

Does Coloring Reduce Anxiety? Comparing the Psychological and Psychophysiological Benefits of Coloring Versus Drawing

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Nicole Turturro¹ and
Jennifer E. Drake² 

Abstract

In this study, we compared the psychological and psychophysiological benefits of coloring to drawing as a means of distraction versus expression. Participants were 60 undergraduates who experienced an anxiety induction. We then randomly assigned them to color a design, draw a design (distract), or draw to express their negative thoughts and feelings. Anxiety was measured before and after the anxiety induction and after drawing. Heart rate, respiratory sinus arrhythmia, and skin conductance were measured throughout the testing session. Finally, participants completed a flow and enjoyment questionnaire. All three activities reduced anxiety and decreased heart rate and increased respiratory sinus arrhythmia with no differences across conditions. Those in the draw a design condition enjoyed the activity more than those in the draw to express condition. We conclude that drawing, regardless of emotion regulation strategy used, reduces anxiety but that distracting graphic activities result in more enjoyment.

¹Albert Einstein College of Medicine, Bronx, NY, USA

²Brooklyn College, Graduate Center of the City University of New York, NY, USA

Corresponding Author:

Jennifer E. Drake, Department of Psychology, Brooklyn College, City University of New York, 2900 Bedford Avenue, Brooklyn, NY 11210, United States.

Email: jdrake@brooklyn.cuny.edu

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In 2016, over 14 million adult coloring books were sold (Begley, 2017). At that time, adult coloring books were ubiquitous: displayed in store windows, featured in entire sections at the bookstore, and found in a variety of countries and languages. In addition to their prevalence, the selection of coloring books available was quite diverse. Coloring books could be found with abstract designs, animals, nature (e.g., the popular *Secret Garden* coloring book), TV shows (e.g., *Broad City*), and even those with profanity. Perhaps, adding to their popularity, these books were often marketed as a way to reduce stress and anxiety. But do coloring books actually lead to such benefits? Researchers have begun to test this question by comparing the benefits of coloring to drawing, with mixed results. We aimed to clarify the benefits of coloring by examining the psychological and psychophysiological benefits of coloring compared with two different kinds of drawing activities—drawing to distract and drawing to express.

Most of the research on coloring has examined the benefits of coloring a mandala—a circle made up of a complex abstract design—to other forms of coloring (a plaid design) or a free draw activity (where participants are given no instructions on what to draw; e.g., Curry & Kasser, 2005; Mantzios & Giannou, 2018; Van der Venet & Serice, 2012). In these studies, anxiety was measured using the self-report State Anxiety Inventory. One study showed that coloring, regardless of the design, reduced anxiety more than a free draw activity (Curry & Kasser, 2005). However, another study found that the design to be colored made a difference: Coloring a mandala resulted in a greater reduction in anxiety than both coloring a plaid design and a free draw activity (Van der Venet & Serice, 2012). The authors argue that there may be something inherently calming about the mandala's circular design that reduces anxiety. In fact, Babouchkina and Robbins (2015) showed that coloring a blank circle improved mood as measured by the Profile of Mood States more after a negative mood induction than coloring a blank square. This occurred even when participants were asked to use the shape to either express negative feelings or draw freely. As the shape was blank, this may be considered more of a drawing than a coloring activity. Still other researchers have found no difference in coloring and free drawing with both activities reducing anxiety (Mantzios & Giannou, 2018). However, in none of these studies can we know how participants were using the activity. It is unclear whether participants were using drawing as a way to express their negative thoughts and feelings or as a way to distract from their negative thoughts and feelings. Perhaps coloring is more anxiety reducing than drawing to express but not drawing to distract. That is what we set out to investigate.

A large body of research has already shown that drawing helps regulate sadness, at least in the short term, when used as a way to distract from negative

thoughts and feelings rather than express negative thoughts and feelings (e.g., Drake & Winner, 2012). For example, De Petrillo and Winner (2005) showed that drawing improved valence (ranging from participants' experience of pleasure to displeasure) as measured by the Affect Grid more than nondrawing activities such as copying shapes or completing a word puzzle. However, in their study, participants were not given instructions on what to draw and possibly could have used the drawing activity as a way to distract from or express their negative thoughts and feelings. Other work has shown that drawing improves mood more when used a way to distract rather than express. Dalebroux et al. (2008) showed that drawing something happy improved valence (as measured by the Affect Grid) more than drawing to express or a control condition (scanning a sheet for symbols). Subsequent work has demonstrated that the drawing content does not need to be positive in valence to improve mood: Drawing a neutral object improved both positive affect and negative affect (as measured by the Positive and Negative Affect Schedule) more than drawing to express after a sad mood induction (Drake & Winner, 2012) and painting a neutral object improved valence (as measured by the Affect Grid) after an anger mood induction (Diliberto-Macaluso & Stubblefield, 2015).

