer-generated performance accuracy score, which is a combined rating of volume, pitch, and note duration, was recorded and participants then completed a measure assessing self-efficacy to assess participants' self-reported levels of excitement and enjoyment as well as a rating of how well they thought they had performed on the task.

Following the previous task, whether it be the heartbeat perception task or the karaoke stress test, participants were given a short two minute break before being informed of the karaoke task and given a brief description of the task.

After being informed of the karaoke task, participants were read detailed instructions outlining the task, as well as specific group-appropriate directions. The detailed description of the karaoke task was as follows:

> "In a few minutes, you will sing "Don't Stop Believin" on the "Karaoke Revolution: Glee" system for the Nintendo Wii videogame console. You will perform this song in front of me and will be scored based on your performance. Additionally, your performance will be videotaped and scored by a jury of your peers. After all the film has been evaluated, you will be scored based on your performance and compared with others in the study. The video recorded during the study will only be used for the purposes of the research and will be deleted when the study is complete.
>
> During the task, you will sing into a microphone and the lyrics will appear at the bottom of the screen."

Participants in the arousal reappraisal condition were read the coping instructions, which were identical to the instructions described previously for the math task and were adapted from Jamieson and colleagues (2012) and Moore and colleagues (2015).

Similar to the arousal reappraisal condition, participants in the suppression condition were read instructions that prompted them to evaluate, or appraise, the upcoming task. The suppression instructions were identical to the instructions described previously for the math task and were adapted from Hofmann et al. (2009).

In addition to being read the instructions for the karaoke task, the control group was read a set of neutral instructions that prompted them to complete a nondemanding cognitive task to account for time. The task asked participants to think about the 50 states for one-minute after they were read the directions (adapted from Moore et al., 2015). The directions for the control group read as follows:

> "It will be just a moment until I have the karaoke system set up. In the meantime, try to create a list of the 50 states. Please write out your list on the paper provided. I will inform you when the task is ready."

After participants had been read their assigned set of directions, the arousal reappraisal and suppression groups rested for one minute so as to process the appraisal techniques they had been assigned, and the control group completed the assigned cognitive task for the allotted time of one minute. To track changes in arousal, both heart rate and skin conductance were monitored throughout the entirety of the karaoke stress task. After the completion of both stress tasks, participants completed the State Anxiety Inventory and a manipulation check, which was used as a means to determine similarities or differences between the groups, particularly in reference to past experience and prior knowledge of the tasks. Finally, participants were debriefed at the completion of the session.

Results

Baseline Physiology

Heart Rate. There were no pre-existing differences among the groups in terms of their heart rate. There was no significant main effect for IA, $F(1, 76) = 1.753$, $p = .189$, $\eta_p^2 = .021$, observed power = .258, or coping condition, $F(2, 76) = 1.354$, $p = .264$, $\eta_p^2 = .036$, observed power = .283. Table 1 presents the pattern of means for baseline physiology.

Skin Conductance. There were no pre-existing differences among the groups in terms of their skin conductance levels. There was no significant main effect for IA, $F(1, 74) = 0.614$, $p = .436$, $\eta_p^2 = .005$, observed power = .121, or coping condition, $F(2, 74) = 0.287$, $p = .752$, $\eta_p^2 = .010$, observed power = .094. Table 1 presents the pattern of means for baseline physiology.

Performance Evaluated Stress Tasks

Hypothesis one predicted an interaction between IA and coping condition, and predicted that individuals with high IA, within the suppression and control condition, would perform worse on the stress task than individuals with low IA of the same condition. Due to the relationship between arousal reappraisal and IA, we also predicted that individuals in the arousal reappraisal condition with high IA would reduce the performance gap between high IA and low IA participants making the performance scores of the high IA individuals more comparable to the scores of low IA individuals (Füstös et al., 2012). Additionally, we predicted that individuals in the suppression condition would have the lowest overall performance scores, whereas individuals in the control condition would present with moderate performance scores, and individuals in the arousal reappraisal condition would have the highest performance scores.

In regard to physiological arousal, hypothesis two predicted a main effect of coping condition. Here we predicted that while physiological arousal would change between conditions, within each condition (arousal reappraisal, suppression, and control) arousal levels would remain constant between high IA and low IA groups (Kindermann et al., 2014b). Additionally, we predicted that individuals in the suppression condition would present with the highest levels of physiological arousal, whereas the control and arousal reappraisal conditions would present with equally moderate levels of arousal.

A 2 X 3 ANOVA was conducted for each performance score, with coping condition (arousal reappraisal, suppression, control) and participant IA (high or low) as independent variables, and performance scores (karaoke performance score, number of correct values stated on the mathematical stress task, and the number of errors made during the mathematical stress task) as the dependent variables.

Karaoke Stress Task. Karaoke performance was evaluated based on the performance score (0 - 100%) generated by the game at the end of the song.

