Stress Management in Young Adults: Implications of Mandala Coloring on Self-Reported Negative Affect and Psychophysiological Response

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ABSTRACT. The purpose of the present experiment was to assess the effectiveness of mandala coloring paired with focused breathing in reducing negative affect, state anxiety, and psychophysiological stress response following a psychosocial stressor. The current study employed a validated psychosocial stressor, the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993) and consisted of four phases that included baseline (sitting and standing), Speech 1, Speech 2, and the poststress manipulation, which consisted of either 7-min of mandala coloring/focused breathing or a no-task control group. Self-reported negative and positive affect, state anxiety, and blood pressure were assessed once after each phase, whereas pulse, skin conductance levels, and heart rate were measured throughout the experiment. Results indicated that self-reported negative affect and state anxiety were lower in the mandala-coloring experimental group as compared to the no-task control group following the psychosocial stressor. Specifically, a marginally significant reduction was found in negative affect, $t(35) = -2.03$, $p = .05$, $\eta^2 = .11$, and a trend toward significant reduction was found in state anxiety, $t(35) = -1.76$, $p = .08$, $\eta^2 = .08$. These findings suggested modest support for the effectiveness of mandala coloring paired with already validated focused breathing as an effective technique for reducing self-reported negative affect and state anxiety. Implications and the need for further research to assess the combination of these techniques are discussed.

Within the United States, the presence of stress is reaching epidemic proportions (Everly & Lating, 2013). Evidence has suggested that 82.8% of adults in the United States will be exposed to traumatic events during their lifetime (Breslau, 2009). Notably, stressors do not need to be considered traumatic in order to have damaging effects. A stressor is defined as a stimulus that elicits a stress response (Everly & Lating, 2013). Stressors come in two different forms. Biogenic stressors directly initiate a stress response and include pain-evoking stimuli, exposure to extreme heat or cold, caffeine, nicotine, and prolonged exercise (Everly & Lating, 2013; Lovallo & Thomas, 2000). Psychosocial stressors can be described as real or imagined events that may elicit the stress response via a cognitive interpretation of the stressor (Everly & Lating, 2013). Examples of psychosocial stressors include public speaking tasks, mental arithmetic tasks, and other daily hassles (Everly & Lating, 2013; Lovallo & Thomas, 2000). Research has demonstrated that the presence of stressors are related to diseases of the gastrointestinal, cardiovascular, respiratory, and psychological systems (Everely & Lating, 2013). Therefore, it is important for clinicians to have a

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variety of therapeutic tools to address the effects of stressors.

The main biological system that responds to a stressor, regardless of whether it is biogenic or psychosocial, is the sympathetic nervous system, also known as the *fight or flight* system (Everely & Lating, 2013). The sympathetic nervous system creates a fast and immediate response that allows the body to prepare to react to a threatening situation. Activation of the sympathetic nervous system results in the discharge of norepinephrine throughout the brain (Chrousos & Gold, 1992). The presence of norepinephrine results in enhanced arousal, vigilance, and anxiety. Additionally, the hippocampus and amygdala are the major brain regions involved in this system along with their relationship between the mesocortical and mesolimbic dopamine pathways that are activated during the stress response (Chrousos & Gold, 1992). During the stress response, 35% of epinephrine and norepinephrine are secreted from the adrenal medulla on the kidneys with the remainder being directly released in the blood stream by sympathetic nerve endings (al'Absi, 2007). Furthermore, catecholamines such as epinehprine impact organ systems by being transported throughout the body (al'Absi, 2007). Thus, the sympathetic nervous system is activated by a stressor, either biogenic or psychosocial, and catecholamines impact the brain and organ system to generate the fight or flight response.

In a threatening situation, the sympathetic nervous system is responsible for inducing the stress response. The stress response can be defined as a range of psychophysiological markers such as increased heart rate (HR), blood pressure (BP), and electrodermal activity as a result of frightening stimuli (Kirschbaum, Pirke, & Hellhammer, 1993). Electrodermal activity refers to the electrical activity occurring in a person's skin. Specifically, skin conductance level (SCL) refers to the tonic level of electrical conductivity of the skin. As a result of sympathetic activation, sweat rises toward the skin's surface in varying amounts from varying glands (Stern, Ray, & Quigley, 2001). The hydration of the skin with sweat increases SCL (Stern et al., 2001). Therefore, SCL should increase as a result of sympathetic activation resulting from a stressor.

The cardiovascular system is how the heart moves blood to various organs. Activation of the sympathetic nervous system produces arousal responses in the cardiovascular system (Stern et al., 2001). These responses include changes in HR, BP, and pulse volume. HR is defined as the number of heart beats that occur per min (Stern et al., 2001). Thus, as a result of a stressor, HR increases in beats per min (bpm). Another response that increases as a result of sympathetic activation is BP. BP is described as the necessary pressure the heart must produce to move blood through arteries, capillaries, and veins (Stern et al., 2001). The maximum amount of BP occurs when the heart contracts. This is referred to as systolic BP. Conversely, the minimum amount of BP occurs after contraction when the heart relaxes (Stern et al., 2001). This is referred to as diastolic BP. Notably, diastolic BP is more sensitive to cardiovascular assessment. Furthermore, mean arterial pressure can be calculated by adding 1/3 systolic BP to 2/3 diastolic BP. Mean arterial pressure represents the average arterial pressure of a single cardiac cycle. A single cardiac cycle includes contraction and relaxation of the cardiovascular system. Pulse volume is another cardiovascular response affected by sympathetic activation. Pulse volume is the change in blood flow as it relates to the pumping of the heart (Stern et al., 2001). Specifically, pulse volume is a measurement of the amplification of single pulse (Stern et al., 2001). Therefore, HR, BP, and pulse are all measures indicative of the psychophysiological stress response.

The biopsychosocial perspective implies that biological, psychological, and social forces work together to determine a person's health or vulnerability to disease (Straub, 2012). The belief in the biopsychosocial paradigm classifies the mind and body as entities that influence each other. Mind-Body Therapies (MBTs) align with the biopsychosocial paradigm and are defined as healing practices with the aim to use the mind's ability to affect biological functioning (Bertisch, Wee, Phillips, & McCarthy, 2009). MBTs are typically alternative therapies used in conjunction with other clinically supported therapies. MBTs include practices such as meditation, mindfulness, deep breathing, muscle relaxation, guided imagery, and biofeedback.

One mechanism of MBTs is mindfulness, which plays a role in treatment of psychological disorders along with use in nonclinical populations (Arch & Craske, 2006). Mindfulness can be described as fostering concentration, attention, and acceptance toward what a person is experiencing in the present moment (Arch & Craske, 2006). Further, focused breathing is a type of mindfulness technique. The premise of focused breathing is to have people become aware of the sensations of breathing while paying attention to experiences in the present moment (Arch & Craske, 2006). Thus, focused breathing has been used to aid the parasympathetic nervous system to return the body to homeostasis after a stress response (Linehan, 1993).