Like drawing to distract, coloring is a form of distraction where we can shift our attention away from our negative thoughts and feelings. However, previous work on coloring has consistently included a free draw condition. This is problematic for two reasons. First, it is unclear whether participants are using drawing to distract or drawing to express. More importantly, the free draw condition may elicit negative emotions in nonartists, who may be uncomfortable with the medium or who lack self-confidence in their drawing abilities, and thus struggle to draw. For example, nonartists may have difficulty expressing themselves through drawing because of a "poor command of the medium" (Betts & Groth-Marnat, 2014, p. 279). Second, in one study that did provide instructions on what to draw, participants were randomly assigned to draw happiness, draw to express, or trace and color a design (Smolarski et al., 2015). In this case, negative mood (as measured by the Profile of Mood States) improved the most in the draw happiness condition. As in the Dalebroux et al.'s (2008) study, it is unclear whether mood improved in the draw happiness condition because participants were thinking about something happy or drawing about something happy. In short, valence (positive) and emotion regulation strategy (distraction) were conflated.

We do know from the work by Forkosh and Drake (2017) that coloring and drawing to distract reap the same mood benefits for sadness. In this study, participants who had experienced a sad mood induction were instructed to color a mandala, draw a design, or draw to express thoughts and feelings. The coloring and draw a design conditions improved positive affect equally (as measured by the Positive and Negative Affect Schedule) and more so than the draw to express condition. However, negative affect improved equally across

all three conditions. Those in the coloring and draw a design conditions enjoyed the activity equally and more than those in the draw to express condition; however, those in the coloring condition reported greater immersion (or flow) in the activity than both the draw a design and draw to express conditions. Thus, coloring and draw a design (the drawing distract condition) yield similar mood benefits although coloring may result in a more immersive experience than drawing (probably because it forces attention to detail). The question remains whether coloring and drawing a design result in the same benefits for reducing anxiety.

Work on the benefits of coloring has focused on self-report measures of anxiety rather than psychophysiological indices. Work on the benefits of writing has demonstrated that writing about a stressful or upsetting event results in bodily responses that are similar to those in a relaxed state (Pennebaker & Chung, 2011). In addition, talking or thinking about a traumatic event compared with talking about or thinking about everyday events (a form of distraction) is associated with decreases in blood pressure and heart rate (Pennebaker et al., 1987). Activities that induce positive emotions (e.g., relaxation, imagery, engaging in an emotion regulation strategy; Butler et al., 2006; Houtveen et al., 2002; Ingjaldsson et al., 2003) are associated with increases in respiratory sinus arrhythmia (RSA). RSA is a physiological indicator of successful emotion regulation and measures activity of the parasympathetic nervous system (Butler et al., 2006). Recent work on the long-term benefits of drawing has shown that drawing to distract increases RSA activity more than drawing to express when regulating sadness over a 1-month period, but the benefits were not found after a single session of drawing (Drake, 2019). Finally, skin conductance has been shown to decrease when successfully regulating emotions. For example, talking about a highly personal and traumatic event leads to lower skin conductance levels than talking about everyday events (Pennebaker et al., 1987).

Current Study

In the study reported here, we compared the psychological and psychophysiological benefits of coloring to drawing in reducing anxiety. We extended previous research in several ways. First, previous research has focused on the benefits of drawing to distract to regulate sadness, an emotion negative in valence and low in arousal. This study examined whether the benefits of drawing to distract also extend to emotions that differ in arousal such as anxiety—also negative in valence but high in arousal. Second, we provided participants with instructions on what to draw, allowing us to compare the benefits of drawing to distract versus drawing to express in reducing anxiety. Third, we included a draw to distract condition that was neutral in valence, allowing us to determine whether the benefits of drawing to distract are due to shifting attention away from negative thoughts and feelings and not due to drawing positive content (as in Smolarski et al., 2015). Finally, we