Performance scores. There was no significant interaction between IA and coping condition $F(2, 72) = 0.288$, $p = .750$, $\eta_p^2 = .009$, observed power = 0.094, thus karaoke performance score did not depend on the combined effects of participant IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 72) = 0.540$, $p = .465$, $\eta_p^2 = .008$, observed power = 0.112, or coping condition, $F(2, 72) = 1.47$, $p = .239$, $\eta_p^2 = .043$, observed power = 0.302. Table 2 presents the pattern of means for karaoke performance scores.

Heart rate. A two-way repeated measures ANOVA was conducted to compare the effect of the independent variables (participant IA and coping condition) on the dependent variable (heart rate) during baseline and the karaoke stress task. There was no significant three-way interaction between IA, coping condition, and time of recording, $F(2,71) = 0.163$, $p = .850$, $\eta_p^2 = .005$, observed power = .74, nor was there a significant two-way interaction between IA and time of recording, $F(1,71) = 0.012$, $p = .914$, $\eta_p^2 = .000$, observed power = .051, or coping condition and time of recording, $F(2,71) = 1.613$, $p = .207$, $\eta_p^2 = .043$, observed power = .330. There was a significant effect of time of recording on heart rate, $F(1,71) = 45.51$, $p < .001$, $\eta_p^2 = .391$, observed power = 1.00. Heart rate was significantly higher during the karaoke stress task,showing heightened arousal.

Skin conductance. A two-way repeated measures ANOVA was conducted to compare the effect of the independent variables (participant IA and coping condition) on the dependent variable (skin conductance level) during baseline and the karaoke stress task. There was no significant three-way interaction between IA, coping condition, and time of recording, $F(2,69) = 2.406$, $p = .098$, $\eta_p^2 = .065$, observed power = .470, nor was there a significant two-way interaction between IA and time of recording, $F(1,69) = 0.520$, $p = .473$, $\eta_p^2 = .007$, observed power = .110, or coping condition and time or recording, $F(2,69) = 0.278$, $p = .758$, $\eta_p^2 = .008$, observed power = .092. There was a significant effect of time of recording on skin conductance level, $F(1,69) = 5.45$, $p = .022$, $\eta_p^2 = .073$, observed power = .634. Skin conductance levels were significantly higher during the karaoke stress task, showing heightened arousal.

Mathematical Stress Task. Performance on the mathematical stress task was based on two indicators: number of correct values stated, and number of errors made. A separate analysis was completed for each performance indicator.

Number of values correctly stated. Results indicated a non-significant trend for an interaction between IA and coping condition $F(2, 78) = 2.94$, $p = .059$, $\eta_p^2 = .075$, observed power = 0.556. Post hoc t-tests revealed that high IA individuals in the control condition stated more correct values than high IA individuals in the suppression condition, $p \leq .01$. Additionally, post hoc t-tests revealed a non-significant trend suggesting that in the suppression condition, low IA individuals stated more correct values than high IA individuals, $p = .065$. There was no main effect for IA, $F(1, 78) = 0.554$, $p = .459$, $\eta_p^2 = .008$, observed power = 0.114, or coping condition, $F(2, 78) = 1.39$, $p = .254$, $\eta_p^2 = .037$, observed power = 0.291. Table 4 presents the pattern of means for math performance scores.

Number of errors made. There was no significant interaction between IA and coping condition $F(2, 78) = 0.516$, $p = .599$, $\eta_p^2 = .014$, observed power = 0.132, suggesting that the number of errors made during the mathematical stress task did not depend on the combined effects of IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.099$, $p = .754$, $\eta_p^2 = .001$, observed power = 0.061, or coping condition, $F(2, 78) = 0.367$, $p = .694$, $\eta_p^2 = .010$, observed power = 0.107. Table 4 presents the pattern of means for math performance scores.

Heart rate. A two-way repeated measures ANOVA was conducted to compare the effect of the independent variables (participant IA and coping condition) on the dependent variable (heart rate) during baseline and the mathematical stress task. There was a significant effect of time of recording on heart rate, $F(1,71) = 24.30$, $p < .001$, $\eta_p^2 = .255$, observed power = .998. Heart rate was significantly higher during the mathematical stress task, showing heightened arousal. There was no significant two-way interaction between IA and time of recording, $F(1,71) = 0.261$, $p = .611$, $\eta_p^2 = .004$, observed power = .080, or coping condition and time or recording, $F(2,71) = 2.54$, $p = .086$, $\eta_p^2 = .067$, observed power = .493, nor was there a significant three-way interaction between IA, coping condition, and time of recording, $F(2,71) = 1.28$, $p = .285$, $\eta_p^2 = .035$, observed power = .269.

Skin conductance. A two-way repeated measures ANOVA was conducted to compare the effect of the independent variables (participant IA and coping condition) on the dependent variable (skin conductance level) during baseline and the mathematical stress task. There was no significant three-way interaction between IA, coping condition, and time of recording, $F(2,69) = 2.636$, $p = .079$, $\eta_p^2 = .071$, observed power = .508, nor was there a significant two-way interaction between IA and time of recording, $F(1,69) = 1.054$, $p = .308$, $\eta_p^2 = .015$, observed power = .173, or coping condition and time or recording, $F(2,69) = 0.242$, $p = .786$, $\eta_p^2 = .007$, observed power = .087. There was a significant effect of time of recording on skin conductance level, $F(1,69) = 10.563$, $p = .002$, $\eta_p^2 = .133$, observed power = .893. Skin conductance levels were significantly higher during the mathematical stress task, showing heightened arousal.