Meditation is a technique that also falls under the category of MBTs. Meditation is described as a relaxing method that limits stimulus input and centers attention on a constant object of focus (Curry & Kasser, 2005). Therefore, the basic principles of meditation are similar to that of mindfulness, but mindfulness is more easily achieved with less practice. Some research has stated that meditation can be used as a relaxation or cognitive technique that could be of therapeutic benefit (Bertisch et al., 2009).

Art therapy is a highly unstudied treatment option with many potential benefits (Curry & Kasser, 2005). Art therapy channels the use of creativity and of art making to help elicit self-expression. This form of expression may help people create a visual representation of their mental state (Curry & Kasser, 2005). In particular, coloring therapy is the combination of art therapy with meditation (Curry & Kasser, 2005). Coloring not only encourages self-expression, but is also understood to produce a meditative state that could alleviate sentiments of anxiety (Curry & Kasser, 2005). In one study, participants in an art-making activity showed reduced anxiety and negative emotions compared to an art-viewing group (Bell & Robbins, 2007). One means to create this meditative state via an art-making process is through the use of a mandala.

A mandala is a circular art form that resembles geometric stained glass (Curry & Kasser, 2005). Mandalas were used in Eastern cultures as a form of meditation. In Sanskrit, the word *mandala* means *healing circle*. Carl Jung first suggested that the drawing of mandalas creates a trance-like or meditative state. Curry and Kasser (2005) along with a replication study by van der Vennet and Serice (2012) both concluded that mandala coloring reduced state anxiety significantly more than plaid pattern coloring or blank page-coloring. Another study similarly concluded that an art-making group that included a mandala activity showed significantly decreased levels of state anxiety following the art making (Sandmire, Gorham, Rankin, & Grimm, 2012). In other words, research has demonstrated that drawing, coloring, or tracing the mandala's structured pattern elicits a decrease in state anxiety and negative emotion understood to operate via that meditative state that these designs create.

The purpose of the current experiment was to assess the effects of mandala coloring and focused breathing on self-reported affect, state anxiety, and psychophysiological response following a psychosocial stressor. Notably, mandala coloring and focused breathing were used together in the present research. This decision was based in the literature in that coloring therapy can be defined as the combination of art therapy with meditation (Curry & Kasser, 2005). Therefore, to create a manipulation that was representative of the components of coloring therapy, focused breathing was used to enhance the meditative aspect of the definition. A control group that received no mandala coloring or focused breathing was included as a comparison. It was primarily hypothesized that the psychosocial stressor would produce elevated measures of self-reported negative affect, state anxiety, and psychophysiological response and reduce positive affect in all participants. It was further predicted that coloring a mandala paired with focused breathing would reduce self-reported affect, state anxiety, and psychophysiological response following a psychosocial stressor greater than controls.

Methods

Participants

Of the 37 participants in the current sample, 81% were women and 19% were men. Participants were primarily European American (81%). Other ethnicities that were represented were Asian (8%), African American (5%), and Hispanic (5%). The average age of participants was 19 years (*SD* = 1.22, range = 18–21). The sample was comprised of 54% first-year students, 11% sophomores, 16% juniors, and 19% seniors. Participants were undergraduate students attending a small liberal arts college in north central Pennsylvania. Participants were notified of the experiment via posters hung across campus to advertise the study. All participants were compensated $10 in cash for participation in the study. All procedures were approved by the local college-wide institutional review board, and the experiment was conducted according to the APA Ethical Principles of Psychologists and Code of Conduct (APA, 2010).

Materials

Self-reported positive and negative affect. The Positive and Negative Affect Schedule (PANAS) was used to assess positive and negative mood

(Watson, Clark, & Tellegan, 1988). Both positive and negative affect scores were dependent variables of the research. This instrument is a self-report survey consisting of 20 descriptor words in no particular order. A high positive score indicates that participants are in an energetic and pleasurable mood, and a high negative score indicates a nervous or aversive mood (Watson et al., 1988). It is important to note that these two mood factors are negatively correlated (Watson et al., 1988). This means that, when negative scores are high, positive scores should be low and vice versa. The PANAS is a validated measure widely used in the field of psychology (Watson et al., 1988). Specifically, Cronbach's alpha coefficients were reported to range from .86 to .90 for positive affect and .84 to .87 for negative affect (Watson et al., 1988). Test-retest coefficients for an 8-week period ranged from .47 to .68 for positive affect and .39 to .71 for negative affect in an 8-week interval (Watson et al., 1988). In the present study, positive and negative affect were assessed at four separate points. For the present sample, Cronbach's alpha internal consistency coefficients of positive affect were .84, .84, .84, and .85 consecutively. Cronbach's alpha coefficients of negative affect for the current sample were .65, .93, .87, and .81 consecutively.

Self-reported state anxiety. The State-Trait Anxiety Inventory (STAI) Form Y-1 was used to assess state anxiety (Spielberger, 1985). State anxiety consists of a stream of subjective feelings that a person might experience during a situation that they perceive as threatening. State anxiety can also be defined as a level of intensity corresponding to the activation of the automatic nervous system (Spielberger, 1985). This instrument consists of 20 questions on a 4-point Likert-type scale. A high score indicates a high level of state anxiety, and a low score represents a low level of anxiety. The STAI is a validated measure and is widely used across a variety of studies throughout the field of psychology (Curry & Kasser, 2005; Spielberger, 1985). Specifically, test-retest reliability coefficients have ranged from .69 to .89 over 2-month intervals (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). There has also been evidence to suggest that this scale has adequate construct and concurrent validity (Spielberger, 1985). State anxiety was assessed at four separate points through the experiment. Cronbach's alpha coefficients for state anxiety of the present sample were .87, .92, .94, and .91 consecutively.

Physiological measures. iWorx® psychological physiology equipment was used to measure all physiological data. The hardware equipment consisted of one plethysmograph that measured HR and pulse, and two other connected electrodes that measured SCL. The data were recorded and analyzed in LabScribe3 computer software (LabScribe3, 2013). The computer with the recording software was in a different room from where the experiment took place so that participants were unaware of what was being recorded.

BP. A ReliOn® BP monitor was used to measure participants' BP. This cuff was secured above the elbow of participants' dominant arm. BP measurements were taken at four points throughout the experiment. These included once during baseline, after Speech 1, after Speech 2, and immediately following the 7-min poststress manipulation. BP was assessed in terms of systolic BP, diastolic BP, and mean arterial pressure.

HR and pulse. The plethysmograph electrode was used to measure pulse and HR. This electrode was attached to the volar surface of the middle finger of participants' nondominant hand. HR was recorded in bpm, and pulse was recorded in mV. Data were analyzed at 30-s intervals for the duration of the 3-min sitting baseline, 3-min standing baseline, both 3-min speeches, and the 7-min poststress manipulation. Psycophysiological recording was analyzed at 30-s intervals. However, to eliminate data that were severely flawed by movement artifact, only the largest and most accurate piece of recording during that specific 30 s was used.