compared the psychophysiological effects (heart rate, RSA, and skin conductance) of coloring versus drawing in reducing anxiety. To our knowledge, the psychophysiological effects of coloring have not yet been examined. Many diagnoses in the DSM-V include psychophysiological components in addition to psychological symptoms. For example, the DSM-V lists a variety of symptoms used to classify a panic attack such as palpitations, sweating, and shortness of breath, among others. Similar criteria are used when diagnosing panic disorder and criteria for Generalized Anxiety Disorder includes muscle tension. As we may have a psychological and psychophysiological reaction to anxiety, it is important to examine both these outcomes to determine how drawing may be used to regulate anxiety and can be used as a part of art therapy programs for psychiatric patients to help reduce both components of their illness.

Consistent with previous research (Forkosh & Drake, 2017), we hypothesized that coloring and drawing a design should reduce anxiety more than drawing to express. We hypothesized that the main ingredient in reducing anxiety would be distraction and therefore expected no difference between the color and draw a design conditions. Also consistent with previous research (Forkosh & Drake, 2017), we hypothesized that participants in the color and draw a design conditions would report more enjoyment and those in the color condition would experience more flow than both drawing conditions. Based on previous research showing that activities that induce positive emotions effect psychophysiological indices particularly RSA (Butler et al., 2006; Houtveen et al., 2002; Ingjaldsson et al., 2003), we hypothesized that the color and draw a design conditions should improve psychophysiological indices more than the draw to express condition.

Method

Participants

Participants were 60 undergraduates (40 females and 20 males) ranging in age from 18 to 51 years ($M=20.6$; standard deviation [SD]=5.0) who were recruited and received research credit as part of a course requirement. The sample was 30.0% Caucasian, 25.0% Asian, 21.7% Hispanic or Latino, 13.3% African American, 6.7% Other, and 3.3% Biracial. Two participants (3.3%) identified themselves as art majors, and the majority of participants (75.0%) had not taken any formal visual arts lessons ($M=0.7$ years; $SD=1.8$). The study was approved by the college's institutional review board, and all participants provided written informed consent.

Measures

Anxiety Induction. To induce anxiety, we asked participants to think of the most fearful event that had ever happened to them (as in Curry & Kasser, 2005; Van

der Vennet & Serice, 2012). We asked participants to think about what happened and how they felt during and after the experience. We then provided participants with a sheet of lined paper and a pen and asked them to write about the experience for 4 min. After thinking about the event, participants were asked if they wanted to continue with the study.

Activity. Participants were randomly assigned to one of the three conditions: color, draw a design, or draw to express. There were no gender differences across conditions ($\chi^2 = 0.051$, $p = 1.0$). All participants were given a set of colored pencils. Participants in the draw a design and draw to express conditions were given a 9" × 11" sheet of blank paper, and participants in the color condition were given a mandala design on a 9" × 11" sheet of paper. Those in the color condition were instructed as follows: "You will have 15 minutes to color in as much of the design as the time allows using these colored pencils. You will use the full 15 minutes to color." Those in the draw a design condition were instructed as follows:

You will have 15 minutes to draw a design on this piece of paper with these colored pencils. This design has to be non-representational. It will be made up of lines, shapes, and colors. No people, places, or things. You will use the full 15 minutes to draw.

Those in the draw to express condition were instructed as follows: "You will have 15 minutes to use these colored pencils to draw about the fearful event that you have just written about. You will use the full 15 minutes to draw." Four participants failed to follow instructions and therefore were removed from subsequent analyses. This included three participants in the draw a design condition who did not draw a design and one participant in the draw to express condition who did not draw for the complete 15 min. Thus, the final sample consisted of 56 participants.¹ Figure 1 presents images from the three conditions.