Additional Measures

ERQ. The ERQ was assessed in comparison with participant IA. This assessment allowed us to see the most common forms of appraisal used within each condition and whether or not there was a tendency towards a specific coping mechanism for high and low IA individuals. A 2 X 3 ANOVA was conducted for each subscale of the ERQ (*i.e.*, cognitive reappraisal and suppression tendencies), with coping condition (*i.e.*, arousal reappraisal, suppression, control) and participant IA (*i.e.*, high or low) as between-subjects factors for both elements of the ERQ (*i.e.*, cognitive reappraisal and suppression tendencies). However, due to the fact that coping condition was not yet assigned at the time of this assessment no interaction or effect of coping condition were expected.

Cognitive reappraisal tendencies. As expected, there was no significant interaction between IA and coping condition $F(2, 78) = 1.06$, $p = .353$, $\eta_p^2 = .028$, observed power = .228, and no significant effect of coping condition $F(2, 78) = 1.26$, $p = .289$, $\eta_p^2 = .034$, observed power = 0.266. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.519$, $p = .474$, $\eta_p^2 = .007$, observed power = .110. Table 6 presents the pattern of means for ERQ scores.

Suppression tendencies. As expected, there was no significant interaction between IA and coping condition $F(2, 78) = 0.019$, $p = .981$, $\eta_p^2 = .001$, observed power = 0.053, and no significant effect of coping condition $F(2, 78) = 1.242$, $p = .295$, $\eta_p^2 = .033$, observed power = 0.262. Additionally, there was no significant main effect for IA, $F(1, 78) = 1.70$, $p = .197$, $\eta_p^2 = .023$, observed power = 0.251. Table 6 presents the pattern of means for ERQ scores.

STAI. The STAI was assessed in two parts, the Trait-STAI and the State-STAI. This assessment allowed us to see both inherent anxiety levels of each group as well as their anxiety levels at the end of the study. A 2 X 3 ANOVA was conducted for both elements of the STAI (trait and state), with coping condition (arousal reappraisal, suppression, control) and participant IA (high or low) as between-subjects factors.

Trait. Since trait anxiety was measured at the beginning of the study, only the effect of IA was assessed. There was no significant main effect for IA, $F(1, 78) = 2.280$, $p = .135$, $\eta_p^2 = .031$, observed power = 0.319. Table 7 presents the pattern of means for the STAI.

State. There was no significant interaction between IA and coping condition $F(2, 78) = 1.419$, $p = .249$, $\eta_p^2 = .038$, observed power = 0.295. Thus, state anxiety at the end of the session did not depend on the combined effects of participant IA and coping condition. Additionally, there was no main effect for IA, $F(1, 78) = 0.511$, $p = .477$, $\eta_p^2 = .007$, observed power = 0.109, or coping condition, $F(2, 78) = 1.668$, $p = .196$, $\eta_p^2 = .044$, observed power = 0.341. Table 7 presents the pattern of means for the STAI.

Self-Efficacy Measures. Measures of self-efficacy were administered after the completion of each stress task. A 2 X 3 ANOVA was used to separately analyze each question; coping mechanism (arousal reappraisal, suppression, control) and participant IA (high or low) were the between-subjects factors.

Karaoke stress task self-efficacy.

"When you learned you would be singing karaoke, how excited were you?" This question was rated 1(not excited at all) – 7(very excited). There was no significant interaction between IA and coping condition $F(2, 78) = 1.003$, $p = .372$, $\eta_p^2 = .027$, observed power = 0.218. Thus, excitement about the task did not depend on the combined effects of participant IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.405$, $p = .527$, $\eta_p^2 = .006$, observed power = 0.096, or coping condition, $F(2,78) = 0.021$, $p = .979$, $\eta_p^2 = .001$, observed power = 0.053. Table 8 presents the pattern of means for karaoke self-efficacy scores.

"How much did you enjoy singing karaoke?" This question was rated 1(hated it) – 7(really enjoyed it). There was no significant interaction between IA and coping condition $F(2, 78) = 1.649$, $p = .199$, $\eta_p^2 = .044$, observed power = 0.337, suggesting that enjoyment of the task did not depend on the combined effects of IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.717$, $p = .400$, $\eta_p^2 = .010$, observed power = 0.133, or coping condition, $F(2, 78) = 0.429$, $p = .653$, $\eta_p^2 = .012$, observed power = 0.117. Table 8 presents the pattern of means for karaoke self-efficacy scores.