Electrodermal activity. The SCL equipment consisted of two connected electrodes used to measure skin conductance. These electrodes were attached to the volar surface where the fingerprints are located on two nonadjacent fingers. Data were generated at 30-s intervals for the duration of the 3-min sitting baseline, 3-min standing baseline, both 3-min speeches, and the 7-min poststress manipulation.

Mandala. A mandala template that was found using a basic Internet search engine was used for the coloring activity of the experimental group (Picture Coloring Book, 2013).

Procedure

Prior to the beginning of the study, participants were randomly assigned to one of two groups: either mandala coloring with focused breathing or control. Upon arrival to the experiment, the consent form was explained to participants. Once informed consent was obtained, the baseline phase began. Participants were not aware of the true purpose of the experiment in order to avoid response bias. Participants were informed that the title of the research was "Effects of Coloring." Additionally, participants were informed that they would be hooked up to electrodes, but they were not told what the electrodes were measuring. Also at the outset of the study, participants were blind to their group assignments. Following completion of each individual session, participants were debriefed.

Baseline. Participants were asked to fill out the demographic survey, STAI (Spielberger, 1985), for state anxiety, and PANAS (Watson et al., 1988). Participants were instructed to fill out all surveys as they felt in the present moment. Following this, participants' BP was taken. Next, participants were asked to wash their hands with soap and water to ensure an effective physiological recording. Next, the electrodes were hooked up to participants' nonwriting hand. At this point, participants were sitting, and a 3-min sitting baseline was recorded.

Trier Social Stress Test (TSST). All participants underwent the TSST. This is a validated measure that increases psychosocial stress (Kirschbaum et al., 1993). The test consisted of two public speaking tasks. Participants were told they had 2 min to prepare for their speech without writing anything down, and that they had 3 min to deliver the speech. Participants were also told that their speech and other nonverbal behaviors would be rated by a lab assistant wearing a white lab coat, and that they would be video recorded.

Speech 1. Participants were then given their first prompt, "You must take on the role of a job applicant who was invited to a personal interview with the company's hiring manager. Convince the manager why you are the perfect applicant for the vacant position," (Kirschbaum et al., 1993). Following the 2-min preparation period, a lab assistant wearing a white lab coat and holding a clipboard entered the room. At this time, the camera light was turned on, but no video was actually recorded. An egg timer was also set for 3 min. If participants stopped talking before the end of their 3 min, the lab assistant instructed them to continue. Following the first speech presentation, BP was measured, and participants filled out the STAI and PANAS.

Speech 2. Next, the second prompt was delivered with the same directions. The prompt stated, "You have just been caught and accused of stealing. Defend yourself, and convince the police why you are innocent and should not be arrested," (al'Absi, Wittmers, Erickson, Hatsukami, & Crouse, 2003). The protocol used during the first speech was also implemented during the second. Following the second speech, BP measure was recorded, and participants filled out STAI and PANAS.

Poststress manipulation. Participants underwent activities dependent upon group assignment. Participants in the experimental group received a predrawn mandala and were instructed on a focused breathing technique. In this focused breathing technique, participants were asked to breathe as evenly and gently as possible (Linehan, 1993). They were asked to pay attention to their breath, and the way their stomach and lungs were moving while still remaining aware of their coloring task. Participants had 7 min to complete the activity and were presented with crayons, markers, and colored pencils. Participants in the control group were asked to sit quietly for 7 min and not use their cell phone. A no-task control group was chosen to maximize differences between groups as a result of no differences found in a previous study that used an unstructured coloring group (Muthard & Williams, 2012). After the final phase ended, all participants again completed the STAI and PANAS, and BP was measured. Following the final measures, participants were debriefed and compensated.

Data Analysis

Baseline data including negative and positive affect, state anxiety, systolic BP, diastolic BP, and mean arterial pressure were assessed separately via independent-samples *t* tests to ensure that mandala coloring and control groups were equated at baseline. In addition, baseline measures of the continuous recording of pulse, SCL, and HR were assessed via repeated measures Analyses of Variance (ANOVAs) for each variable. A second set of analyses assessed the hypothesis that the psychosocial stressor would elevate self-reported negative affect, state anxiety, and psychophysiological response and reduce self-reported positive affect for all participants. For these analyses, separate repeated measures ANOVAs were conducted on all dependent variables to assess change over time from baseline through the poststress manipulation. Finally, a third set of analyses assessed the hypothesis that the mandala coloring group would demonstrate less self-reported negative affect, state anxiety, and psychophysiological response and more self-reported positive affect to the psychosocial stressor as compared to the noncoloring control. These analyses included independent-samples *t* tests for negative affect, positive affect, state anxiety scores, systolic BP, diastolic BP, and mean arterial pressure. Grand average means of pulse, SCL, and HR were included. Additionally, repeated measures ANOVAs were used to assess change across time for seven time points (1-min intervals) of pulse, SCL, and HR measurements taken during the poststress phase. When significance occurred in repeated measures ANOVAs, post-hoc analyses were conducted to determine between or within group differences.

Results

Demographics

Chi-squared tests were completed on demographic variables as a randomization check to confirm no significant differences between groups. Analyses confirmed no differences in frequency of sex, $\chi^2(1, N = 37) = 0.12$, $p = .73$, $\varphi = .06$, ethnicity, $\chi^2(3, N = 37) = 2.44$, $p = .49$, $\nu = .26$, and graduation year, $\chi^2(3, N = 37) = 0.98$, $p = .81$, $\nu = .16$. Additionally, an independent-samples t test revealed that there were no differences in mean age between groups, $t(35) = 0.53$, $p = .60$, $\eta^2 = .008$.

Baseline

Self-reported measurements. Independent-samples t tests were conducted on baseline self-report data to ensure that there were no group differences at baseline. There were no significant differences in mean state anxiety, $t(35) = -0.27$, $p = .79$, $\eta^2 = .002$, positive affect, $t(35) = 0.47$, $p = .64$, $\eta^2 = .006$, or negative affect between groups, $t(35) = 0.86$, $p = .40$, $\eta^2 = .02$.

BP. Independent t tests were used to confirm that there were no significant group differences in BP measures at the baseline phase. There were no differences between groups in mean systolic BP, $t(34) = -0.41$, $p = .68$, $\eta^2 = .005$, mean diastolic BP, $t(34) = -0.54$, $p = .59$, $\eta^2 = .009$, or mean arterial pressure, $t(35) = -1.13$, $p = .27$, $\eta^2 = .04$, following baseline.