State Trait Anxiety Inventory. To measure anxiety, we asked participants to complete the State Trait Anxiety Inventory (STAI; Spielberger et al., 1970). The STAI contains a list of 20 statements that people use to describe themselves (e.g., "I feel nervous," "I feel content," "I feel calm"). The scale assesses both state anxiety and trait anxiety (Spielberger et al., 1983). State anxiety is a temporary emotion that combines with physiological arousal and conscious feelings of apprehension, dread, and tension, whereas trait anxiety is an individual's predisposition to respond to stimuli in an anxious manner (Spielberger, 1966). The state scale was administered to examine temporary changes in anxiety after engaging in the activity. Participants were asked to indicate the extent to which they agreed with each statement in the moment on a 4-point scale with 1 being *not at all* and 4 being *very much so*. Participants completed the STAI



Figure 1. Examples From the Color (Top Left), Draw a Design (Top Right), and Draw to Express (Bottom) Conditions.

before (Time 1) and after the anxiety induction (Time 2) and after drawing (Time 3). Ten of the items were reverse-coded, and all the items were summed to create a total anxiety score. Cronbach's α for this measure was as follows: Time 1, $\alpha = .89$; Time 2, $\alpha = .95$; and Time 3, $\alpha = .95$.

Flow State Scale. To measure the level of flow participants experienced during the activity, we administered the Flow State Scale (Jackson & Marsh, 1996).

Participants were presented with 36 statements (e.g., “I was not concerned with what others may have been thinking of me”) and were asked to indicate how they experienced each of the statements during the activity on a 5-point scale with 1 being *never* and 5 being *always*. Cronbach’s α for the overall flow score was $\alpha = .84$.

Enjoyment. Participants were asked to rate how much they enjoyed the activity on a 5-point scale with 1 being *did not really enjoy* and 5 being *really enjoyed* (as in Forkosh & Drake, 2017).

Psychophysiological Measures. Heart rate, RSA, and skin conductance were collected using the BIOPAC hardware (Goleta, CA) and analyzed using AcqKnowledge 4.2 software. These measurements were taken for participants in all three conditions at the beginning of the study for 2 min (Time 1), during the anxiety induction for 4 min (Time 2), and after drawing for 2 min (Time 3).

Heart Rate. Heart rate was continuously recorded from a three-lead electrocardiogram. The experimenter applied two disposable electrodes to the participant’s skin—one below the right collarbone and the other above the left hip. After inspecting the electrocardiogram for signal artifacts, we converted the signal to R-R intervals using the AcqKnowledge automated modified Pan-Tompkins QRS detector. Heart rate was measured in beats per minute based on the average of interbeat intervals.

Respiratory Sinus Arrhythmia. RSA measures variation in heart rate during the breathing cycle. To assess RSA, we placed a respiration belt around the participant’s chest and abdomen. RSA was derived using the peak-valley method (Grossman et al., 1990) and measured in milliseconds as the difference between the minimum and the maximum R-R intervals during respiration. The RSA variables were found to positively skewed with significant skewness and kurtosis ($p < .001$). To reduce skewness and prevent potential outliers, a log transformation was performed on all RSA variables.

Skin Conductance. The experimenter placed two prejelled disposable electrodes on the index finger and the middle finger of the participants’ nondominant hand. Leads were attached to the electrodes, and a strap was then placed around the participant’s wrists to secure the leads. The skin conductance variables were found to positively skewed with significant skewness and kurtosis ($p < .001$). To reduce skewness and prevent potential outliers, a log transformation was performed on all skin conductance variables.

Procedure

Participants were tested individually in a private room. Participants were instructed to sit quietly for 2 min, while the psychophysiological indices were collected (Time 1). Next, they completed the STAI (Time 1) and then they were asked to recall the most fearful event that they had ever experienced and to record it on a sheet of paper. Psychophysiological indices were again measured during the anxiety induction and afterward participants completed the STAI (Time 2). Participants were randomly assigned to one of the three conditions: color, draw a design, or draw to express. After engaging in their assigned activity for 15 min, participants completed the STAI (Time 3), Flow State Scale, and enjoyment question. Finally, they were instructed to sit quietly for 2 min, while the psychophysiological indices were again collected (Time 3). At the study's conclusion, the experimenter provided participants with a debriefing form with contact information for the principal investigator and the college counseling service.

Results

Effect of Condition on Decreasing Anxiety

Table 1 presents the means and *SDs* for STAI at Time 1, Time 2, and Time 3 by condition. To compare the effectiveness of the conditions in decreasing anxiety, a mixed-design analysis of variance (ANOVA) was performed with time as the repeated measures (3) and condition as the between subjects factor (3). There was an effect of time, $F(2, 106) = 58.98, p < .001, \eta_p^2 = .527$. Paired samples *t* tests showed that anxiety increased from Time 1 to Time 2, $t(55) = 8.503, p < .001, d = 1.13$, and anxiety decreased from Time 2 to Time 3, $t(55) = -8.6, p < .001, d = -1.14$. Thus, the anxiety induction was effective in increasing anxiety, and the activity was effective in decreasing anxiety. There was an effect of condition, $F(2, 53) = 3.872, p = .027, \eta_p^2 = .127$: Overall, those in the draw a design condition experienced less anxiety than those in the draw to express condition ($p = .003$, 95% confidence interval [CI] = $[-15.5, -2.5]$).

