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Inhale, Exhale, Draw: A Guided Drawing and Mindfulness Intervention for Anxiety Reduction

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Anxiety is among the most common emotional difficulties impacting well-being, highlighting the need for approachable anxiety-reduction tools. Both mindfulness- and art-based interventions have been shown to decrease anxiety symptoms. The current studies integrate these approaches via a novel guided drawing intervention. In Study 1, we tested feasibility using a single group design ($n = 54$). Study 2 was a randomized controlled trial consisting of an analyzed sample of 156 participants assigned to groups using a single-blind design (guided drawing: $n = 55$; free drawing control: $n = 51$; basic control: $n = 50$). Outcome measures for both studies were anxiety (pre/postdrawing and at 1-week follow-up) and physiological regulation (respiratory sinus arrhythmia). Study 1 results showed that guided drawing significantly decreased state anxiety and anxiety symptoms 1 week later, as well as increased physiological regulation across the drawing session. Those reporting emotion regulation difficulties at baseline showed greater anxiety reductions. In Study 2, the guided drawing group emerged as distinct from controls regarding state anxiety and physiological changes. In both studies, the degree of anxiety reduction during guided drawing was associated with greater improvements 1 week later. Findings suggest that guided drawing is a promising avenue for anxiety management.

Keywords: mindfulness, drawing, anxiety, emotion regulation, respiratory sinus arrhythmia

Supplemental materials: https://doi.org/10.1037/aca0000838.supp

Anxiety symptoms commonly emerge by early adulthood, but research suggests that only about 25% of those who experience symptoms seek treatment (Roness et al., 2005). Factors associated with low treatment seeking include difficulty disclosing symptoms to medical professionals, inadequate access to affordable care, and societal sigma associated with formal treatment (e.g., Mechanic, 2007). These trends highlight the need for approachable, effective, and accessible anxiety-reducing interventions (e.g., Kazdin & Rabbitt, 2013; Rotheram-Borus et al., 2012). Research has established the psychological benefits of mindfulness (Enkema et al., 2020; Keng et al., 2011) and drawing-based interventions (Carsley & Heath, 2018; Drake et al., 2016). Emotion regulation (ER) is a core capacity that promotes positive psychological adjustment (Aldao et al., 2015; Compas et al., 2017; Zeman et al., 2006), and difficulties with ER have been consistently linked with elevated anxiety (Amstadter, 2008; Dryman & Heimberg, 2018). Furthermore, ER has been implicated as a mechanism by which art-based and mindfulness-based interventions (MBIs) can provide psychological benefits (e.g., Gratz & Tull, 2010; James et al., 2018). Using drawing as a delivery tool infused with mindfulness elements, the current studies propose and examine an approachable avenue to reduce anxiety through a novel guided drawing intervention.

Mindfulness to Reduce Anxiety

Mindfulness, the intentional practice of nonjudgmental attention and awareness in the present moment (Kabat-Zinn, 2003), has been gaining traction in mental health and research fields for nearly 2 decades. Trait mindfulness, the general tendency to be aware and attentive in daily life experiences (Keng et al., 2011), has been shown to increase after MBIs, resulting in benefits to psychological well-being (Gu et al., 2015). In addition, previous research shows that MBIs reduce symptoms of anxiety (Shapiro et al., 1998) and depression (Anderson et al., 2007) and improve affect (Bränström et al., 2010) across both clinical and nonclinical populations (Creswell, 2017; review). A core principle of MBIs is that mindfulness facilitates the ability to nonjudgmentally observe

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thoughts and feelings, particularly in stressful situations, which contribute to ER improvements, equipping the individual to better manage their stress response and anxiety (Desrosiers et al., 2013; Gratz & Tull, 2010; Malinowski, 2008). The dual-mode model of mindful ER (Raugh & Strauss, 2024) suggests that mindfulness experiences can shape ER by improving one's ability to deploy attention and change cognitive processes when encountering unpleasant emotions. Supporting this, mindfulness has been shown to improve aspects of ER, including cognitive flexibility (Moore & Malinowski, 2009; Shapiro et al., 2006), metacognitive insight (Bishop, 2004), coping self-efficacy (Luberto et al., 2014), and attentional control (e.g., Moore & Malinowski, 2009), as well as to reduce the use of less effective ER strategies, including worry and rumination (e.g., Desrosiers et al., 2013; Deyo et al., 2009).

However, despite their benefits, many experience barriers to building a regular mindfulness habit. Difficulty initiating and maintaining engagement during sessions and over time, in part due to the abstract and effortful nature of meditation (e.g., Lymeus et al., 2019), may result in low mindfulness engagement and attenuated benefits. Moreover, occupation with negative thoughts during mindfulness practice may increase distress and lead to negative reinforcement (Bishop, 2002). Self-reported difficulties include finding time or struggling to engage, having the available resources (apps, books, etc.), and feeling the need to "get it right" (Allen et al., 2009; Birtwell et al., 2019; Hindman et al., 2015; Martinez et al., 2015). Therefore, there is a significant need for accessible mindfulness-based exercises that may be more approachable for some in the pursuit of alleviating anxiety.

Drawing-Based Interventions

Art-based interventions are accessible tools that include creative activities, such as mandala drawing, coloring, expressive writing, and music, and have been shown to have positive impacts on both psychological and physiological markers of stress and anxiety (e.g., Bell & Robbins, 2007; Girija Kaimal et al., 2016; Pennebaker, 1997). Drawing, in particular, presents accessibility advantages such that materials are easily available (i.e., pencil and paper) and is approachable for those with varying prior experience, language abilities, and across developmental periods. Drawing-based interventions have been investigated as tools to communicate/express emotions and thoughts or to distract from emotions and thoughts (e.g., Altay et al., 2017; James et al., 2018; Turturro & Drake, 2022), both of which are ER processes related to mental health, including anxiety (e.g., Hu et al., 2014; Lincoln et al., 2022). Thus, drawing may provide opportunities to practice emotion modulation and strengthen the associated regulatory physiological processes.

When used as an avenue for expression, drawing-based interventions provide a means for processing internal emotions and experiences. As a distraction tool, art-based interventions can assist in shifting attention away from negative emotions through focusing on a more engaging activity. Previous research suggests that using art-based interventions both as an expression and as a distraction improves affective state (Altay et al., 2017; James et al., 2018; Turturro & Drake, 2022). However, when used as a distraction tool, affect is improved more than when used as an expression tool (e.g., Dalebroux et al., 2008; Drake et al., 2016) and is enjoyed more by participants (Turturro & Drake, 2022). One possible explanation for this pattern is that affect management approaches that emphasize creative expression may be less approachable for individuals who do not consider themselves artistic. This suggests that providing a designated object to draw, providing guidance throughout the drawing experience, and emphasizing nonjudgement regarding the outcome of the drawing itself may bolster the approachability of drawing-based interventions for a wider audience.

Furthermore, drawing-based interventions can address psychological difficulties by providing individuals with a way of connecting to the self and their immediate environment. In particular, Frederick Franck, a Dutch-born artist and scientist, spent years developing a method he termed Seeing/Drawing, "as a way of meditation, a way of getting into intimate touch with the visible world around us, and through it, with ourselves" (Franck, 1973). Thus, the notion that using drawing as an avenue to engage with meditation is not new but has yet to be rigorously tested in a formal intervention context.

ER as a Shared Mechanism for Mindfulness and Drawing Interventions

Given that ER has been implicated as a potential mechanism of change for both mindfulness- and art-based interventions, the combination of these experiences may enhance this regulatory benefit. ER includes behavioral, biological/physiological, cognitive, and subjective processes that we use to manage the experience and expression of emotions (Aldao et al., 2015; Bonanno & Burton, 2013; Gross, 2014). ER is a cornerstone of mental health (e.g., Hu et al., 2014), with decades of research illuminating the critical role of ER in anxiety (e.g., Cisler et al., 2010). In addition, previous studies suggest that maturation of brain regions related to ER extends into early adulthood (e.g., Paus et al., 2008; Veroude et al., 2013), highlighting the importance of continued development of ER processes throughout this period.