Physiological measurements. Repeated measures ANOVAs were used to assess the six time points (30-s intervals) of pulse, SCL, and HR during the baseline phase to analyze change through baseline among these time points and differences in change across baseline between groups. Between-subjects and within-subjects statistics were analyzed in all ANOVAs. Note that within-subjects analyses refer to both groups. For pulse, between-subjects analyses revealed no significant differences in mean pulse between groups during baseline, $F(1, 35) = 0.32$, $p = .57$, $\eta_p^2 = .009$. Within-subjects analyses revealed a decrease in mean pulse measurements (mV) across baseline, $F(5, 175) = 4.40$, $p = .001$, $\eta_p^2 = .11$. However, the time by group interaction was not significant, suggesting that both groups decreased similarly across baseline, $F(5, 175) = 0.52$, $p = .76$, $\eta_p^2 = .02$. For SCL, between-subjects effects indicated no significant difference between groups of mean SCL measurements (mS) during baseline, $F(1, 35) = 1.07$, $p = .31$, $\eta_p^2 = .03$; within-subjects effects revealed that there were no significant changes across time of baseline, $F(5, 175) = 0.63$, $p = .68$, $\eta_p^2 = .02$, and there were no group by time interactions in mean SCL, $F(5, 175) = 0.58$, $p = .72$, $\eta_p^2 = .02$. Finally, for HR, between-subjects effects indicated no differences between groups in mean HR during baseline, $F(1, 35) = 1.89$, $p = .18$, $\eta_p^2 = .05$. Within-subjects effects revealed a significant increase in mean HR measurements (bpm) across baseline, $F(5, 175) = 2.78$, $p = .02$, $\eta_p^2 =.07$. However, there were no time by group interactions in mean HR, indicating that the groups increased similarly across baseline, $F(5, 175) = 1.39$, $p = .23$, $\eta_p^2 = .04$. In summary, analyses indicated a general decrease in pulse and increase in HR during baseline, but the groups moved similarly across time. However, SCL did not change over baseline.

Change Over Procedure: Response to Psychosocial Stressor in All Participants

Self-reported measurements. Repeated measures ANOVAs were conducted separately on self-report variables. Between-subjects analyses indicated no differences between groups in state anxiety, $F(1, 33) = 0.26$, $p = .61$, $\eta_p^2 = .01$, positive affect, $F(1, 33) = 0.31$, $p = .31$, $\eta_p^2 = .01$, and negative affect, $F(1, 33) = 0.01$, $p = .91$, $\eta_p^2 < .001$. Within-subjects analyses on self-reported affect indicated a significant change across the entire experiment for state anxiety, $F(3, 99) = 23.17$, $p = .001$, $\eta_p^2 = .42$, positive affect, $F(3, 99) = 10.33$, $p = .001$, $\eta_p^2 = .24$, and negative affect, $F(3, 99) = 6.82$, $p = .001$, $\eta_p^2 = .17$ (see Figures 1, 2, & 3). There was a time by group interaction only for positive affect, $F(3, 99) = 2.86$, $p = .04$, $\eta_p^2 = .08$. There were no time by group interactions for state anxiety, $F(3, 99) = 1.41$, $p = .25$, $\eta_p^2 = .04$, or negative affect, $F(3, 99) = 1.45$, $p = .23$, $\eta_p^2 = .04$. In summary, the experimental and control groups' self-reported affect was not different across the course of the experiment. Additionally, self-reported affect did change over the procedure, but only positive affect demonstrated a change in different directions.

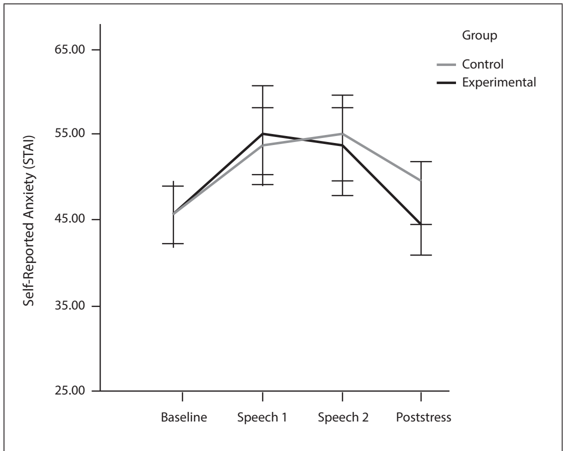
Post-hoc analyses indicated that measurements increased from baseline to Speech 1 in state anxiety,

$t(34) = -6.12$, $p < .001$, $\eta^2 = .52$, and negative affect, $t(34) = -2.64$, $p = .01$, $\eta^2 = .17$. Self-reported measurements did not change between speeches in state anxiety, $t(34) = .50$, $p = .62$, $\eta^2 = .01$, and negative affect, $t(34) = .85$, $p < .40$, $\eta^2 = .02$. Measurements decreased from Speech 2 to poststress in state anxiety, $t(36) = 5.45$, $p < .001$, $\eta^2 = .45$, and negative affect, $t(36) = 3.33$, $p = .002$, $\eta^2 = .24$. Post-hoc analyses also indicated that positive affect decreased from baseline to Speech 1, $t(34) = 4.49$, $p < .001$. $\eta^2 = .37$, did not change between speeches, $t(34) = 1.71$, $p = .10$. $\eta^2 = .04$, and increased from Speech 2 to poststress, $t(36) = -1.96$, $p = .05$, $\eta^2 = .10$. To recap, this means that state anxiety and negative affect increased as a result of the psychosocial stressor, and decreased during the poststress phase; positive affect decreased as a result of the psychosocial stressor, and increased during the poststress phase. These results reflected expected changes due to the experimental manipulations.

BP. Between-subjects analyses revealed that there were no significant differences between groups for systolic BP, $F(1, 32) = 1.27$, $p = .27$, $\eta_p^2 = .04$, diastolic BP, $F(1, 32) = 0.07$, $p = .79$, $\eta_p^2 = .002$, or mean arterial pressure when analyzing the procedure as a whole, $F(1, 35) = 1.63$, $p = .21$, $\eta_p^2 = .04$. Within-subjects analyses indicated a significant change over procedure for systolic BP, $F(3, 96) = 6.44$, $p = .001$, $\eta_p^2 = .17$, diastolic BP, $F(3, 96) = 76.01$, $p = .001$, $\eta_p^2 = .70$, and mean arterial pressure, $F(3, 105) = 3.39$, $p = .02$, $\eta_p^2 = .09$ (see Figures 4, 5, & 6). Further, there were no time by group interactions for systolic BP, $F(3, 96) = 0.84$, $p = .48$, $\eta_p^2 = .03$, diastolic BP, $F(3, 96) = 0.55$, $p = .65$, $\eta_p^2 = .02$, or mean arterial pressure, $F(3, 105) = 0.03$, $p = .99$, $\eta_p^2 < .001$. In summary, BP measurements were not different according to group over the course of the experiment, but did change in similar directions as the experiment went on.