More importantly, there was an interaction between time and condition, $F(4, 106) = 2.870, p = .027, \eta_p^2 = .098$ (Figure 2). First, to determine whether the conditions were similar in anxiety before and after the anxiety induction, we ran a multivariate ANOVA by condition on Time 1 and Time 2 anxiety. Before the anxiety induction (Time 1), there was no effect of condition, $F(2, 57) = 1.023, p = .366, \eta_p^2 = .035$. However, after the anxiety induction (Time 2), there was an effect of condition, $F(2, 57) = 3.488, p = .037, \eta_p^2 = .109$. Bonferroni post hoc tests showed that the draw to express condition experienced more anxiety after the anxiety induction than the draw a design condition ($p = .045$, 95% CI $[0.2, 20.1]$). There were no differences in Time 2 anxiety between the color

Table 1. Means and SDs for the State Trait Anxiety Inventory at Time 1, Time 2, and Time 3 by Condition.

	<i>n</i>	Time 1		Time 2		Time 3	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Color	21	34.0	8.7	43.3	12.3	31.4	10.2
Draw a design	17	31.4	6.7	44.2	10.5	27.6	5.4
Draw to express	18	34.1	9.2	51.3	13.7	39.9	12.0

Note. SD = standard deviation.

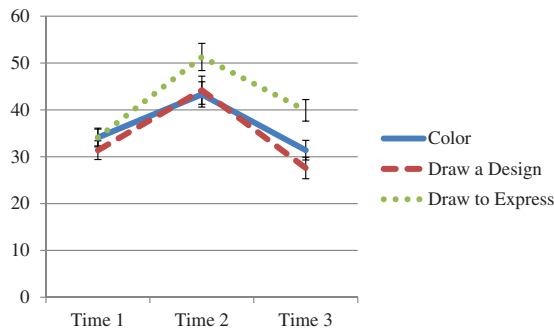


Figure 2. Means on the State Trait Anxiety Inventory at Time 1, Time 2, and Time 3 by Condition. Error bars represent standard errors.

and draw to express ($p = .149$, 95% CI $[-17.8, 1.8]$) and color and draw a design ($p = 1.0$, 95% CI $[-7.6, 11.8]$) conditions.

To determine whether the reduction in anxiety differed by condition, we ran a paired sample t test comparing anxiety before (Time 2) to after (Time 3) the activity separately by each condition and used a Bonferroni adjusted significance level of .017 ($\alpha = .05/3$ tests = .017 due to running three post hoc tests). We found that all three conditions resulted in a decrease in anxiety: Anxiety decreased from before to after the activity in the draw a design, $t(16) = -7.179$, $p < .001$, $d = -0.95$, color, $t(20) = -4.474$, $p < .001$, $d = -1.69$, and draw to express conditions, $t(17) = -3.988$, $p = .001$, $d = -0.91$.

Effect of Condition on Overall Flow and Enjoyment

Table 2 presents the means and SDs for enjoyment and overall flow by condition. To determine how enjoyment and overall flow differed by condition, an univariate ANOVA by condition was performed separately for

Table 2. Means and SDs for Enjoyment and Overall Flow by Condition.

	Enjoyment		Overall flow	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Color	4.0	0.8	33.3	4.7
Draw a design	4.5	0.6	34.1	6.6
Draw to express	3.8	1.0	31.4	5.6

Note. The highest possible score for enjoyment is 5.0 and for overall flow is 45.0. *SD* = standard deviation.

enjoyment and overall flow. There was an effect by condition for enjoyment, $F(2, 53) = 3.695$, $p = .031$, $\eta_p^2 = .122$. Bonferroni post hoc tests revealed that the draw a design condition enjoyed the activity more than the draw to express conditions ($p = .032$, 95% CI [0.1, 1.5]), but there were no differences in enjoyment between the color and draw to express conditions ($p = 1.0$, 95% CI [-0.4, 0.9]) and color and draw a design conditions ($p = .176$, 95% CI [-1.2, 0.2]). There was no effect by condition for overall flow,² $F(2, 52) = 1.079$, $p = .347$, $\eta_p^2 = .040$.