ER has been investigated as a key mechanism through which mindfulness confers benefits for well-being (e.g., Desrosiers et al., 2013; Guendelman et al., 2017; Grecucci et al., 2015). Mindfulness has been linked to regulatory processes, including greater emotional acceptance (e.g., Hayes et al., 1999), reduced experiential avoidance (Roemer & Orsillo, 2007), and reduced reactivity to thoughts (e.g., Bernstein et al., 2015). Furthermore, according to the embodied ER framework (Guendelman et al., 2017), mindfulness engages ER strategies by leveraging both top-down (e.g., thought processes and cognitive control) and bottom-up (e.g., interoceptive and sensory) elements. Similarly, drawing-based interventions have been shown to engage regulatory processes and improve emotional state (e.g., Brechet et al., 2022; Yan et al., 2021). When engaged in drawing activities, distraction from negative emotions is useful in coping with the present emotions and improvement in mood (Dalebroux et al., 2008; Drake et al., 2016; Turturro & Drake, 2022). However, much of the literature on ER strategies used in drawing interventions has solely focused on distraction and expression. Emerging findings suggest that art-based interventions also target acceptance, an important ER strategy that encourages nonjudgmental embracing of emotion, through the intervention's emphasis on the art process rather than its product (Ford et al., 2018; Lee & Choi, 2023). Thus, both mindfulness and drawing engage overlapping

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ER processes, potentially making them complementary tools for reducing anxiety through shared regulatory pathways.

Mindfulness- and art-based interventions have been shown to engage the biological underpinnings of ER, including both neural (e.g., fronto–limbic circuitry; Barnett and Vasiu, 2024; Nakamura et al., 2021; Tang et al., 2015) and peripheral (Bellaiche et al., 2025; Bourne et al., 2019) systems. Peripheral physiology (e.g., activity of the parasympathetic nervous system) provides the advantage of free movement during the assessment of biological aspects of ER *during* intervention engagement. Respiratory sinus arrhythmia (RSA) is a type of heart rate variability aligned with cyclic increases and decreases in heart rate across the respiratory cycle. RSA is an index of parasympathetic nervous system engagement, which maintains homeostasis and returns the body to a state of relaxation and rest after a challenge. As RSA reflects the ability to regulate physiological responses to emotional stimuli, it is a well-established marker of ER (e.g., Porges, 2007). Higher baseline RSA is associated with stronger ER abilities (e.g., Porges, 2007), suggesting that those with higher RSA are more prepared to manage stress and balance emotions. In addition, RSA reactivity, or the change in RSA from baseline to task, reflects physiological coping in response to the stimulus and may provide more valuable information about the effects of mindfulness activities. RSA withdrawal indicates a reduction in parasympathetic nervous system ("rest and digest") activity in response to the situation, whereas RSA augmentation indicates an increase in parasympathetic nervous system activity in response to the situation. RSA augmentation during mindfulness and/or drawing experiences would thus reflect greater physiological regulation during the periods of rest and safety. Enhanced physiological regulation (e.g., RSA augmentation) has been observed in mindfulness meditation interventions (e.g., Nesvold et al., 2012; Price et al., 2019; Reid et al., 2019) and in art-based interventions (i.e., music therapy; e.g., Mangiacotti et al., 2024), although no studies, to our knowledge, have used RSA to investigate physiological regulation during combined drawing and mindfulness experiences. As individuals learn to regulate emotions better, they also learn to modulate their physiological responses to emotions, which is reflected in greater parasympathetic nervous system activity. Thus, RSA can provide insight into how drawing and mindfulness relate to the physiological component of ER and the degree to which RSA augmentation corresponds to reduced anxiety.

The Current Studies

Due to established links among ER, anxiety, mindfulness, and drawing, the current studies test a novel mindfulness-based drawing intervention by examining impacts on anxiety symptoms and the role of physiological regulation in potential anxiety change. Study 1 aims to test the feasibility of the guided-drawing intervention with mindfulness elements to alter physiological regulation, state anxiety, and anxiety symptoms 1 week later. Study 2 aims to examine these questions in a randomized controlled trial, with comparison of outcomes across the active guided drawing group versus controls. Through addressing these gaps, this research aims to provide insights into the effectiveness of integrating mindfulness and creative engagement for anxiety management. This integration leverages mechanisms of change identified in research on MBIs (i.e., ER processes) applied to the drawing context, which has also been shown to enhance well-being through the regulation of attentional (e.g., distraction) and affective (e.g., expression) processes. The drawing experience is also tangible by delineating a specific task involving focused, intentional movement and attunement to a natural object. Thus, the mindfulness and drawing elements share the potential mechanism of change of ER, and drawing adds an opportunity for creative engagement and increased approachability through grounding to the task at hand.

Study 1

Study 1 explores a novel intervention combining drawing and mindfulness to address anxiety. We aim to (a) examine whether the proposed intervention results in significant changes in anxiety (i.e., state anxiety during lab sessions and anxiety symptoms 1 week later) and physiological regulation, and (b) investigate mediators (i.e., RSA augmentation patterns) and moderators (i.e., ER difficulties) of anxiety change. Our specific hypotheses for Study 1 are as follows:

H1: Guided drawing will significantly (a) decrease state anxiety from predrawing to postdrawing, (b) decrease anxiety symptoms from predrawing to 1 week follow-up, and (c) increase RSA across the predrawing to postdrawing periods (i.e., RSA augmentation reflecting increased parasympathetic nervous system engagement).

H2: RSA augmentation will mediate anxiety change, as measured by state anxiety decreases from predrawing to postdrawing and anxiety symptom changes from predrawing to 1-week follow-up.

H3: ER difficulties will moderate the magnitude of anxiety change (i.e., state anxiety and anxiety symptoms) induced by guided drawing such that greater effects will be observed among those with higher levels of ER difficulties.

Method

Participants

Fifty-four adults (40 women, eight men, five nonbinary individuals, and one identifying as another gender), aged 18–25 years ($M = 20.53$, $SD = 2.13$), participated in Study 1. Participants identified their race and ethnicity as follows: 35 (64.8%) White, nine (16.7%) Asian, two (3.7%) Black or African American, four (7.4%) more than one race, and five (9.3%) Hispanic or Latine. Participants were recruited via flyers and social media advertisements targeting the local community and through the psychology department subject pool at the Pennsylvania State University. Target sample size was determined using G*Power Version 3.1.9.7 a priori power analysis. Given 80% power and an α level of .05, a sample size of 34 or greater would be needed to detect small-to-medium effect sizes ($d = .30$) and greater for repeated-measures tests (*H1* and *H2*), and a sample size of 48 would be needed to detect medium effect sizes ($d = .50$) for moderation analyses (*H3*). Thus, our sample size of 54 individuals was equipped to test the proposed hypotheses. All research activities for Study 1 were approved by the Institutional Review Board at the Pennsylvania State University.

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Materials

Difficulties in Emotion Regulation Scale–Short Form

The Difficulties in Emotion Regulation Scale-Short Form (DERS-SF; Kaufman et al., 2016) is an 18-item self-report questionnaire designed for assessing ER problems. Items include statements such as "I care about what I am feeling," "When I'm upset, I have difficulty focusing on other things," and "When I'm upset, it takes me a long time to feel better." Participants indicate their response on a 5-point scale (1 = *almost never*, 5 = *almost always*). The total sum score was used in the current study, with higher scores indicating greater overall difficulty in ER. The measure exhibited excellent internal consistency ($\alpha = .92$).

Screen for Adult Anxiety-Related Disorders

The Screen for Adult Anxiety Related Disorders (SCAARED; Angulo et al., 2017) is a 44-item self-report questionnaire designed for screening anxiety disorders in adulthood. Factors assessed include generalized anxiety disorder, social anxiety disorder, separation anxiety disorder, and somatic/panic/agoraphobia. Items include statements such as "I worry about people liking me," "People tell me that I look nervous," "I am afraid to be alone in the house," and "When I get anxious, I feel dizzy." Participants indicate their response on a 3-point scale (0 = *not true or hardly true ever*, 1 = *somewhat true or sometimes true*, 2 = *very true or often true*). Higher scores indicate a higher likelihood of anxiety disorder(s). Excellent internal consistency was confirmed for both time points (predrawing $\alpha = .92$; follow-up $\alpha = .97$).

State-Trait Anxiety Inventory–State Scale

The State-Trait Anxiety Inventory-State Scale (STAI-S; Spielberger et al., 1983) is a 20-item self-report questionnaire designed to assess state anxiety (current anxiety feelings). Items include statements such as "I feel calm," "I feel strained," and "I am jittery." Participants indicate their response on a 4-point scale (1 = *not at all*, 4 = *very much so*). Sum scores were used in analyses, with higher scores indicating greater state anxiety. Internal consistency for predrawing and postdrawing were excellent ($\alpha = .95$ and $\alpha = .93$, respectively).

Guided Drawing Activity

The guided drawing activity consisted of a prerecorded video (∼20 min) presented full screen on a computer monitor positioned on a table across from the participant. The experimenter gave the participant the following instructions before playing the video and exiting the room:

> Next, you're going to watch a video that will walk you through a drawing exercise. You have a pencil and some paper here to use. I'll leave the room, and you will not be asked to show your drawing to anyone. The video will explain everything else you need to know. When I leave the room, press the space bar to begin the video when you are ready. I'll be back shortly after the video is done playing.