"How well do you think you did on your performance?" This question was rated 1(very bad) – 7(very good). There was no significant interaction between IA and coping condition $F(2, 78) = 0.072$, $p = .351$, $\eta_p^2 = .002$, observed power = 0.061 , suggesting that self-efficacy did not depend on the combined effects of IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.882$, $p = .351$, $\eta_p^2 = .012$, observed power = 0.153, or coping condition, $F(2, 78) = 1.257$, $p = .291$, $\eta_p^2 = .034$, observed power = 0.265. Table 8 presents the pattern of means for karaoke self-efficacy scores.

Mathematical stress task.

"When you learned you would be completing a math test, how excited were you?" This question was rated 1(not excited at all) – 7(very excited). There was no significant interaction between IA and coping condition $F(2, 78) = 0.041$, $p = .959$, $\eta_p^2 = .001$, observed power = 0.056. Thus, excitement about the task did not depend on the combined effects of participant IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 1.956$, $p = .166$, $\eta_p^2 = .026$, observed power = 0.281, or coping condition, $F(2, 78) = 0.586$, $p = .559$, $\eta_p^2 = .016$, observed power = 0.144. Table 9 presents the pattern of means for math self-efficacy scores.

"How much did you enjoy the math test you just completed?" This question was rated 1(hated it) – 7(really enjoyed it). There was no significant interaction between IA and coping condition $F(2, 78) = 1.033$, $p = .361$, $\eta_p^2 = .028$, observed power = 0.224, suggesting that enjoyment of the task did not depend on the combined effects of IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.566$, $p = .454$, $\eta_p^2 = .008$, observed power = 0.115. Results also indicated a non-significant trend towards a main effect of

coping condition, $F(2, 78) = 2.813$, $p = .067$, $\eta_p^2 = .072$, observed power = 0.536. Table 9 presents the pattern of means for math self-efficacy scores.

"How well do you think you did on the math test?" This question was rated 1(very bad) – 7(very good). There was no significant interaction between IA and coping condition $F(2, 78) = 0.394$, $p = .676$, $\eta_p^2 = .011$, observed power = 0.111, suggesting that self-efficacy did not depend on the combined effects of IA and coping condition. Additionally, there was no significant main effect for IA, $F(1, 78) = 0.239$, $p = .626$, $\eta_p^2 = .003$, observed power = 0.007, or coping condition, $F(2, 78) = 1.952$, $p = .149$, $\eta_p^2 = .051$, observed power = 0.392. Table 9 presents the pattern of means for math self-efficacy scores.

Manipulation Check (MC). The manipulation check was administered at the end of each session as a means to determine similarities and differences among the groups in terms of previous experience with the equipment and similar cognitive/social tasks, as well as to determine if any individual had known the details of our tasks prior to the session. No significant differences were observed among groups. However, four participants revealed they had known about the stress tasks prior to the session and were thus removed from the analysis. Appendix B provides the questions asked during the manipulation check.

Discussion

By combining the ideas of the arousal reappraisal and interoceptive awareness, the goal of this study was to broaden the general understanding of arousal reappraisal and its connection to an individual's perceived arousal. We predicted that individuals in the control condition with low IA would outperform the individuals with high IA. Additionally, we predicted that individuals in the control condition would have moderate levels of arousal. A similar pattern was expected to occur for participants in the suppression condition. For this group, we hypothesized that participants with low IA would have higher performance scores when compared to the individuals with high IA; however, unlike the control condition, individuals in the suppression condition were expected to have the highest levels of physiological arousal across the three groups. Finally, we predicted that the highest performance scores would be seen within the arousal reappraisal condition; more specifically, we predicted that the performance gap between high IA and low IA individuals would be reduced within this group. The results of the study did not fully support either hypothesis.

Previous research has shown arousal reappraisal to be an effective means of improving performance during a stressful situation (Jamison et al., 2013); however, our results showed that arousal reappraisal did not improve performance during a stressful task. Additionally, previous research found that those with high IA were more likely to benefit from arousal reappraisal techniques than individuals with low IA were (Füstös et al., 2012); however, our results found IA to have no significant impact on one's ability to benefit from reappraisal. That being said, results did show a non-significant trend towards an interaction between IA and coping condition when considering the number of values correctly stated during the mathematical stress task. Post hoc tests revealed that participants with high IA performed significantly worse in the suppression condition than they did in the control condition. This trend supports our prediction that suppression would hinder performance ability. Post hoc tests also indicated a non-significant trend showing that, in the suppression condition, participants with low IA tended to perform better than those with high IA, suggesting that IA may be an important variable to consider. Finally, this variable showed moderate effect size and power suggesting that if number of participants was increased significance may have been reached.

As for physiological arousal, there was a significant difference between baseline physiology and physiology during the two stress tasks. This increase in physiological arousal (heart rate and skin conductance levels) suggests that the two stress tasks served as an effective manipulation. However, while both the karaoke and the mathematical stress tasks have been utilized in previous research, more traditional intellectual and performance stressors have been used with more frequency to support the idea of arousal reappraisal as an important and successful coping mechanism. There has been a strong preference for the TSST as a psychological stressor. As previously described, the TSST requires participants to give a speech in front of two evaluators and a video camera. In this task participants are given ten minutes to prepare and are required to speak for five minutes. Not only have multiple studies supported this as an efficient stress manipulation, but when utilized for emotion regulation studies, participants in the arousal reappraisal condition consistently outperformed those in the control group (Brooks, 2014; Jamieson et al., 2012).