Psychophysiological Benefits of Drawing

Table 3 presents the means and *SDs* for heart rate, RSA, and skin conductance at Time 1, Time 2, and Time 3 by condition.

Effect of Condition on Decreasing Heart Rate. To compare the effectiveness of the conditions in decreasing heart rate, a mixed-design ANOVA was performed with time as the repeated measure (3) and condition as the between subjects factor (3). There was an effect of time, $F(2, 106) = 9.857$, $p < .001$, $\eta_p^2 = .157$. A paired samples *t* test showed that heart rate did not increase significantly from Time 1 to Time 2, $t(55) = 1.193$, $p = .238$, $d = 0.16$, but did decrease significantly from Time 2 to Time 3, $t(55) = -5.053$, $p < .001$, $d = -0.67$. There was no effect of condition, $F(2, 53) = 0.783$, $p = .462$, $\eta_p^2 = .029$, and no interaction between time and condition, $F(4, 106) = 0.617$, $p = .651$, $\eta_p^2 = .023$.

Effect of Condition on Increasing RSA. To compare the effectiveness of the conditions in increasing RSA, a mixed-design ANOVA was performed with time as the repeated measure (3) and condition as the between subjects factor (3). There was an effect of time, $F(2, 106) = 29.62$, $p < .001$, $\eta_p^2 = .358$. Paired samples *t* tests showed that RSA decreased from Time 1 to Time 2, $t(55) = -3.939$, $p < .001$, $d = -0.52$, and that RSA increased from Time 2 to Time 3, $t(55) = 7.503$, $p < .001$, $d = 0.99$. There was no effect of condition,

Table 3. Means and SDs for Heart Rate, RSA, and Skin Conductance at Time 1, Time 2, and Time 3 by Condition.

	Time 1		Time 2		Time 3	
	M	SD	M	SD	M	SD
Heart rate						
Color	88.8	11.2	90.5	10.1	87.4	10.2
Draw a design	95.1	20.2	95.0	15.8	92.0	15.4
Draw to express	92.8	12.1	94.5	13.6	89.0	11.1
Overall	92.0	14.7	93.1	13.1	89.3	12.2
RSA						
Color	70.3	37.6	56.5	33.4	91.0	47.7
Draw a design	76.4	39.6	71.1	67.4	106.1	67.3
Draw to express	82.7	51.3	60.9	33.5	84.3	40.0
Overall	76.1	42.6	62.4	46.0	93.4	52.1
Skin conductance						
Color	1.6	1.3	2.6	2.1	4.6	3.1
Draw a design	1.4	1.3	2.8	3.1	4.0	2.7
Draw to express	1.6	1.4	2.7	2.1	5.2	2.9
Overall	1.5	1.3	2.7	2.4	4.6	2.9

Note. Values presented for RSA and skin conductance are untransformed. As no differences were found by condition, we have included the overall scores for each psychophysiological measure by time. Does coloring reduce anxiety? Comparing the psychological and psychophysiological benefits of coloring versus drawing. RSA = respiratory sinus arrhythmia; SD = standard deviation.

$F(2, 53) = 0.139$, $p = .871$, $\eta_p^2 = .005$, and no interaction between time and condition, $F(4, 106) = 0.536$, $p = .710$, $\eta_p^2 = .020$.

Effect of Condition on Decreasing Skin Conductance. To compare the effectiveness of the conditions in decreasing skin conductance, a mixed-design ANOVA was performed with time as the repeated measure (3) and condition as the between subjects factor (3). There was an effect of time, $F(2, 106) = 47.54$, $p < .001$, $\eta_p^2 = .473$. Paired samples t tests showed that skin conductance increased from Time 1 to Time 2, $t(55) = 6.410$, $p < .001$, $d = 0.85$, and skin conductance increased from Time 2 to Time 3, $t(55) = 4.784$, $p < .001$, $d = 0.63$. There was no effect of condition, $F(2, 53) = 0.347$, $p = .709$, $\eta_p^2 = .013$, and no interaction between time and condition, $F(4, 106) = 0.469$, $p = .759$, $\eta_p^2 = .017$.