A full transcript and a detailed description of the guided drawing video are available in the Supplemental Material. The video began with an introduction from the guide and a brief explanation (∼30 s) of what the participant would be asked to do in the session. The guide then proceeded with a brief focused breathing exercise (∼1 min), followed by an orientation and preparation to draw (∼3 min), two subsequent periods of drawing elements of nature from photographs of leaves (∼13 min total), and a conclusion (∼30 s). Mindfulness elements consisted of being nonjudgmental of thoughts and behaviors ("Try not to look away if you can, but you can look away if that's your impulse. Just follow that impulse. Now, there's no need to erase. There are no mistakes here," "It's not about producing a great drawing"), reminders to focus on breathing ("Another gentle reminder to stay aware of your breath, paying attention, to acknowledge the inhale, the exhale, and its connection to that leaf, to that object that you're seeing"), embodiment ("Think about how your hand moves when you inhale, how it moves when you exhale, and connect that to the leaf," "Let your hand record what it sees"), and staying connected to the present moment through awareness of the natural object ("Think about that leaf as you look at it. Feel like you're really getting to know it," "Connect to that leaf and allow your hand to trace its contours, its shapes, its features").

Participants were alone in the room during the guided drawing session but were monitored by an experimenter through a one-way mirror, so they could assist if questions arose. Thus, participants' drawings were not observed, nor did they receive feedback or additional instruction from the experimenter during the experience. This allowed the participants to draw without a feeling of being socially evaluated. After the video finished, the experiment reentered the room and allowed the participants to choose whether to keep or destroy their drawings (a choice that was explained to participants at the start of the visit). This was done to ensure that participants knew that they would not be evaluated on their drawing products. The only data collected *during* the drawing activity were cardiac data.

Cardiac Activity Recording and Data Processing

Electro-cardiogram (ECG) data were recorded using Mindware WiFi ACQ software (Mindware Technologies, Ltd., Westerville, OH) with a sampling rate of 500 ms. Three electrodes were applied to the participants: on the distal right collarbone, the lower left rib, and the lower right rib to acquire the ECG signal. Four additional electrodes were placed on participants' torsos to obtain impedance data, although these data are not included in the current analysis. Experimenters manually marked the beginning and end of each episode in the cardiac data using Mindware's BioLab software. During the session, markers were placed to indicate the onset and offset of the predrawing period (8 min), the guided drawing activity (∼20 min), and the postdrawing period (8 min). During the predrawing and postdrawing periods, participants completed state questionnaires (∼2–3 min) and then remained seated until a total of 8 min elapsed.

To analyze the data, the Mindware editing program Mindware HRV, Version 3.2.13, was used, which identified interbeat intervals and physiologically unlikely intervals using a validated algorithm (Berntson et al., 1990). The data were manually inspected by trained staff to identify and correct artifacts. RSA was calculated in 60-s epochs with the 0.12–0.40 Hz frequency band. RSA values were derived using the Porges (1985) method, with the software applying an algorithm to compute the natural logarithm of

heart rate period variance adjusted for respiratory activity. To ensure reliability, interrater consistency was calculated on approximately 20% of the data. For data to be considered reliable, the RSA values from two different raters for any 60-s epoch could differ by no more than 0.1 (e.g., Buss et al., 2018).

RSA was calculated separately for three episodes: predrawing, drawing, and postdrawing periods. Average RSA within each episode was used to examine within-subjects change across the lab session. RSA change across episodes was computed via residual scores, with predrawing RSA predicting drawing RSA and postdrawing RSA. Greater residual scores reflected greater RSA augmentation, or the recruitment of parasympathetic nervous system activity during or following drawing, in comparison with baseline (predrawing).

Procedure

During the informed consent procedure, in addition to describing what to expect from the session, participants were told that they would have the choice to keep their drawings or have them destroyed using a paper shredder. Following informed consent (~10 min), participants were instructed to put their phone and any digital devices (i.e., smartwatch) on silent. Participants completed multiple questionnaires to capture demographic (age, race, and gender) information and individual differences in anxiety symptoms and ER difficulties (SCAARED and DERS-SF). After the questionnaires, cardiac activity monitors were applied (~15 min), and participants were seated to complete state questionnaires and sitting cardiac resting state (8 min). After completion of the predrawing activity portion, the experimenter returned to the observation room and prepared the guided drawing activity. Participants were seated in front of a desktop computer loaded with the guided drawing activity video. The experimenter placed two pencils, a pencil sharpener, and an 8.5″ × 11″ blank sketchbook on the table in front of the participant.

After completion of the guided drawing activity (~20 min), participants again completed state questionnaires and sitting cardiac resting state (8 min). ECG electrodes were then removed (~5 min), and participants completed closing questionnaires (~10 min). Upon closing questionnaires, participants were given a debriefing document explaining the study's purpose and experimenters answered any questions they had (~5 min). Participants spent approximately 90 min in the laboratory.

One week after the laboratory visit, participants were sent a link, via email, to their follow-up questionnaires, including SCAARED. Deidentified data used in each study is available in an osf.io repository (https://osf.io/d3uve/overview?view_only=74e7876a7ca84009a79d2127b95639b7).

Handling Missing Values

Missing values were examined, and multiple imputation was conducted using SPSS Version 27 Missing Values Analysis and Multiple Imputation tools. Little's test was nonsignificant, χ^2 (10) = 1.96, p = .997, indicating that data may be missing completely at random and appropriate for the multiple imputation approach. One participant (1.85%) was missing data for follow-up measures, constituting 0.31% total missing data. To maintain consistency across the current studies, we conducted 20 imputations, which has been shown (Graham et al., 2007) to yield results comparable with other approaches to handle missing data (e.g., full information maximum likelihood). Pooled data were used for analyses presented in the following text, and all patterns and significance levels were confirmed with nonimputed data.

Results

Descriptive Statistics

Descriptive statistics for study variables are presented in Table 1.

Main Analyses

Anxiety Effects

Paired-samples t tests were conducted to examine change from predrawing to postdrawing for state anxiety and from predrawing to 1 week follow-up for anxiety symptom change. Pearson's correlations were used to examine associations between the magnitude of change during the lab visit and subsequent anxiety symptom change at follow-up.

State Anxiety Change. In support of our hypothesis (*H1a*), state anxiety significantly decreased from predrawing (M = 39.35, SD = 12.42) to postdrawing, M = 33.64, SD = 10.51, d = .81, t(53) = 5.98, p < .001.

Anxiety Symptom Change. Consistent with predictions (*H1b*), anxiety symptoms significantly decreased from predrawing (M = 33.17, SD = 18.16) to 1-week follow-up, M = 25.82, SD = 18.72, d = .66, t(53) = 4.86, p < .001. Greater decrease in state anxiety change (r = .442, p < .001) during the lab visit was significantly associated with greater anxiety symptom decrease 1 week later (Table 2).

RSA Effects

RSA Change Induced by Guided Drawing. A one-way repeated-measures analysis of variance (ANOVA) was conducted, with Time (predrawing, drawing, and postdrawing) as the within-subjects factor and RSA as the outcome variable. Bonferroni's

Table 1
Study 1 Descriptive Statistics

Variable	Range	*M* (*SD*)
RSA		
Predrawing	3.00–7.92	6.05 (1.02)
Drawing	4.24–8.22	6.16 (0.95)
Postdrawing	3.07–8.43	6.40 (1.14)
ΔPredrawing to drawing	−0.88–1.21	0.00 (0.44)
ΔPredrawing to postdrawing	−1.02–1.87	0.00 (0.57)
State anxiety		
Predrawing	20.00–66.00	39.35 (12.42)
Postdrawing	20.00–54.00	33.64 (10.51)
ΔPredrawing to postdrawing	−24.00–5.00	−5.72 (7.02)
Anxiety symptoms		
Predrawing	3.00–67.00	33.17 (18.16)
Follow-up	0.00–74.00	25.82 (18.72)
ΔPredrawing to follow-up	−31.00–26.00	−7.35 (11.12)
ER difficulties		
Total difficulties	21.00–78.00	42.44 (14.14)

Note. RSA = respiratory sinus arrhythmia.

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Table 2
Study 1 Correlations

Variable	1	2	3	4	5
1. ΔRSA predrawing to drawing	—	**.48 (<.001)**	−.13 (.340)	−.19 (.163)	.04 (.780)
2. ΔRSA predrawing to postdrawing		—	.08 (.560)	.18 (.186)	−.25 (.072)
3. ΔState anxiety			—	**.44 (<.001)**	**−.36 (.007)**
4. ΔAnxiety symptoms				—	**−.44 (<.001)**
5. ER difficulties					—

Note. RSA = respiratory sinus arrhythmia; ER = emotion regulation; values represent *r* (*p*); bolded values indicate significant correlations.