There has also been a trend within the research to utilize high stakes and challenging mathematical exams (Brooks, 2014; Jamieson et al., 2010). Similar to the TSST, when utilized in emotion regulation studies, individuals in the arousal reappraisal condition continue to outperform those in the control group (Brooks, 2014; Jamieson et al., 2010). These significant and established results suggest the importance of arousal reappraisal as a useful coping mechanism. The difference between these previously established methodologies and the stress tasks used in the current research (e.g. task length or lack of a practice session) explain one possible limitation to our study. Additionally, it is likely that the difference between the power and effect size of the mathematical stress task and the karaoke stress task is due to an issue with sample size or distribution across cells. The issue of sample size is further discussed in the limitations section. Additionally, there was a great deal of variability among participant performance scores, making it difficult to see the specific effects of the manipulations.

It is also interesting to note that when it came to enjoyment of the math task, although no significant differences were found, the means were in the predicted direction for condition, and a non-significant trend showed that individuals in the reappraisal condition tended to rate their experience as more enjoyable. With a larger sample size, this trend has the potential to become significant.

In sum, contrary to our predictions, arousal reappraisal did not serve as a means to improve performance during a stressful situation, and individuals with high IA did not appear to benefit more from stress reappraisal techniques. These results suggest the need for more research on this topic.

Limitations

The current study utilized a 2 X 3 between groups design and each participant was only assigned to one of three experimental conditions: arousal reappraisal, suppression, or control. In an attempt to limit potential threats to internal and construct validity, the procedure was carefully thought out and assessed; however, as with any study there were still some potential limitations to keep in mind.

Despite collecting data from over 80 participants, sample size was a significant limitation of the study. Due to the eventual exclusion of some participants, and the use of a participant variable (IA) that had to be measured during the experimental session and could not be assessed until after all of the data had been collected, there was an uneven distribution of participants across cells that contributed to the low power we observed. Additionally, because only students enrolled in Introductory Psychology courses at the College of Saint Benedict and Saint John's University were invited to participate in the study, female first-year participants were overrepresented in our sample.

Tied to the issue of sample size and population was the fact that our sample differed from previously published samples in regards to interceptive awareness. By using a median split value of 0.71025, as opposed to the previously published 0.85 cut-off score (Kindermann & Werner, 2014a; Kindermann & Werner., 2014b, our high IA group could potentially be viewed as a 'mixed' group representing both low and high IA individuals, while the low IA group remains a 'pure' group. What this means is that, while individuals in the high IA group were considered to be high IA for this specific sample, not all of them would universally have qualified as high IA individuals. This then means that some individuals who would have qualified as low IA in previous studies were mixed in with high IA individuals during the analysis, muddling the groups and making our results more difficult to interpret.

The aforementioned issue indicates that our sample generally performed worse than previously published samples on the Heartbeat Perception task. One potential reason may be that they were informed prior to enrolling in the study that they would be asked to do two stressful tasks, and it is possible that they misunderstood the Heartbeat Perception task to be one of the stress tasks. If this was the case, it is likely that nervousness could have adversely affected their performance on the task.

Similar to the issue of the participants potentially misinterpreting the nature of the Heartbeat Perception task, it is possible that, due to the unfamiliar nature of their assigned coping condition, individuals in the arousal reappraisal and suppression conditions could have become preoccupied with the appraisal instructions and thus lost focus on the task they were intended to complete. This is one possible explanation for the similarities in performance between the arousal reappraisal and the suppression groups and a possible explanation as to why the arousal reappraisal intervention had no significant impact on the way participants performed on the two stress tasks. Another possible explanation is the length of the stress tasks. Both the mathematical stress task and the karaoke stress task were relatively short task, especially when compared with previous research methodologies like the TSST, and this brevity may not have allowed the participants to fully adapt to using their assigned coping condition.

Finally, it is possible that, since the karaoke task has only been used once before in an empirical study, the innovative research methodology could potentially have posed some limitations to reliability. However, since the two tasks were counterbalanced, the limitations to internal validity were likely eliminated, suggesting that the order in which the tasks were completed had no effect on the performance scores or physiological response they induced.

Outstanding Questions and Future Research

Due to the fact that the effects of IA on coping ability are still unclear, we would suggest that future researchers utilize a two-appointment system in which the Heartbeat Perception Task is completed separately from the two stress tasks. This would allow researchers the ability to determine IA before proceeding with the stress task and would eliminate the possibility for participants to misunderstand the task as one of the performance evaluated stress tasks. Additionally, by determining IA in advance, researchers would have the ability to use the established 0.85 cut-off score and, if they so choose, they could eliminate moderate IA scores and create a greater difference between the high and low IA groups. This two-appointment system would also allow researchers to ensure that an equal number of participants are assigned to each experimental condition, thus eliminating the issue of unequal group size.