Discussion

This study sought to compare the benefits of coloring and drawing in reducing anxiety and to examine whether the psychological and psychophysiological

benefits of engaging in the graphic arts differed depending on whether the activities were used as a means of distraction (coloring or draw a design) or expression. After an anxiety induction, we randomly assigned participants to a color, draw a design, or draw to express condition. Anxiety was measured before and after the anxiety induction and after the activity. Psychophysiological responses (heart rate, RSA, and skin conductance) were measured at approximately the same time points as the anxiety measure. We hypothesized that distraction would be key for reducing anxiety, and therefore both distraction conditions (color and draw a design) would reduce anxiety and improve psychophysiological measures more than the draw to express condition. Our hypotheses were not supported.

Contrary to our hypothesis, we did not find that the color and draw a design conditions reduced anxiety more than the draw to express condition. We found that all three conditions resulted in a decrease in anxiety. Our results add to the mixed findings in the coloring-mood literature. Whereas previous researchers have compared the benefits of coloring and drawing, they have done so without providing instructions on what to draw. It therefore remained unclear whether participants were using drawing as a way to express their negative thoughts and feelings or as a way to distract by shifting their attention away from negative thoughts and feelings. Work on the emotion regulation benefits of drawing for reducing sadness has shown that drawing has a more positive immediate effect on mood when used to distract rather than express (e.g., Diliberto-Macaluso & Stubblefield, 2015; Drake & Winner, 2012; Pizarro, 2004). However, our work demonstrates that in the case of reducing anxiety, the content of the drawing activity does not need to be distracting in order to be beneficial: Participants can draw as a means of distraction or expression and have a reduction in anxiety that is similar to coloring a design. Coloring researchers have argued that there is something inherently calming in coloring a mandala (Van der Venet & Serice, 2012). Citing its meditative properties, researchers argue that the mandala's symmetrical form and repeated pattern allow participants to feel calm resulting in reduced feelings of anxiety (Curry & Kasser, 2005). Further support of the calming effects of the circular design is provided by work that has shown that coloring a circle reduces anxiety more than coloring a square (Babouchkina & Robbins, 2015). In our study, we asked participants to color a mandala design or draw a design of their own choosing. Further inspection of the designs revealed that very few participants drew a circular design. Thus, we do not know whether drawing a mandala shape would be more beneficial than coloring one. Drawing a design might be considered more active and involve more imagination as participants have to plan out what to draw. Future research should examine whether the benefits of coloring and drawing a design would differ if participants were given specific instructions on what type of design to draw and whether drawing a mandala reduces anxiety more than coloring one.

Recent research on the benefits of drawing and coloring in reducing sadness (Forkosh & Drake, 2017) found that all three drawing activities (color a design, draw a design, and draw to express) decreased negative affect but that only the two distracting activities (color a design and draw a design) improved positive affect. This study focused on reducing anxiety and therefore focused on improvements in negative affect. It would be interesting to compare whether there would be differences in positive affect across the three drawing conditions after an anxiety induction. Perhaps anxiety is reduced regardless of the drawing activity but that only distracting graphic activities result in increases in positive affect. Future research is warranted on this topic.

Contrary to our hypothesis, we did not find any differences across conditions for the psychophysiological indicators of anxiety. All three activities increased RSA (an indicator of successful emotion regulation). As we did not find any differences in RSA reactivity across conditions, it is unclear whether the increase in RSA was due to engaging in an arts activity or the passage of time. Research has shown that engaging in activities that induce positive emotions are associated with increases in RSA. Studies on the benefits of drawing to regulate sadness have shown that coloring and drawing a design are associated with increases in positive emotion, and therefore it seems plausible that coloring and drawing a design to regulate anxiety would also increase positive emotion. However, we did not measure increases in positive emotion in this study. Future research should examine whether coloring and drawing a design increase RSA more than nondrawing activities and whether these two activities are associated with increases in positive emotions when regulating anxiety.