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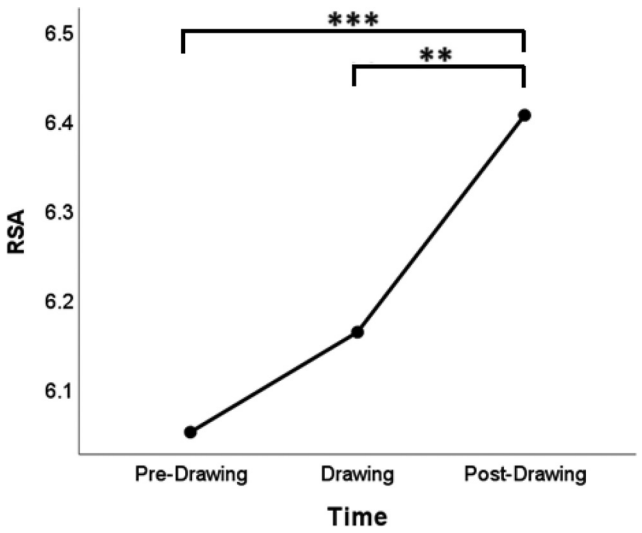
correction was used to adjust for multiple pairwise comparisons. We tested the hypothesis (*H1c*) that RSA augmentation would occur across the predrawing to postdrawing periods, reflecting enhanced parasympathetic nervous system engagement indicative of ER. As predicted, a significant main effect of Time emerged, $F(2, 106) = 12.54$, $p < .001$, $\eta_p^2 = .19$, such that RSA significantly increased from predrawing ($M = 6.05$, $SE = 0.14$) to postdrawing ($M = 6.41$, $SE = 0.16$, $d = .62$, $p < .001$) and also between the drawing ($M = 6.16$, $SE = 0.13$) and postdrawing periods ($d = .44$, $p = .006$; Figure 1). No significant change in RSA emerged between predrawing and drawing periods ($p = .257$).[1]

RSA Mediation of Change. RSA was tested as a mediator of anxiety change using the MEMORE (Mediation and Moderation for Repeated Measures) Macro Version 2.1 for SPSS (Model 1). This tool estimates indirect effects for two-instance repeated-measures designs. Separate models were conducted for state anxiety and anxiety symptoms, with RSA predrawing to drawing, and RSA predrawing to postdrawing as mediators, for a total of four models. Contrary to predictions (*H2*), RSA augmentation did not significantly mediate state anxiety—RSA predrawing to drawing mediator: $R^2 = .02$, $F(2, 51) = 0.46$, $p = .636$; RSA predrawing to postdrawing mediator: $R^2 = .01$, $F(2, 51) = 0.17$, $p = .844$—or anxiety symptom change 1 week later—RSA predrawing to drawing mediator: $R^2 = .04$, $F(2, 51) = 1.01$, $p = .372$; RSA predrawing to postdrawing mediator: $R^2 = .03$, $F(2, 51) = 0.90$, $p = .411$. This is consistent with the correlation results, which showed that RSA augmentation during drawing and postdrawing were not significantly correlated with anxiety change (Table 2).

Figure 1
RSA Change Across Time



Note. RSA significantly increased from pre-drawing to post-drawing and from drawing to post-drawing periods. RSA = respiratory sinus arrhythmia; **p < .01; ***p < .001.

ER Difficulties and Magnitude of Anxiety Change

Greater degrees of state anxiety change ($r = -.364$, $p = .007$) and anxiety symptom change ($r = -.444$, $p < .001$) were significantly associated with higher levels of ER difficulties (Table 2). We examined the moderating role of ER difficulties in anxiety change (*H2*) using the SPSS MEMORE macro (Model 2) to test conditional effects at levels of ER difficulties. ER difficulties significantly moderated state anxiety change, $R^2 = .13$, $F(1, 52) = 7.95$, $p = .007$, $b = -0.18$, lower limit confidence interval (LLCI) = −0.13, upper limit confidence interval (ULCI) = −0.05. The strength of the effect on state anxiety change increased as ER difficulties increased, with significant change detected at difficulties scores of 27 and above (90.74% of the sample). ER difficulties also significantly moderated anxiety symptom change, $R^2 = .20$, $F(1, 52) = 12.78$, $p < .001$, $b = -0.35$, LLCI = −0.55, ULCI = −0.15. The strength of the effect on state anxiety change increased as ER difficulties increased, with significant change detected at difficulties scores of 32 and above (74.07% of the sample).

Discussion

Study 1 provided feasibility evidence that guided drawing could increase subjective well-being and bolster physiological relaxation as indexed by RSA augmentation. Consistent with our hypotheses, state anxiety significantly decreased from predrawing to postdrawing, as well as anxiety symptoms significantly decreased from predrawing to 1 week later. Although drawing induced significant RSA augmentation, this physiological change did not mediate state anxiety change. We found that ER difficulties (DERS) significantly moderated state anxiety change, suggesting that the guided drawing activity may be most beneficial for those with ER difficulties.

However, as Study 1 did not include control group comparisons, we do not know whether or to what extent these changes were due to the passage of time. Furthermore, whether the mindfulness elements

[1] We further tested whether gender moderated anxiety and RSA changes and found no significant interactions with gender (*p*s > .317). However, this null effect should be interpreted with caution, given that the sample was predominately women.

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of the guided drawing experience set it apart from the potential benefits of dedicated time to draw on one's own is not apparent.

Study 2

Building on the findings from Study 1, Study 2 expands the investigation of the effects of the novel guided drawing activity by including control groups: free drawing control group and basic control group. By including a free drawing control group and a basic control group, Study 2 allows for comparative analyses of the guided drawing effects on anxiety and physiological regulation in contrast to drawing experiences without guidance or mindfulness elements. The free drawing control additionally provided a comparison group whose drawing experience was fully self-directed and without mindfulness elements, whereas the basic control comparison would allow us to test the effects of guided drawing in comparison to simply the passage of time and using a pencil and paper. Informed by previous research (e.g., Pascoe et al., 2017) and the findings from Study 1, we aimed to (a) examine whether the guided drawing group diverges from control groups in terms of within-group patterns and between-group magnitude of changes in anxiety and physiological regulation; (b) investigate whether the ER difficulties moderation of anxiety change detected in study 1 will be replicated in Study 2 guided drawing group in comparison to controls; and (c) test whether the association between magnitude of state anxiety change and longer term anxiety symptom change detected in Study 1 was specific to the guided drawing group in Study 2. Our specific hypotheses for Study 2 are as follows:

H4: Within-group patterns of change will emerge such that guided drawing will significantly (a) decrease state anxiety from predrawing to postdrawing, (b) decrease anxiety symptoms from predrawing to 1 week follow-up, and (c) increase RSA across the predrawing to postdrawing periods, with significant changes detected among the guided drawing group specifically but not controls.

H5: Significant between-group differences in the magnitude of change will emerge such that the guided drawing group will show larger (a) decreases in state anxiety, (b) decreases in anxiety symptoms, and (c) increases in RSA augmentation, all in comparison with control groups.

H6: Self-reported ER difficulties would moderate the magnitude of (a) state anxiety change and (b) anxiety symptom change induced by guided drawing such that greater effects would be observed among those with higher levels of ER difficulties in the guided drawing group.

H7: Group will moderate the association between state anxiety change and anxiety symptom change such that the strongest positive correlation will be observed in the guided drawing group in comparison with control groups.

Method

Participants

One hundred fifty-eight participants were recruited through flyers posted in the community and via the psychology department subject pool at the Pennsylvania State University to participate in Study 2. Participants were eligible if they were in the specified age range (18–25 years old) and were able to speak, read, and understand English. Data were collected at the University Park campus between October 26, 2022 and April 18, 2024, and follow-up questionnaires were collected remotely for each participant 1 week after their lab visit, concluding on April 25, 2024. Data collection for this study ended when each group consisted of at least 50 participants. Two participants were excluded from analyses: one due to an audio issue during data collection and the other due to not following task instructions throughout the visit. The included sample consisted of 156 adults (108 women, 46 men, one nonbinary individual, and one preferred not to report gender), aged 18–24 years ($M = 19.35$, $SD = 1.08$). Participants were randomly assigned to a guided drawing group ($n = 55$), free drawing control group ($n = 51$), or basic control group ($n = 50$). Self-reported race/ethnicity was the following: 101 (64.7%) White, 10 (6.4%) Asian, nine (5.8%) Black or African American, 1 (0.6%) American Indian or Alaskan Native, 23 (14.7%) more than one race, 23 (14.7%) Hispanic or Latine, and three (1.9%) another race or ethnicity. Groups did not significantly differ regarding age, gender, race, or ethnicity ($ps > .293$). Target sample size was determined using G*Power Version 3.1.9.7 a priori power analysis and considering that Study 1 detected predominately medium effect sizes. Given 80% power and an α level of .05, a sample size of 120 or greater would be needed to detect medium effect sizes ($d = .50$) and greater. Thus, our sample size of 156 individuals was equipped to test the proposed hypotheses. All research activities for Study 2 were approved by the Institutional Review Board at the Pennsylvania State University, and this study was registered with ClinicalTrials.gov (Identifier: NCT06838351). See the CONSORT flow diagram in Figure 2 for an overview of Study 2.