FIGURE 1

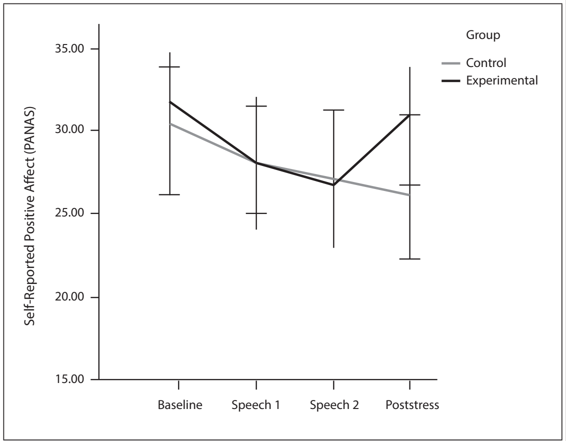
State Anxiety Change Over Time



Note. State anxiety scores significantly changed across the course of the experiment. Post-hoc analysis indicated that state anxiety increased from baseline to Speech 1, did not change between the speeches, and decreased from Speech 2 to poststress. Additional analyses indicated no change directly from baseline to poststress manipulation, indicating that participants returned to baseline levels of anxiety at the conclusion of the experiment, $t(36) = -0.13$, $p = .90$, $\eta^2 < .001$. The error bars indicate +/- 2 standard errors of the mean.

FIGURE 2

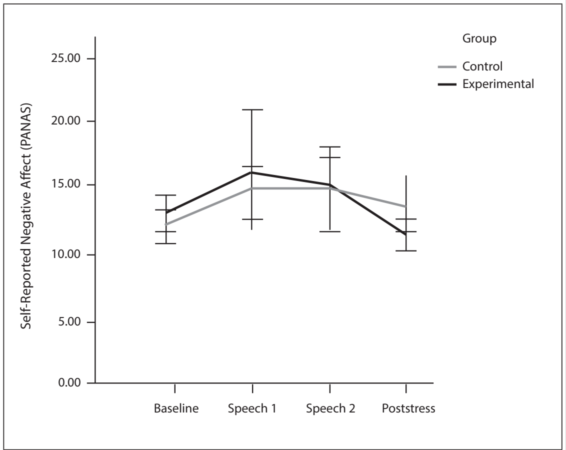
Positive Affect Change Over Time



Note. Positive affect scores significantly changed across the entire experiment. Post-hoc analysis also indicated that positive affect decreased from baseline to Speech 1, did not change between speeches, and increased from Speech 2 to poststress. Further analyses indicated that positive affect was significantly decreased directly from baseline to poststress manipulation, $t(36) = 3.24$, $p = .003$, $\eta^2 = .23$. The error bars indicate +/- 2 standard errors of the mean.

FIGURE 3

Negative Affect Change Over Time



Note. Negative affect scores significantly changed over the course of the experiment. Post-hoc analysis indicated that negative affect increased from baseline to Speech 1, did not change between speeches, and decreased from Speech 2 to poststress. Additional analyses indicated a time by group interaction directly from baseline to poststress manipulation in which the experimental group's negative affect decreased and the control group's increased, $F(1, 35) = 10.21$, $p = .003$, $\eta_p^2 = .23$. The error bars indicate +/- 2 standard errors of the mean.

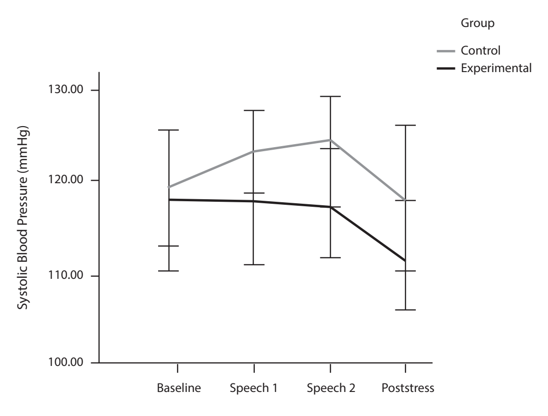
Post-hoc analysis on diastolic BP indicated that diastolic BP significantly increased from baseline to Speech 1, $t(33) = -10.02$, $p < .00$, $\eta^2 = .75$, did not change between the speeches, $t(33) = -.035$, $p = .97$, $\eta^2 < .001$, and significantly decreased from Speech 2 to poststress, $t(35) = 11.93$, $p < .001$, $\eta^2 = .80$. Post-hoc analyses indicated that systolic BP and mean arterial pressure did not change from baseline to Speech 1, $t(33) = -1.02$, $p = .31$, $\eta^2 = .03$, $t(36) = -0.47$, $p = .64$, $\eta^2 = .006$, or Speech 1 to Speech 2, $t(33) = 0.31$, $p = .76$, $\eta^2 = .003$, $t(36) = -1.36$, $p = .18$, $\eta^2 = .05$, but did decrease from Speech 2 to poststress, $t(35) = 4.11$, $p < .001$, $\eta^2 = .33$, $t(36) = 11.28$, $p < .001$, $\eta^2 = .78$. However, a paired-samples *t* test indicated that there was a significant increase in average mean arterial pressure from baseline to directly after the second speech, $t(36) = -8.35$, $p = .001$, $\eta^2 = .70$. Mean arterial pressure increased from 82.67 mmHg, ($SD = 16.72$) during baseline to 89.49 mmHg ($SD = 17.12$) following Speech 2. This suggested that the psychosocial stressor might not have been effective at increasing systolic BP, but mean arterial pressure increased as a result of the second speech. However, diastolic BP changed over the course of the experiment as expected.

Physiological measurements. Between-subjects analyses revealed a trend toward difference between groups in mean pulse, $F(1, 35) = 3.80$, $p = .06$, $\eta_p^2 = .14$, but there were no group differences in SCL, $F(1, 35) = 0.72$, $p = .40$, $\eta_p^2 = .02$, or HR, $F(1, 35) = 0.04$, $p = .84$, $\eta_p^2 = .001$. Within-subjects analyses also indicated significant change across the entire procedure for pulse, $F(3, 99) = 3.73$, $p = .01$, $\eta_p^2 = .10$, SCL, $F(3, 105) = 42.99$, $p = .001$, $\eta_p^2 = .55$, and HR, $F(3, 105) = 89.77$, $p = .001$, $\eta_p^2 = .72$ (see Figures 7 & 8). There was a time by group interaction only for HR measurements, $F(3, 105) = 2.86$, $p = .04$, $\eta_p^2 = .08$. There were no time by group interactions for pulse, $F(3, 105) = 1.77$, $p = .16$, $\eta_p^2 = .05$, or SCL, $F(3, 105) = 1.37$, $p = .26$, $\eta_p^2 = .04$. To review, the only variable to demonstrate slight group differences across the experiment was pulse. Additionally, pulse and SCL variables changed over the course of the experiment in the same direction by both groups, but the experimental and control groups' HR moved in opposite directions of each other.