We also found, contrary to our hypothesis, that skin conductance increased (instead of decreased), for all of the activities. This finding is in contrast to the expressive writing literature, which has shown that expressive writing is associated with decreases in skin conductance. It is possible that this contrast is due to the differences in the duration of our study and the expressive writing literature. Pennebaker (Pennebaker & Chung, 2011) found that initially writing about a stressful event is painful (as indicated by increases in negative mood and increases in heart rate and skin conductance reactivity) but beneficial over several writing sessions (as indicated by declining slopes in negative mood from the first to final testing session). In fact, the expressive writing literature has reported that greater physiological reactivity (as evidenced by increases in heart rate and skin conductance) at the initial testing session for those in the expressive writing condition is associated with reduced depression and physical illness symptoms 1-month later (Sloan et al., 2007). It is possible that the benefits of drawing and coloring may follow a similar pattern: Drawing and coloring may increase skin conductance initially but lead to better psychological outcomes over time.

We did not find that heart rate increased from before to after the anxiety induction. This might indicate that the anxiety induction was unsuccessful in inducing anxiety. However, self-report measures of perceived anxiety did reveal

that participants' anxiety increased after thinking about and writing a brief description of their most fearful event. It is possible that the anxiety induction did not elicit the amount or type of anxiety that would manifest itself physically. Thinking about a fearful event (while used in previous coloring book studies) may have not had induced the same anxiety as giving a speech (Muthard & Gilbertson, 2016) or taking a difficult test (Park et al., 2014). Future research should continue to examine whether varying the anxiety induction has an impact on psychophysiological indicators of anxiety and how different activities (i.e., drawing and coloring) help with recovery. We did find that all three activities decreased heart rate from before to after the activity. Similar to the RSA findings, it is unclear whether this decrease was due to engaging in the activity or the passage of time.

Finally, we hypothesized that the color and draw a design conditions would result in greater enjoyment and states of flow than draw to express condition. Partial support was found for this hypothesis. We did find that those in the draw a design condition enjoyed the activity more than those in the draw to express condition. However, those in the coloring condition did not experience more enjoyment than the draw to express condition, and there were no difference in levels of enjoyment between the coloring and draw a design conditions. Contrary to our hypothesis, we found no differences in flow (a measure of immersion) across conditions. Despite the fact that the mandala is theorized (and advertised) as having meditative properties, this activity did not result in greater states of flow. As theorized by Csikszentmihalyi, flow occurs when a person is deeply absorbed in an activity and can pursue goals freely (Csikszentmihalyi & Csikszentmihalyi, 2000). Contrary to previous research (Forkosh & Drake, 2017), we did not find that coloring resulted in greater states of flow. However, it has been suggested that what participants experienced in the Forkosh and Drake study, was a type of "microflow" or "flow hack" (Roston, 2016). Flow is described as a balance between challenge and skill. Activities that are too easy lead to boredom, those that are too difficult lead to anxiety, but when a balance between challenge and skill occurs, we experience flow (Csikszentmihalyi, 2000; Csikszentmihalyi & Csikszentmihalyi, 2000). As coloring is an activity that anyone can do, it may not necessarily elicit a balance between challenge and skill. It is possible that those participants in the Forkosh and Drake study might have been experiencing a simulation of flow while in a relaxed state (Roston, 2016).

A limitation of this study is that after the anxiety induction, anxiety levels differed across conditions: Those in the draw to express condition experienced more anxiety than those in the draw a design and color conditions. It is unclear how this difference may have impacted the results. Future research is needed to replicate this study with conditions that have a similar experience during the anxiety induction.

Taken together, this study adds to the previous literature on the benefits of drawing to regulate sadness and anger and demonstrates that drawing can also

be used to regulate anxiety. However, we did not find differences in the benefits of drawing across activities: All three drawing activities resulted in a decrease in anxiety. Drawing a design resulted in more enjoyment than drawing to express, but there were no difference in flow across conditions. Finally, we found that all three activities had an impact on our bodily response to stress as indicated by decreases in heart rate and increases in RSA. Further research is needed to examine whether the benefits of drawing (distract vs. express) and coloring have a different effect on reducing anxiety in the long term.

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ORCID iD

Jennifer E. Drake  <https://orcid.org/0000-0001-7494-3624>

Notes

1. Removal of these participants resulted in the conditions being unequal with 21 in the color condition, 17 in the draw a design condition, and 18 in the draw to express condition.
2. One participant failed to complete all questions on the Flow State Scale and thus an overall flow score could not be calculated for this participant.

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Author Biographies

Nicole Turturro is a medical student at Albert Einstein College of Medicine. She conducted this study while an honor thesis student at Brooklyn College, City University of New York.

Jennifer E. Drake is an assistant professor in the Psychology Department at Brooklyn College, City University of New York.