Materials

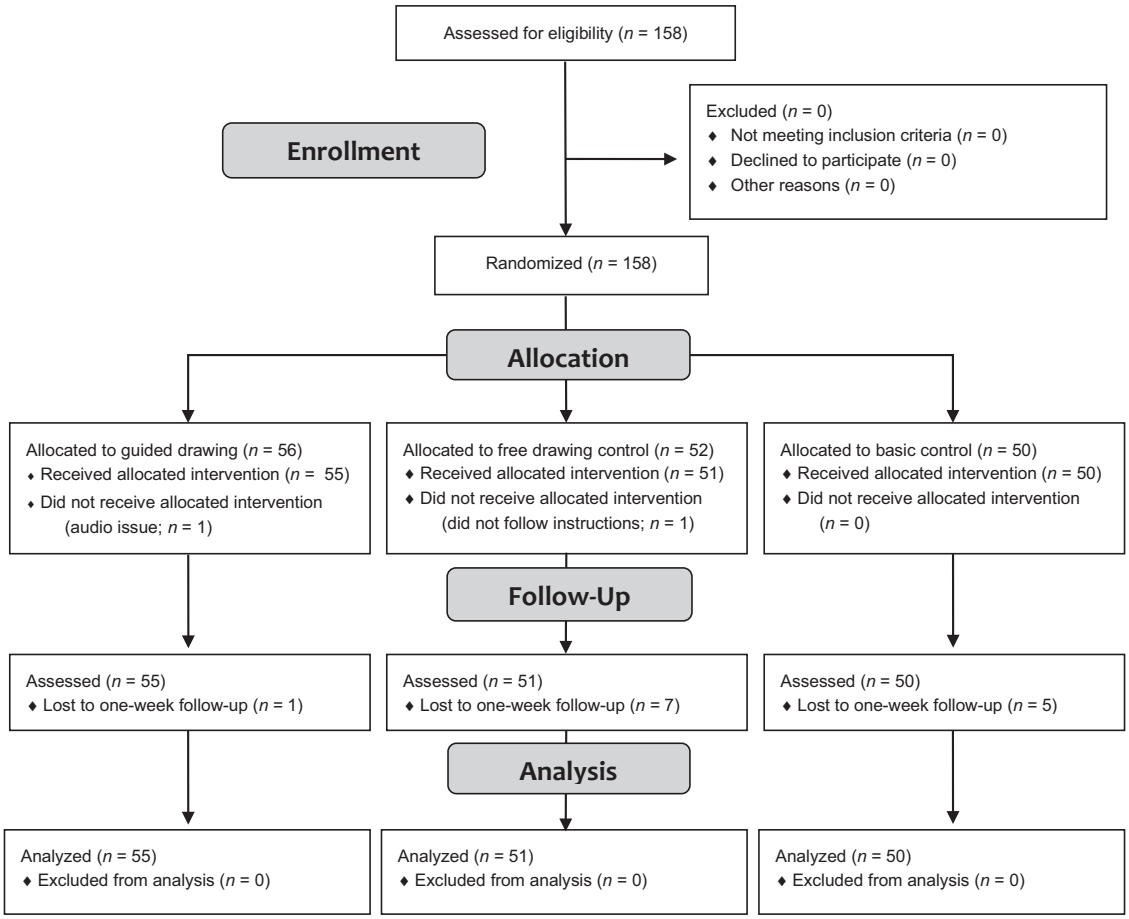
Questionnaires

In Study 2, participants completed the same self-report measures as Study 1. All measures exhibited excellent internal consistency for Study 2 (DERS: $\alpha = .90$; SCAARED: predrawing [$\alpha = .94$], follow-up [$\alpha = .95$]; STAI-S: predrawing [$\alpha = .90$], postdrawing [$\alpha = .90$]).

Drawing Groups and Randomization

This study used a parallel group trial design and simple randomization predetermined by the study coordinator with a random number generator. A single-blind approach was used for group assignment, with participants being unaware of the specifics of drawing activity differences and to which group they were assigned. Experimenters were aware of group assignments at the start of the visit, so they could prepare and deploy the appropriate drawing materials (i.e., blank paper or simple paper-and-pencil activities, and appropriate video component). Participants were randomly assigned to one of three groups: guided drawing (same as Study 1) or one of two control groups (free drawing control or basic control). In the free drawing group, participants watched a video with brief instructions and then were asked to

Figure 2
Consolidated Standards Of Reporting Trials (CONSORT) Flow Diagram



draw whatever they would like. The introductory prompt was as follows:

> Today you're going to be doing a free drawing exercise. We'll be together for about 20 minutes, and you'll be able to do the drawings with paper and pencils that we've provided. You'll be drawing anything you'd like to draw. You can draw objects you see around you, or you can draw anything that's on your mind. Periodically, I'll check in to just remind you of how much time is left in this exercise. Let's begin.

This intro was followed by a blank screen for the drawing portion of the session, with an audio voice-over occurring at 6 and 12 min with reminders to continue drawing (e.g., "We have 5 or 6 minutes left. This is a reminder to keep drawing for the time we have left."). Thus, these participants had the opportunity to be creative with a paper and pencil for the same period of time as the guided drawing group, but this experience was not guided and did contain any mindfulness elements. In the basic control group, participants were asked to complete simple paper-and-pencil activities (e.g., connect the dots and mazes) on their own. The basic control was included to evaluate guided drawing in comparison to a paper-and-pencil task that did not feature creativity but consisted of the same passage of time. The guided drawing activity was the same as in Study 1.

Procedure

Following informed consent, participants completed the same trait measures as in Study 1 (demographics, SCAARED, and DERS-SF). Cardiac activity monitors were applied (∼15 min), and participants completed the same sequence of self-report state anxiety (STAI-S) and cardiac resting state as in Study 1 (8 min). After completion of the predrawing portion, the experimenter returned to the observation room and prepared the drawing activity to which the participant was assigned: guided drawing, free drawing control, or basic control.

After completion of the assigned drawing activity (∼ 20 min), participants again completed the same state anxiety report and postdrawing resting state as in Study 1 (8 min). Next, ECG electrodes were then removed (∼5 minutes), and participants completed closing questionnaires (∼10 min). Participants spent approximately 90 min in the laboratory.

One week after the laboratory visit, participants were sent a link via email to complete the follow-up SCAARED. Subsequently, participants were debriefed and informed about the group to which they were assigned.

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Handling Missing Values

Missing values were handled the same in Study 2 as in Study 1. Little's test was nonsignificant, χ^2 (26) = 26.28, p = .426, indicating that data may be missing completely at random. Fifteen participants (9.62%) were missing data for one or more questionnaire measure or RSA data during one of the drawing activity phases. All participants had data for two or more questionnaire measures and at least one RSA phase. Overall, 1.36% of the data were missing. Pooled data were used for analyses presented in the following text, and all patterns and significance levels were confirmed with nonimputed data.

Results

Descriptive Statistics

Descriptive statistics for Study 2 variables are presented in Table 3. Correlations among Study 2 variables for the full sample and separately by group are presented in Supplemental Table S1.

Main Analyses

Within-Group Patterns of Change

State Anxiety. To examine change from predrawing to postdrawing for state anxiety, a 3 (Group: guided drawing, free drawing control, basic control) × 2 (Time: predrawing, postdrawing) repeated-measures ANOVA was conducted, with Bonferroni's correction applied to account for multiple comparisons. A main effect of Time, F(1, 153) = 45.03, p < .001, η_p^2 = .23, showed that state anxiety significantly decreased from predrawing to postdrawing (d = .54, p < .001) in the full sample. A significant Time × Group interaction also emerged, F(1, 153) = 3.55, p = .031, η_p^2 = .04 (Figure 3, left). Partially supporting our hypothesis (*H4a*), state anxiety significantly decreased from predrawing to postdrawing for both the guided drawing (d = .80, p < .001) and free drawing (d = .52, p < .001) groups but not for the basic control group (d = .29, p = .144).