In conclusion, it would appear as though little is known about the universality of arousal reappraisal. So, with that in mind, it is advised that future researchers aim to answer this question by utilizing a variety of different stress tasks (e.g., academic, social, emotional) to see if arousal reappraisal can be used globally or if it is best used for one specific type of stressor. Due to the fact that previous research emphasizes pressurized stress tasks in relationship to arousal reappraisal, it is suspected that arousal reappraisal would be most beneficial for short term, high stakes, and academic or social stressors. Conversely it is suspected that since more abstract emotional stressors are associated with longer processing times, it could be thought that a different coping mechanism (e.g., mindset shift or optimism) might be more beneficial for these cases.

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Table 1

Means and Standard Deviations for Baseline Physiology as a Function of IA and Coping Condition.

		Heart Rate			Skin Conductance		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	76.08	6.88	11	5.59	1.62
	High IA	14	72.51	11.09	13	6.41	1.83
Suppression	Low IA	12	77.54	10.46	11	6.18	2.28
	High IA	13	79.58	10.41	13	6.45	2.83
Control	Low IA	16	78.56	10.67	16	5.81	2.73
	High IA	12	71.85	6.90	12	5.73	2.37
Participant IA	Low IA	39	77.55	9.49	38	5.85	2.28
	High IA	39	74.66	10.13	38	6.21	2.34
Coping Condition	Arousal Reappraisal	25	74.08	9.46	24	6.03	1.75
	Suppression	25	78.60	10.27	24	6.32	2.54
	Control	28	75.69	9.70	28	5.78	2.54

Table 2

Means and Standard Deviations for Karaoke Performance Scores as a Function of IA and Coping Condition.

		Karaoke Performance Scores		
		n	*M*	*SD*
Arousal Reappraisal	Low IA	10	86.00	10.46
	High IA	14	82.07	18.86
Suppression	Low IA	12	76.91	19.34
	High IA	11	78.00	20.92
Control	Low IA	14	77.79	27.13
	High IA	11	69.55	24.31
Participant IA	Low IA	36	79.78	20.85
	High IA	36	77.00	21.31
Coping Condition	Arousal Reappraisal	24	83.71	15.74
	Suppression	23	77.43	19.65
	Control	25	74.16	25.74

Table 3

Means and Standard Deviations for Physiology During the Karaoke Stress Task as a Function of IA and Coping Condition.

		Heart Rate			Skin Conductance		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	100.80	14.20	11	8.06	2.76
	High IA	14	99.30	23.36	13	8.43	2.17
Suppression	Low IA	12	98.52	15.85	11	7.82	2.92
	High IA	13	100.09	16.44	13	8.85	2.92
Control	Low IA	16	98.31	12.70	16	8.75	3.42
	High IA	12	93.55	9.71	12	7.45	2.24
Participant IA	Low IA	39	99.07	13.81	38	8.28	3.05
	High IA	39	97.80	17.54	38	8.27	2.57
Coping Condition	Arousal Reappraisal	25	99.96	19.50	24	8.26	2.41
	Suppression	25	99.34	15.84	24	8.38	3.04
	Control	28	96.27	11.57	28	8.20	2.80

Table 4

Means and Standard Deviations Math Performance Scores as a Function of IA and Coping Condition.

		Number of Values Correctly Stated			Number of Errors Made		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	39.36	17.22	11	2.91	2.07
	High IA	14	35.07	13.46	14	3.21	1.37
Suppression	Low IA	12	41.25	24.98	12	3.42	2.61
	High IA	13	26.62	10.55	13	3.46	2.26
Control	Low IA	16	37.44	19.84	16	3.38	2.06
	High IA	12	47.08	19.29	12	2.58	1.78
Participant IA	Low IA	39	39.15	20.41	39	3.26	2.20
	High IA	39	35.95	16.84	39	3.10	1.82
Coping Condition	Arousal Reappraisal	25	36.96	15.54	25	3.80	1.68
	Suppression	25	33.64	19.93	25	3.44	2.38
	Control	28	41.57	19.85	28	3.04	1.95

Table 5

Means and Standard Deviations for Physiology During the Mathematical Stress Task as a Function of IA and Coping Condition.

		Heart Rate			Skin Conductance		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	92.82	8.49	11	8.46	3.05
	High IA	14	90.47	16.87	13	8.48	2.31
Suppression	Low IA	12	82.54	25.16	11	7.90	2.64
	High IA	13	94.14	15.54	13	9.09	3.91
Control	Low IA	16	90.97	10.80	16	9.02	3.78
	High IA	12	82.14	10.96	12	7.65	2.16
Participant IA	Low IA	39	88.90	16.35	38	8.53	3.23
	High IA	39	89.13	15.26	38	8.43	2.90
Coping Condition	Arousal Reappraisal	25	91.50	13.62	24	8.47	2.62
	Suppression	25	88.57	21.12	24	8.54	3.37
	Control	28	87.19	11.55	28	8.43	3.21

Table 6

Means and Standard Deviations of ERQ Scores as a Function of IA and Coping Condition.