Additionally, post-hoc analyses indicated that pulse significantly decreased from baseline to Speech 1, $t(36) = -9.46$, $p < .001$, $\eta^2 = .71$, and between speeches, $t(36) = 9.48$, $p < .001$, $\eta^2 = .71$, but did not change from Speech 2 to poststress, $t(36) = -1.35$, $p = .18$, $\eta^2 = .05$. These results might have been affected by an outlier. Further, post-hoc analyses revealed that SCL significantly increased from baseline to Speech 1, $t(36) = -6.53$, $p < .001$, $\eta^2 = .54$, did not change between speeches, $t(36) = -1.92$, $p = .06$, $\eta^2 = .09$, and did not change from Speech 2 to poststress, $t(36) = 1.25$, $p = .22$, $\eta^2 = .04$. Lastly, post-hoc analyses indicated that HR significantly increased from baseline to Speech 1, $t(36) = -9.56$, $p < .001$, $\eta^2 = .72$, did not change between speeches, $t(36) = -1.14$, $p = .26$, $\eta^2 = .03$, and

FIGURE 4

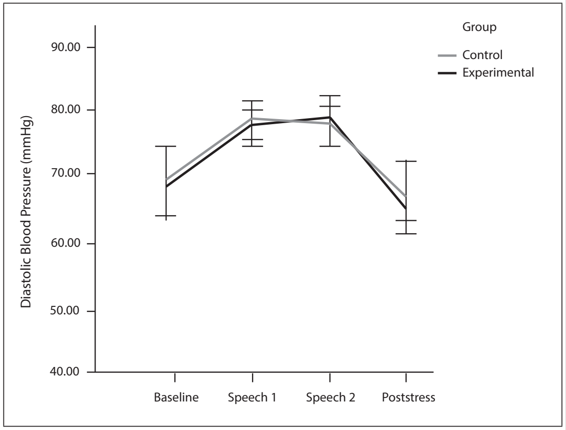
Systolic Blood Pressure Change Over Time



Note. Systolic blood pressure significantly changed over the course of the experiment. Post-hoc analysis indicated that there was no significant change from baseline to Speech 1, no change from Speech 1 to Speech 2, but a decrease from Speech 2 to poststress. Further analyses indicated the systolic BP significantly decreased directly from baseline to poststress manipulation, $t(35) = 2.61$, $p = .01$, $\eta_p^2 = .16$. The error bars indicate +/- 2 standard errors of the mean.

FIGURE 5

Diastolic Blood Pressure Change Over Time



Note. Diastolic blood pressure significantly changed course over the course of the experiment. Post-hoc analysis indicated that diastolic blood pressure significantly increased from baseline to Speech 1, did not change between the speeches, and significantly decreased from Speech 2 to poststress. Additional analyses indicated no change directly from baseline to poststress manipulation, $t(35) = 0.33$, $p = .75$, $\eta^2 = .003$. The error bars indicate +/- 2 standard errors of the mean.

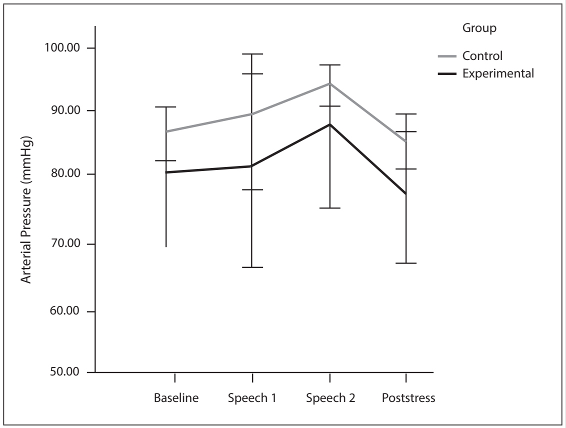
significantly decreased from Speech 2 to baseline, $t(36) = 10.42$, $p < .001$, $\eta^2 = .75$. In summary, these analyses indicated that all dependent variables changed over time as a result of the psychosocial stressor with the exception of systolic BP, mean arterial pressure, and pulse.

Poststress Measurements of Mandala Coloring and Focused Breathing Versus Control

Self-reported measurements. Self-reported measures were only administered once during the poststress phase that occurred at the end of the 7-min poststress manipulation. Independent-samples *t* tests were used to assess differences between experimental and control groups during the 7-min post stress manipulation phase. These independent-samples *t* tests also revealed a marginally significant difference and moderate effect size in mean negative affect between groups $t(35) = -2.03$, $p = .05$, $\eta^2 = .11$ (see Figure 9). Mean negative affect scores for the experimental group were 11.05 (*SD* = 1.87), and mean negative affect scores for the control group were 12.94 (*SD* = 3.59). There was a trend toward significance in mean STAI score between groups with a moderate effect size, $t(35) = -1.76$, $p = .08$, $\eta^2 = .08$ (see Figure 10). Mean state anxiety of the experimental group was 44.53 (*SD* = 6.63), and mean state anxiety of the control group was 49.06 (*SD* = 8.39) within the context of potential scores ranging from 34 to 63. There were no significant differences in mean positive affect between groups, $t(35) = 1.44$, $p = .16$, $\eta^2 = .06$. To specify, state anxiety and negative affect were higher in the control group.

FIGURE 6

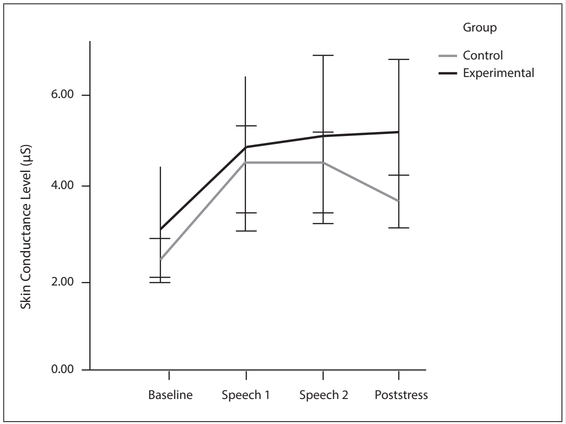
Mean Arterial Pressure Change Over Time



Note. Mean arterial pressure significantly changed across the course of the experiment. Post-hoc analysis indicated that there was no significant change from baseline to Speech 1, no change from Speech 1 to Speech 2, but a decrease from Speech 2 to poststress. Further analyses indicated no change directly from baseline to poststress manipulation, $t(36) = 1.79$, $p = .08$, $\eta^2 = .08$. The error bars indicate +/- 2 standard errors of the mean.

FIGURE 7

Skin Conductance Level Change Over Time



Note. Skin conductance level significantly changed over the course of the experiment. Post-hoc analysis revealed that skin conductance level significantly increased from baseline to Speech 1 and did not change between speeches and from Speech 2 to poststress. Additional analyses indicated a significant increase directly from baseline to poststress manipulation, $t(36) = -9.62$, $p < .001$, $\eta^2 = .72$. The error bars indicate +/- 2 standard errors of the mean.