Anxiety Symptom Change 1 Week Later. A main effect of Time on anxiety symptoms, F(1, 153) = 55.08, p < .001, η_p^2 = .27, indicated that, in the full sample, anxiety symptoms significantly decreased from predrawing to 1 week follow-up (d = .60, p < .001). However, contrary to predictions (*H4b*), the Time × Group interaction was nonsignificant for anxiety symptoms, F(2, 153) = 0.53, p = .592, η_p^2 = .01.

Respiratory Sinus Arrhythmia. A 3 (Group: guided drawing, free drawing, basic control) × 3 (Time: predrawing, drawing, postdrawing) repeated-measures ANOVA was conducted to test whether within-group RSA change was significantly greater for the guided drawing group compared with free drawing and basic control groups, with Bonferroni's correction applied to account for multiple comparisons. A significant main effect of Time emerged, F(2, 306) = 26.68, p < .001, η_p^2 = .15, such that, in the sample as a whole, RSA significantly increased from predrawing to drawing (d = .25, p = .009), from predrawing to postdrawing (d = .57, p < .001), and also between the drawing and postdrawing periods (d = .36, p < .001). A significant Time × Group interaction also emerged, F(4, 306) = 2.56, p = .039, η_p^2 = .03 (Figure 3, right). In support of our hypothesis (*H4c*), only the guided drawing group showed significant RSA increases across all three episodes (predrawing to drawing: d = .48, p < .001; predrawing to postdrawing: d = .75, p < .001; drawing to postdrawing: d = .37, p = .024). In the free drawing group, RSA

Table 3
Study 2 Descriptive Statistics

	Full sample		Group					
			Guided drawing		Free drawing control		Basic control	
Variable	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)
RSA								
Predrawing	3.21–9.15	6.16 (1.08)	3.21–9.15	6.17 (1.21)	3.44–8.35	6.17 (1.01)	3.66–8.24	6.14 (1.02)
Drawing	3.49–9.20	6.29 (0.99)	4.54–9.20	6.43 (1.06)	3.49–8.12	6.15 (1.01)	4.55–8.30	6.29 (0.87)
Postdrawing	3.54–9.25	6.46 (1.06)	4.43–9.25	6.59 (1.18)	3.54–8.39	6.39 (1.07)	4.69–8.41	6.38 (0.89)
ΔPredrawing to drawing	−1.31–1.42	0.00 (0.50)	−0.72–1.42	0.13 (0.48)	−1.31–0.88	−0.15 (0.50)	−1.26–1.08	0.01 (0.47)
ΔPredrawing to postdrawing	−1.25–1.47	0.00 (0.51)	−0.84–1.47	0.12 (0.55)	−1.25–1.32	−0.07 (0.55)	−1.02–0.68	−0.06 (0.38)
State anxiety								
Predrawing	20.00–63.00	39.70 (9.43)	21.00–60.00	39.74 (9.13)	20.00–63.00	40.96 (10.78)	20.00–53.00	38.37 (8.20)
Postdrawing	20.00–60.00	35.39 (8.37)	20.00–57.00	33.74 (8.05)	20.00–60.00	36.17 (9.07)	20.00–53.00	36.41 (7.82)
ΔPredrawing to postdrawing	−32.00–15.00	−4.31 (8.03)	−23.00–15.00	−6.00 (7.49)	−32.00–13.00	−4.79 (9.19)	−16.00–12.00	−1.96 (6.85)
Anxiety symptoms								
Predrawing	0.00–71.00	28.13 (16.34)	0.00–71.00	29.66 (17.83)	0.00–62.00	28.69 (16.24)	1.00–62.00	25.87 (14.72)
Follow-up	0.00–73.00	20.87 (15.14)	0.00–66.51	21.12 (15.68)	1.00–51.00	22.52 (13.28)	0.00–73.00	18.92 (16.34)
ΔPredrawing to follow-up	−69.98–44.65	−7.26 (12.10)	−69.98–13.51	−8.54 (14.90)	−22.63–28.00	−6.18 (9.22)	−28.00–44.65	−6.94 (11.35)
ER difficulties								
Total difficulties	19.00–73.00	40.88 (12.51)	19.00–68.00	41.16 (12.40)	19.00–73.00	41.02 (13.94)	21.00–65.00	40.44 (11.27)

Note. RSA = respiratory sinus arrhythmia; ER = emotion regulation.

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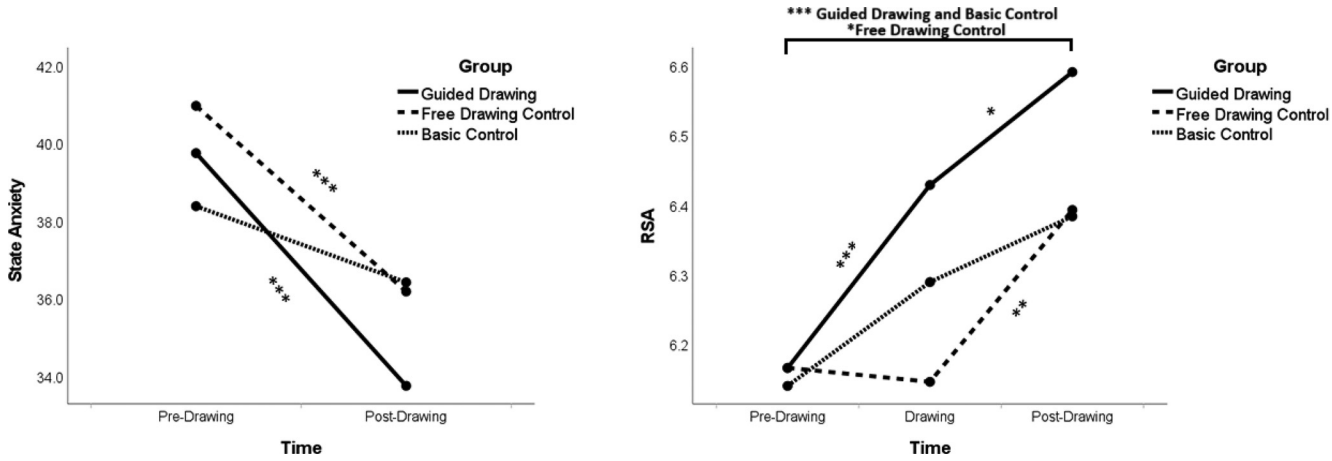
Figure 3
State Anxiety and RSA Change Over Time by Group



Note. Left: State anxiety significantly decreased from predrawing to postdrawing for the guided drawing group and the free drawing group but not for the basic control group. Right: Significant RSA augmentation emerged across all three phases for the guided drawing group only. The free drawing control group showed RSA augmentation from predrawing to postdrawing and drawing to postdrawing comparisons. The basic control group showed RSA augmentation from predrawing to postdrawing only. RSA = respiratory sinus arrhythmia; *$p < .05$; **$p < .01$; ***$p < .001$.

significantly increased from predrawing to postdrawing ($d = .41$, $p = .015$), and from drawing to postdrawing ($d = .48$, $p = .003$), but RSA did not significantly change for this group between predrawing and drawing ($d = .04$, $p > .999$). In the basic control group, RSA significantly increased from predrawing to postdrawing only ($d = .56$, $p < .001$), whereas changes from predrawing to drawing ($d = .27$, $p = .186$) and drawing to postdrawing ($d = .20$, $p = .465$) were nonsignificant.

Between-Group Differences in Magnitude of Change

Univariate ANOVAs were conducted with Group (guided drawing, free drawing control, basic control) as the fixed factor and change scores (RSA residuals from predrawing to during drawing and from predrawing to postdrawing, and state anxiety from predrawing to postdrawing) as dependent variables. Helmert contrasts were used to test whether the guided drawing group differed from the two control groups regarding each dependent variable. Pairwise comparisons were then used to examine the contrast between each of the three groups, with Bonferroni's correction applied to account for multiple comparisons.

State Anxiety. As predicted (*H5a*), there was a significant between-group difference in magnitude of state anxiety change from predrawing to postdrawing, $F(2, 153) = 3.55$, $p = .031$, $\eta_p^2 = .04$ (Figure 4, left). The state anxiety decrease was significantly greater for the guided drawing group ($M = -6.00$, $SD = 7.49$) compared with control groups (Helmert contrast estimate = -2.62, $p = .049$). Pairwise comparisons showed that this between-group difference was driven by contrast between guided drawing and basic groups (mean difference = -4.03, $p = .030$), with the direct comparison between guided drawing and free drawing groups (mean difference = -1.21, $p < .999$) being nonsignificant.

Anxiety Symptom Change 1 Week Later. Contrary to predictions (*H5b*), no significant between-group differences in the magnitude of anxiety symptom change emerged ($p = .592$; Figure 4, left).