		Cognitive Reappraisal Tendencies			Suppression Tendencies		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	27.09	5.74	11	13.55	5.22
	High IA	14	28.21	6.59	14	14.50	4.40
Suppression	Low IA	12	28.50	2.97	12	13.92	2.71
	High IA	13	31.38	5.56	13	15.32	3.22
Control	Low IA	16	30. 13	3.99	16	15.13	4.33
	High IA	12	28.75	6.41	12	16.33	3.45
Participant IA	Low IA	39	28.77	4.37	39	14.31	4.15
	High IA	39	29.44	6.22	39	15.33	3.73
Coping Condition	Arousal Reappraisal	25	27.72	6.13	25	14.08	4.70
	Suppression	25	30.00	4.65	25	14.64	3.01
	Control	28	29.54	5.11	28	15.64	3.96

Table 7

Means and Standard Deviations of STAI Scores as a Function of IA and Coping Condition.

		Trait-STAI			State-STAI		
		n	*M*	*SD*	*n*	*M*	*SD*
Arousal Reappraisal	Low IA	11	39.63	8.18	11	44.00	7.90
	High IA	14	35.93	7.64	14	46.71	11.51
Suppression	Low IA	12	42.00	13.93	12	44.25	8.96
	High IA	13	37.69	8.89	13	43.08	12.02
Control	Low IA	16	36.69	8.65	16	43.69	7.40
	High IA	12	35.08	7.42	12	37.42	9.24
Participant IA	Low IA	39	39.15	10.42	39	43.95	7.83
	High IA	39	36.26	7.88	39	42.64	11.42
Coping Condition	Arousal Reappraisal	25	37.56	7.94	25	45.52	9.98
	Suppression	25	39.76	11.55	25	43.64	10.46
	Control	28	36.00	8.04	28	41.00	8.67

Table 8

Means and Standard Deviations of Self-Efficacy Scores (Post Karaoke Stress Task) as a Function of IA and Coping Condition.

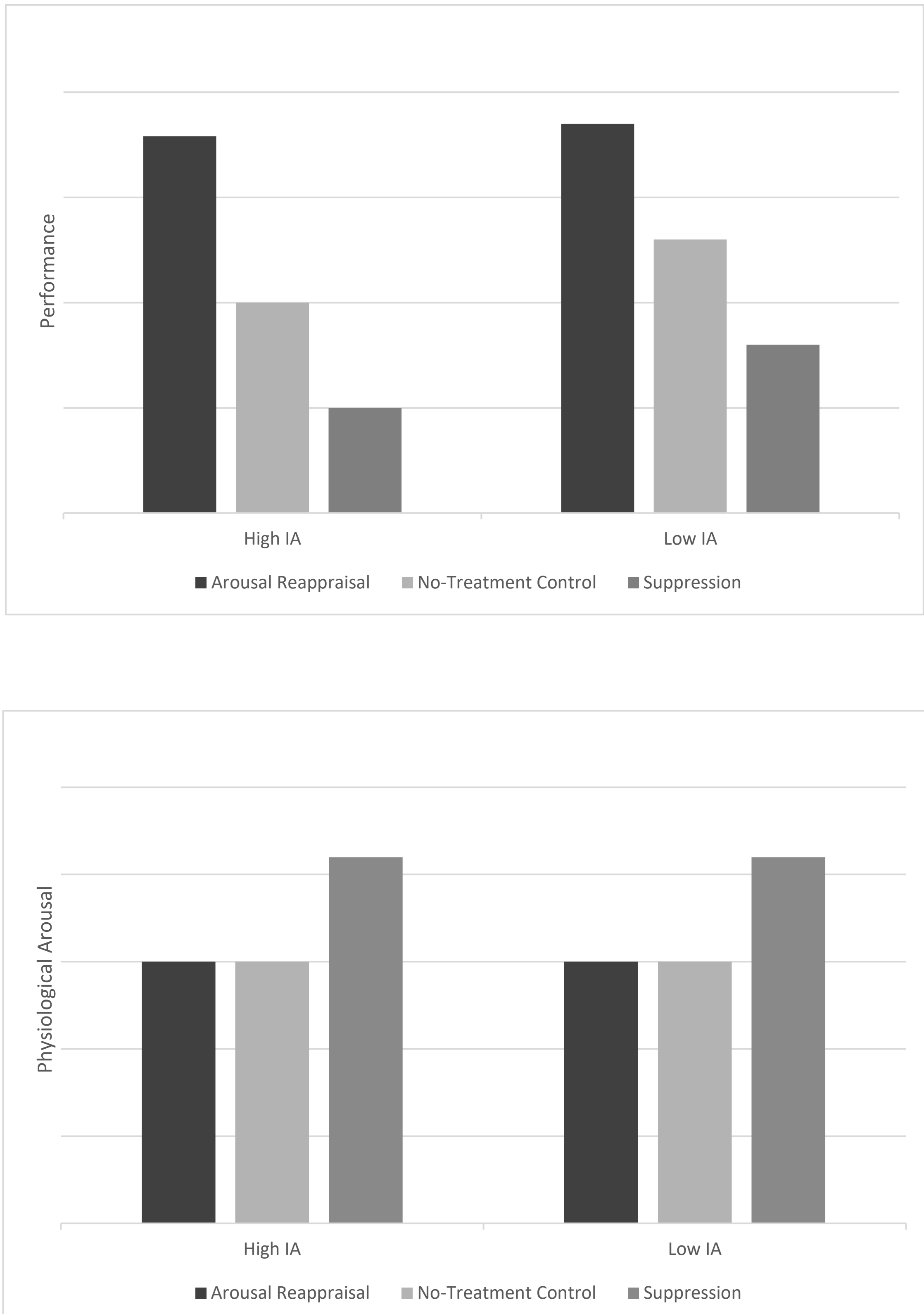
		Excitement		Enjoyment		Self-Efficacy	
		M	*SD*	*M*	*SD*	*M*	*SD*
Arousal Reappraisal	Low IA	3.09	1.92	4.09	1.81	3.82	1.99
	High IA	2.50	2.07	3.43	2.31	3.29	1.68
Suppression	Low IA	2.50	1.73	3.00	1.81	3. 17	1.47
	High IA	3.31	1.84	3.54	1.98	3.00	1.91
Control	Low IA	2.56	1.93	2.88	1.45	3.00	1.83
	High IA	3.17	1.75	4.08	1.78	2.58	1.44
Participant IA	Low IA	2.69	1.84	3.26	1.71	3.38	1.76
	High IA	2.97	1.88	3.67	2.01	2.97	1.68
Coping Condition	Arousal Reappraisal	2.76	1.98	3.72	2.09	3.52	1.81
	Suppression	2.92	1.80	3.28	1.88	3.08	1.68
	Control	2.82	1.85	3.46	1.87	3. 13	1.66