BP. Independent *t* tests were used to analyze differences in BP measurements between experiment and control groups during the poststress manipulation. There were no significant differences in mean systolic BP, $t(34) = -1.47$, $p = .15$, $\eta^2 = .06$, diastolic BP, $t(34) = -0.77$, $p = .45$, $\eta^2 = .02$, or mean arterial pressure between groups, $t(35) = -1.47$, $p = .15$, $\eta^2 = .06$. Overall, the groups did not differ in any BP variable during the poststress manipulation.

Physiological measurements. An independent *t* test was used on grand means created for pulse, SCL, and HR measures throughout the poststress manipulation phase. Analyses indicated no significant differences in pulse, $t(35) = -0.86$, $p = .40$, $\eta^2 = .02$, SCL, $t(35) = 1.32$, $p = .20$, $\eta^2 = .05$, or HR between groups, $t(35) = 0.1$, $p = .90$, $\eta^2 < .001$. Thus, the means of these variables did not differ according to group during the poststress manipulation.

Repeated measures ANOVAs were conducted separately on seven time points at 1-min intervals for pulse, SCL, and HR measures taken during the poststress manipulation phase to reveal differences between the experimental and control group during the poststress phase. It is important to note that poststress data were collapsed into 1-min intervals as opposed to 30 s to make analyses more manageable. Between-subjects analyses revealed no group differences in pulse measurements during poststress manipulation, $F(1, 35) = 0.73$, $p = .40$, η_p^2

$= .02$; within-subjects effects revealed no significant changes in mean pulse across the poststress phase, $F(6, 210) = 0.98$, $p = .44$, $\eta_p^2 = .03$, and no significant group by time interactions suggesting that groups interacted similarly across the poststress phase, $F(6, 210) = 1.61$, $p = .15$, $\eta_p^2 = .04$. Between-subjects effects revealed no group differences in SCL during poststress manipulation, $F(1, 35) = 1.74$, $p = .20$, $\eta_p^2 = .05$. Within-subjects analyses on mean SCL indicated a decrease across time during the poststress manipulation, $F(6, 210) = 2.47$, $p = .03$, $\eta_p^2 = .07$. However, there were no group by time interactions indicating that the groups decreased in the same direction, $F(6, 210) = 0.99$, $p = .43$, $\eta_p^2 = .03$. Between-subjects analyses indicated no significant differences between groups of mean HR during poststress manipulation, $F(1, 35) = 0.02$, $p = .90$, $\eta_p^2 < .001$, and within-subjects effects of the repeated measures revealed no significant differences across time, $F(6, 210) = 0.62$, $p = .72$, $\eta_p^2 = .02$. However, a group by time interaction in mean HR was found between groups during the poststress manipulation, $F(6,210) = 3.80$, $p = .001$, $\eta_p^2 = .10$.

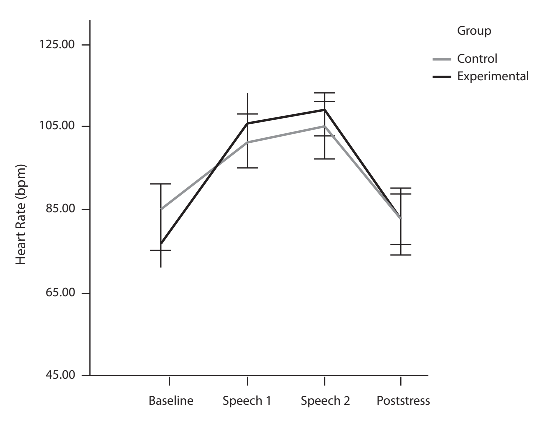
Post-hoc paired-samples *t* tests on HR revealed that both the control and experimental groups had a marginally significant change from the 0-s to 1-min time point to the 2-min to 3-min time point, $t(17) = 1.90$, $p = .075$, $\eta^2 = .18$, $t(18) = -1.91$, $p = .07$, $\eta^2 = .17$. The means indicated that the control group's HR decreased from 85.02 ($SD = 13.47$) to 82.83 ($SD = 13.39$), and the experimental group's mean HR increased from 79.97 ($SD = 9.99$) to 83.47 ($SD = 11.83$), suggesting that these changes can account for most of the time by group interaction. However, it is important to mention that the mean HR of the experimental group ($M = 83.76$, $SD = 10.86$) was higher than the control group ($M = 81.74$, $SD = 14.32$) during the last 5 min of the poststress manipulation. This pattern of HR results was opposite of the primary hypothesis and will be further discussed.

Discussion

The purpose of the present experiment was to assess the effectiveness of mandala coloring combined with focused breathing as potential techniques to change negative and positive affect, state anxiety, and psychophysiological response following a psychosocial stressor. By linking art therapy and mindfulness techniques, the study sought to bring validation to the art-making process, especially coloring, as a possible therapeutic tool. It was hypothesized that the psychosocial stressor would produce elevated measures of self-reported negative affect, state anxiety, and psychophysiological response and reduce positive affect in all participants. This hypothesis was fully supported. It was further hypothesized that, following the psychosocial stressor, mandala coloring paired with focused breathing in the experimental group would reduce negative affect, state anxiety, and psychophysiological indices of the stress response and

FIGURE 8

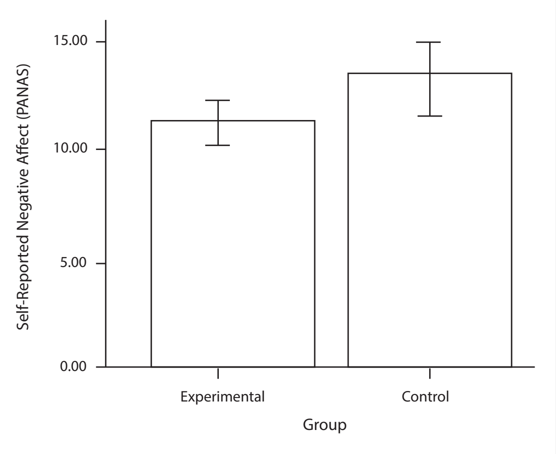
Heart Rate Change Over Time



Note. Heart rate significantly changed over the course of the experiment. Post-hoc analysis indicated that heart rate significantly increased from baseline to Speech 1, did not change between speeches, and significantly decreased from Speech 2 to baseline. Further analyses indicated a significant time by group interaction in which the experimental group's HR increased directly from baseline to poststress manipulation, whereas the control group's decreased, $F(1, 35) = 6.54$, $p = .02$, $\eta_p^2 = .12$. The error bars indicate +/- 2 standard errors of the mean.