Respiratory Sinus Arrhythmia. There was a significant between-group difference in the magnitude of RSA change from predrawing to drawing, $F(2, 153) = 4.52$, $p = .012$, $\eta_p^2 = .06$. RSA augmentation was significantly greater for the guided drawing group ($M = 0.13$, $SD = 0.48$) compared with control groups (Helmert contrast estimate = 0.20, $p = .015$; Figure 4, right). Pairwise comparisons showed that this between-group difference was driven by contrast between guided drawing and free drawing groups (mean difference = 0.28, $p = .009$), with the direct comparison between guided drawing and basic control groups (mean difference = 0.12, $p = .632$) being nonsignificant.

There was a marginally significant between-group effect on RSA change from predrawing to postdrawing, $F(2, 153) = 2.61$, $p = .077$, $\eta_p^2 = .03$. RSA augmentation was significantly greater for the guided drawing group ($M = 0.12$, $SD = 0.55$) compared with both control groups (Helmert contrast estimate = 0.19, $p = .024$; Figure 4, right). However, pairwise comparisons were nonsignificant after adjusting for multiple comparisons ($ps > .132$).[2]

ER Difficulties and Magnitude of Anxiety Change

We used MEMORE Model 3 to examine interactions between Group and ER difficulties to predict anxiety and RSA change. The model predicting state anxiety was significant, $R^2 = .13$, $F(3, 152) = 7.52$, $p < .001$, and indicated that ER difficulties moderated state anxiety change regardless of Group ($b = -0.18$, $p < .001$, LLCI = -0.28, ULCI = -0.09), and Group also significantly independently moderated state anxiety change ($b = 1.94$, $p = .009$, LLCI = 0.48, ULCI = 3.40). However, no significant

[2] As in Study 1, we additionally tested whether gender moderated anxiety and RSA changes within and between groups for Study 2 and found no significant interactions with gender ($ps > .172$).

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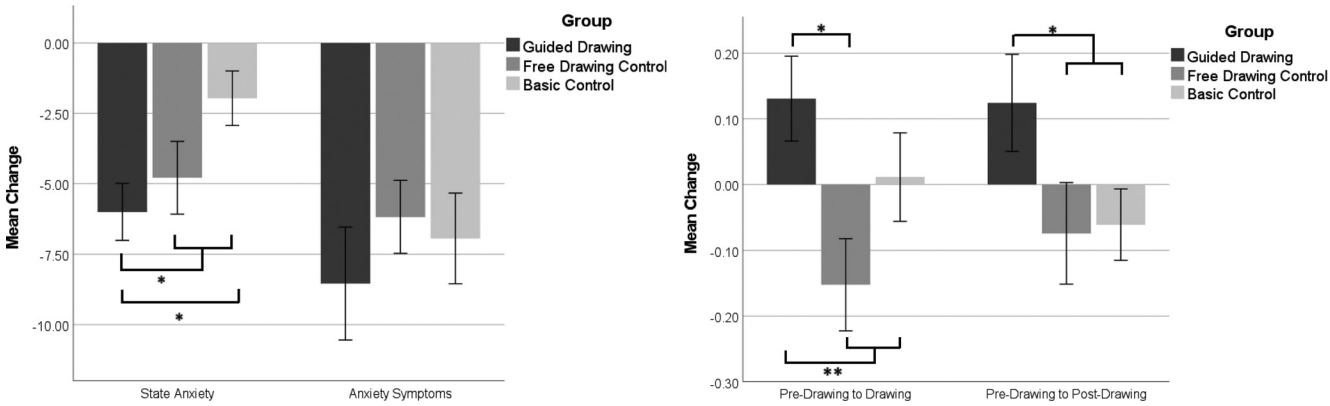
Figure 4

Magnitude of Anxiety and RSA Change by Group



Note. Left: Guided drawing resulted in significantly greater magnitude state anxiety changes in comparison with controls, and this pattern was driven by the basic control comparison. Groups did not significantly differ in magnitude of anxiety symptom change from predrawing to 1-week follow-up. Right: Guided drawing resulted in significantly greater magnitude RSA augmentation across the predrawing to drawing period, in comparison with controls, and this pattern was driven by the free drawing control comparison. RSA augmentation was also greater among the guided drawing group versus controls for the predrawing to postdrawing period; however, this model was marginally significant, and pairwise comparisons did not reach significance after Bonferroni's correction. RSA = respiratory sinus arrhythmia; *$p < .05$; **$p < .01$.

Group × ER Difficulties interaction emerged ($p = .415$), contrary to our hypothesis (*H6a*). For anxiety symptom change, the model was significant, $R^2 = .05$, $F(3, 152) = 2.77$, $p = .044$, and also indicated an effect of ER difficulties on anxiety symptoms change regardless of Group ($b = -0.19$, $p = .013$, LLCI = −0.34, ULCI = −0.04). However, again contrary to our hypothesis (*H6b*), there was no significant Group × ER Difficulties interaction ($p = .304$).

Predictors of Anxiety Symptom Change: Group Differences in Relations Between State Changes and Longer Term Changes

We next tested whether Group moderated the association between state anxiety change and anxiety symptoms change between visit and follow-up. The model with state anxiety change predicting anxiety symptom change was significant, $R^2 = .09$, $F(5, 150) = 2.84$, $p = .018$. Overall, the majority of participants declined in their reported anxiety symptoms from predrawing to 1 week follow-up (Main effect of state anxiety: $b = 0.32$, $p = .012$). In support of our hypothesis (*H7*), a significant Group × State Anxiety Change interaction, $\Delta R^2 = .05$, $F(2, 150) = 3.77$, $p = .025$ (Figure 5), indicated that only in the guided drawing group did a greater degree of drawing-induced state anxiety change (pre to post decline) significantly predict greater anxiety symptom decreases 1 week later (in comparison with predrawing).

Discussion

Study 2 examined the effects of the guided drawing intervention compared with two controls that both lacked mindfulness elements. Our results showed significant within-group declines in state anxiety from predrawing to postdrawing for both the guided and free drawing groups. More specifically, the guided drawing group showed a large effect size (i.e., $d = .80$), whereas the free drawing group showed a medium effect size (i.e., $d = .52$). This suggests that although the free drawing experience may provide some individuals with anxiety benefits, illustrating the value of a drawing experience on its own, the degree of this benefit is stronger when drawing is combined with mindfulness elements. Furthermore, when compared with the basic control group, only the guided drawing group, but not the free drawing group, showed a significantly greater *magnitude* state anxiety decrease, and this decrease was greater in the guided drawing group compared with both control groups considered together.

The guided drawing group was also set apart from the control groups in terms of RSA augmentation patterns across the drawing period. Only the guided drawing group showed significant increases in RSA across all episodes and was the only group evidencing within-group RSA augmentation *during drawing* versus baseline. The between-group magnitude of change also differentiated the guided drawing group, with greater magnitude RSA augmentation emerging during drawing in comparison to controls. Furthermore, anxiety change from visit to follow-up in the guided drawing group sets it apart from either control group. That is, the positive association observed in Study 1 between state anxiety decline across the drawing session and anxiety symptom decline 1 week later was shown to be specific to the guided drawing group in Study 2.

Taken together, Study 2 results provide insight into the unique effects provided by guided drawing. Namely, only guided drawing resulted in both state anxiety declines *and* RSA augmentation during drawing, and those who seemed to benefit from guided drawing during the visit also showed longer term benefits 1 week later, providing promising initial evidence for the utility of this intervention.

General Discussion

Previous studies have established the psychological benefits of both mindfulness (e.g., Enkema et al., 2020; Keng et al., 2011)

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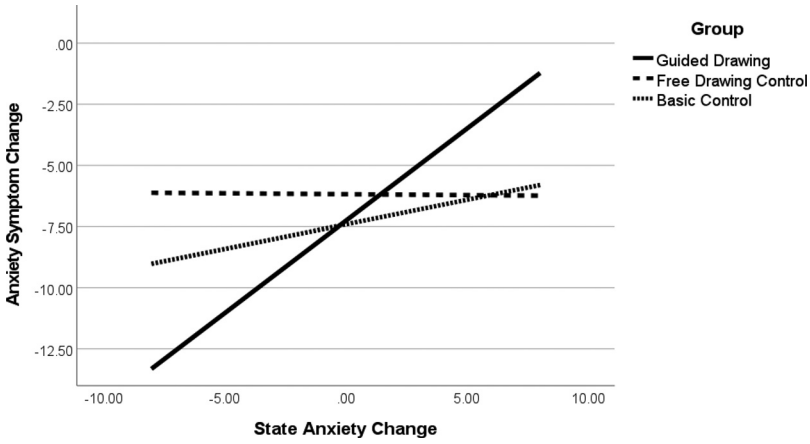
Figure 5
State Anxiety and Symptom Change Associations



Note. The significant association between state anxiety change during the lab visit and longer-term anxiety symptom change was specific to the guided drawing group.