Table 9

Means and Standard Deviations of Self-Efficacy Scores (Post Mathematical Stress Task) as a Function of IA and Coping Condition.

		Excitement		Enjoyment		Self-Efficacy	
		M	*SD*	*M*	*SD*	*M*	*SD*
Arousal Reappraisal	Low IA	3.27	2.00	2.91	1.38	.345	1.29
	High IA	2.71	1.44	2.07	0.92	3.14	1.35
Suppression	Low IA	3.17	1.40	2.17	0.83	2.83	1.34
	High IA	2.77	2.01	2.31	0.95	2.46	1.39
Control	Low IA	3.75	1.61	3.06	0.83	3.19	1.17
	High IA	3.08	1.68	3.08	0.95	3.42	1.62
Participant IA	Low IA	3.44	1.65	2.74	1.77	3.15	1.25
	High IA	2.85	1.68	2.46	1.62	3.00	1.47
Coping Condition	Arousal Reappraisal	2.96	1.70	2.44	1.19	3.28	1.31
	Suppression	2.96	1.72	2.24	0.88	2.64	1.35
	Control	3.46	1.64	2.60	1.68	3.29	1.36

Figure 1. Illustration of Hypotheses



Appendix A. Emotion Regulation Questionnaire (ERQ)
Gross & John
9/03

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

Citation

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.

Instructions and Items

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 B. Manipulation Check

Below is a list of statements and questions. Read each carefully and respond with the answer that best fits your experience.

1. I have used the Nintendo Wii system before. *(True/False)*
2. How familiar are you with the Nintendo Wii system? *(1 Not Familiar at All – 7 Very Familiar)*
3. How often do you use the Nintendo Wii system? *(1 Not at All – 7 Very Frequently)*
4. I have played a "Karaoke Revolution" game before. *(True/False)*
5. How often have you played a "Karaoke Revolution" game? *(1 Never – 7 Very Frequently)*
6. How familiar with the song "Don't Stop Believin'" are you? *(1 Not Familiar at All – 7 Very Familiar)*
7. I have experience with karaoke. *(True/False)*
8. In the space below, please describe your previous experience with karaoke.
9. I have experience singing. *(True/False)*
10. In the space below, please describe your previous experience with singing (e.g., singing in a choir or taking voice lesson).
11. I am comfortable singing in front of an audience. *(True/False)*
12. How comfortable with singing in front of an audience are you? *(1 Not Comfortable at All – 7 Very Comfortable)*
13. What is the highest level math class you took in high school?
14. How comfortable are you with verbal math? *(1 Not Comfortable at All – 7 Very Comfortable)*
15. I had already heard about the math test before I came in to participate. *(True/False)*
16. A friend told me I would have to sing if I participated in this study. *(True/False)*
17. A friend told me the experimenter would keep telling me to go faster during the math test. *(True/False)*
18. A friend told me that my singing would not really be recorded by the video camera. *(True/False)*