FIGURE 9

Negative Affect Poststress Group Differences



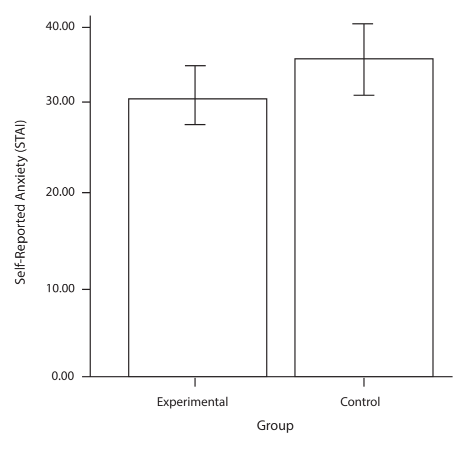
Note. Independent-samples *t* tests revealed a marginally significant difference in mean negative affect between the mandala coloring and focused breathing group when compared to the control group during the poststress phase. The error bars indicate +/- 2 standard errors of the mean.

increase positive affect greater than the control. This hypothesis was partially supported.

Concerning the first hypothesis, the psychosocial stressor was effective in elevating state anxiety, negative affect, and psychophysiological indices of the stress response while reducing positive affect in the present experiment. This conclusion supported the hypothesis that self-reported affect, state anxiety, and psychophysiological variables would change over time, and is also consistent with other literature that demonstrated the same effect (Campisi, Bravo, Cole, & Gobeil, 2012; Kirschbaum et al., 1993). Results indicated that, from baseline to both Speech 1 and Speech 2 independently, all self-reported measurements changed in the proper direction to indicate that participants experienced psychosocial stress. Specifically, state anxiety and negative affect scores increased as a result of the TSST, and positive affect scores decreased (p's < .05). In analyzing the effect of the TSST on BP, results indicated that diastolic BP increased from baseline to both speeches, and mean arterial pressure increased from baseline to Speech 2. However, there were no changes in systolic BP, which was consistent with the literature that has reflected that diastolic BP is more susceptible to stress (Stern et al., 2001). Additionally, HR and SCL both significantly increased from baseline to both speeches, demonstrating that the psychosocial stressors worked effectively. However, pulse decreased from baseline to both speeches. This might have been a result of overall variability in pulse measurements during the psychosocial stressor. In this case, it is important to note that there is much heterogeneity of the stress response, and that there are individual differences in responses (Kudielka, Hellhammer, & Wüst, 2009; Stern et al., 2001).

FIGURE 10

State Anxiety Poststress Group Differences



Note. Independent-samples t tests revealed a trend toward a significant difference in mean state anxiety between mandala coloring and focused breathing group when compared to the control group during the poststress phase. The error bars indicate +/- 2 standard errors of the mean.

Concerning the second hypothesis, it is possible to conclude that the findings partially supported that mandala coloring would reduce negative affect, state anxiety, and psychophysiological indices of the stress response while increasing positive affect as an intervention compared to a control. However, it is important to note that it cannot be determined whether mandala coloring or focused breathing individually contributed to the reductions because they were used together. A pilot study found no differences between control and a mandala-coloring group (Muthard & Williams, 2012), thus focused breathing was added to the experimental paradigm to strengthen the mandala-coloring manipulation. In the current study, self-reported negative affect and state anxiety demonstrated a trend toward stress reduction in the experimental group in the predicted direction. These results supported the secondary hypothesis and were consistent with research that has also demonstrated a decrease in state anxiety after mandala coloring (Curry & Kasser, 2005; Sandmire et al., 2012; van der Vennet & Serice 2012). Thus, the findings showed limited support for the effectives of mandala coloring with focused breathing in reducing self-reported measures of negative affect and state anxiety.

However, the psychophysiological measures did not demonstrate any differences between groups, thus not supporting the secondary hypothesis. A very common model of affect proposes that affect functions on a three-way systems model that includes physiological, behavioral, and cognitive components (Lang, 1978). This suggests a possible disconnect between self-reported measures of negative affect and state anxiety with psychophysiological measures. Therefore, each aspect has its own individual system that can respond to a stressor. For example, the behavioral system might register avoidance, whereas, the physiological system might physically increase HR. Viewing affect as a systems model justifies why the present study found effects in self-reported affect, but not in physiological measures. The Cannon-Bard Theory of Emotion (Cannon, 1949) also explains these results by indicating that autonomic arousal and conscious emotions are separate systems that do not result from one another. Therefore, the finding that differences were found only in self-reported affect and state anxiety can be explained by the literature. Although participants were not told the full nature of the study, their personal biases might have exacerbated the significant results found in self-reported measurements, as is true in all studies assessing self-reported measures.

Additionally, a slight trend moved in the opposite direction than predicted. SCL levels during the entire poststress manipulation and HR measurements during the latter portion of the poststress manipulation were actually higher in the experimental group than the control group, which suggested that the control group was more psychophysiologically aroused. Two reasons might explain this trend of HR and SCL moving in the opposite direction than anticipated in the experimental group. One possibility is that the experimental group had a task to complete compared to the control group that had no task. The presence of the task itself might have been more arousing than sitting with no task. Initially, a no-task control group was incorporated into the study design because it was thought to maximize differences between control and experimental groups. Future research may be able to address this issue by giving the control group a neutral task such as reading or writing. Second, some research has suggested that mindfulness techniques actually increase arousal as opposed to decreasing arousal. One of the fundamental components of mindfulness is that it requires an attention that is characterized by observing one's moment-to-moment experiences (Arch & Craske, 2006). Therefore, if mindfulness requires attentional processes, this may explain why the experimental group's physiological arousal was higher. Other studies have concluded that meditational activities also cause higher arousal in HR variables (Jevning, Wallace, & Beidbach, 1992; Peng et al., 1999). Although these findings were not consistent with the hypothesis, literature has supported that meditation creates an attentive state that may cause increases in psychophysiological measures.

The study findings were limited by several factors. It is first important to note that, because focused breathing and mandala-coloring were completed at the same time, it is not possible to conclude whether one technique led to the self-reported negative affect or state anxiety reduction more than the other. The decision was made to combine techniques in order to generate a stronger manipulation based on results from previous research (Muthard & Williams, 2012). However, additional research is needed to address the effectiveness of both of these techniques in reducing negative affect, state anxiety, and psychophysiological response. A limitation regarding demographics was that the sample consisted of a very narrow age range. Thus, the results from the present study were constrained to young adults and may not apply to wider audiences of varied ages such as younger or older populations. Additionally, the sample consisted of mostly women (81%), meaning that the results might also not be generalizable to normal populations regarding sex. Third, the study was limited because factors that could affect stress response such as sleep deprivation, caffeine use, and exercise were not measured. These factors were only controlled for through random assignment to groups. Lastly, the present research was limited because participants were not experienced in focused breathing or mindfulness techniques. Therefore, it cannot be guaranteed that participants were practicing the focused breathing exercises as instructed.

In conclusion, this study found limited support for the effectiveness of the combination of mandala coloring with focused breathing techniques in reducing self-reported negative affect and state anxiety as compared to controls. Future research is needed to assess whether combining lesser validated art therapy coloring techniques with relatively highly studied mindfulness techniques such as focused breathing could potentially help improve the validation of art therapy techniques, giving practitioners additional therapeutic tools to use with clients.

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