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and drawing-based interventions (e.g., Carsley & Heath, 2018; Drake et al., 2016). However, despite these benefits, a large portion of people introduced to such stress and anxiety reduction techniques either drop out of interventions or do not develop a regular practice (e.g., Lymeus et al., 2019) due to barriers such as difficulties focusing attention and staying alert and discomfort with difficult emotions. Our studies extend this line of research by assessing the feasibility and efficacy of a novel guided drawing intervention, with a particular focus on providing an accessible tool to reduce anxiety and increase physiological regulation.

Study 1 and Study 2 provided converging evidence that guided drawing significantly decreases state anxiety and increases RSA. The timing of significant RSA augmentation differed between Study 1 and Study 2 such that significant RSA augmentation was detected across all three episodes (predrawing, drawing, postdrawing) in Study 2, whereas in Study 1, significant changes occurred between predrawing to postdrawing and between drawing to postdrawing, but not between predrawing and drawing. There may be variability in the timing of autonomic nervous system effects that could only be apparent with larger samples and consideration of individual differences such as stress reactivity or broader autonomic nervous system flexibility (e.g., Beauchaine et al., 2019). Interestingly, it was RSA augmentation *during* drawing that distinguished the guided drawing group from controls in Study 2. This could be driven by the mindfulness elements or increased engagement elicited by the guide, both of which are unique elements to this group compared with controls. Future research could tease apart these components by contrasting the guided drawing with mindfulness elements experience versus a guided drawing without mindfulness contrast.

Although both studies illustrated subjective and physiological benefits of the intervention, RSA did not significantly mediate state anxiety change. One interpretation of this null finding is that habit formation may be needed for the link between the possible RSA mechanism and subjective outcomes to emerge. Although there is substantial evidence that RSA is shaped by experience and interventions (e.g., Porges, 2025), more guided drawing sessions may be needed to illuminate RSA's mechanistic effects on anxiety symptom change. For instance, RSA augmentation induced by guided drawing may increase over time, or those who show greater augmentation during an initial session, signaling an individual difference in physiological flexibility or malleability, may be those who continue to show benefits over repeated sessions. More work is needed to investigate the individual differences and the longer term potential mechanistic role of RSA in anxiety-reduction driven by guided drawing. Nevertheless, both the Study 1 sample and the guided drawing group in the Study 2 sample showed significant RSA augmentation, providing evidence for the physiological benefit of guided drawing with mindfulness elements.

By introducing control groups in Study 2, results revealed that some effects detected in Study 1 were not specific to the guided drawing experience. In particular, Study 1 results showed that ER difficulties moderated the magnitude of anxiety change following guided drawing such that greater declines were detected among those with more self-reported regulatory challenges. However, Study 2 revealed that this pattern was not unique to the guided drawing group, with both control groups showing the same moderation effect. This suggests that those with greater ER difficulties may benefit from any period of calm and quiet set aside to use a pencil and paper. In addition, in Study 1, anxiety symptoms significantly decreased from predrawing to 1-week follow-up, with greater decreases of anxiety during the visit being associated with larger reductions in anxiety symptoms 1 week later. However, Study 2 showed that this follow-up effect may not be specific to guided drawing, because a significant decline in anxiety symptoms was only detected for the full Study 2 sample, with no interaction based on group. One possible explanation for this pattern is that anxiety symptom report at baseline may have been increased due to the novelty of being in a lab environment and that overall anxiety decreases compared with 1 week later were driven by this context effect at baseline. Yet, group differences did emerge when both state anxiety change and symptom change were examined together. That is, although there were no significant

between-group differences in anxiety symptom changes in Study 2, the guided drawing group showed a greater reduction in state anxiety during the visit that significantly predicted greater anxiety symptom decreases 1 week later. In both Study 1 and the guided drawing group in Study 2, the degree of anxiety reduction during the session predicted greater symptom improvements 1 week later. This suggests that the initial emotional change from the intervention may be a key factor influencing its long-term benefits.

Although the results of these studies are encouraging, there are a few limitations to discuss. First, our samples were predominantly composed of women, which limits the generalizability of the results to a broader population. This also precluded us from rigorously examining gender differences in intervention responsiveness across genders, which may be particularly informative given documented gender differences in anxiety symptoms (e.g., McLean et al., 2011). Our samples were also predominately White, limiting our ability to generalize findings across racial and ethnic groups. More balanced and representative samples, including a more even distribution of genders and cultural backgrounds, as well as targeted clinical samples (e.g., anxiety disorder diagnosis), are needed in future work to assess whether the effects hold across different demographic populations and who may reap the most benefit from the intervention. Second, in an effort to control extraneous variables, the drawing sessions were conducted in a controlled lab setting. Although this helped minimize environmental distractions, it may have introduced limitations such as artificially inducing stress or anxiety in participants or participants altering their behavior in a way that is not typical in real-life situations. Finally, the single-session design in the current studies was chosen to examine initial feasibility and short-term change effects but likely does not capture the full potential impact of the intervention. Although it is notable that anxiety and physiological changes were observed after this single session, MBIs targeting ER typically involve several weeks of habitual sessions (e.g., Gratz & Tull, 2010). Thus, important next steps in this line of research are to examine the effects of guided drawing with mindfulness across multiple sessions integrated into daily life to test for long-term benefits with increased ecological validity. This longitudinal approach would also be needed to isolate the potential habit-forming benefit that the drawing element may provide (e.g., by increasing engagement and approachability) beyond a mindfulness-only comparison group.

In addition, future research should investigate *how* guided drawing with mindfulness provides benefits and *why* (for some) these benefits differ from mindfulness without drawing. Possible explanations are that drawing may serve as an external focus, the tangible nature of drawing may anchor attention to feel grounded more easily, and/or the act of drawing may create a sense of personalization of the mindfulness practice. Individual differences at baseline (e.g., trait mindfulness, artistic ability, or interest) and subjective aspects of the guided drawing experience (e.g., enjoyment and immersion), including which mindfulness components (e.g., nonjudgement, guided breathing) may have been more salient or effective for individual participants, should also be more deeply explored to isolate the highest impact components that may make guided drawing most effective. The impact of distinct mindfulness elements could be disentangled by introducing multiple active controls, each emphasizing a specific component, and subjective measures of what makes the experience work best for different individuals could be assessed through qualitative analysis of follow-up interviews.

Future studies can also isolate distinct potential mechanisms of change by leveraging neurophysiology (e.g., electroencephalogram [EEG]). EEG would allow for a better understanding of regulatory and creative processes as both mechanisms and outcomes of the intervention. For instance, EEG can be used to index cognitive engagement and attentional control (e.g., Natalizio et al., 2024; Putman et al., 2014), balance of emotion-generating and cognitive-control neural processes (e.g., Myruski et al., 2022; Poppelaars et al., 2018), and flow state, or periods of heightened absorption in a task (e.g., Katahira et al., 2018). These constructs could be measured during guided drawing (vs. controls) to examine task-based effects, as well as at baseline and follow-up, in conjunction with subjective or behavioral measures of cognitive and affective regulation, to test whether the intervention shapes biobehavioral change across single sessions and habitual practice.

In conclusion, the present studies provide promising evidence for the feasibility and potential benefits of guided drawing for reducing anxiety and promoting relaxation. Both Study 1 and Study 2 demonstrated significant reductions in state anxiety and increases in RSA after the guided drawing, suggesting that it can be an effective intervention in reducing anxiety symptoms and engaging regulatory processes. The relationship between anxiety changes after the intervention and anxiety reduction 1 week later highlights the potential for the guided drawing intervention to provide lasting benefits.

Practical Implementation

As described earlier, although the current studies provide initial evidence for the utility of the guided drawing intervention, open questions remain regarding replication with larger, more diverse samples and examining longitudinal and mechanistic effects. However, given the current promising evidence for a single (~20 min) session for reducing anxiety and bolstering physiological regulation, we provide a full transcript and details of the guided drawing session developed for the current studies in the Supplemental Material to facilitate future research and implementation.

This guided drawing activity could be adapted to a live guided session, a remote session conducted outside a lab, or for telehealth, classroom, or group settings. Although additional research is needed to directly test whether the effects detected in the current studies carry over these other contexts, we predict similar benefits would be likely to emerge for adaptations that incorporate the following features of the guided drawing experience: mindfulness elements (e.g., nonjudgment, embodiment, and connection to the present moment), drawing natural objects (e.g., either from photographs or physical objects), delivery (i.e., guide uses a calm, soothing tone and a slow, steady speaking speed), length (i.e., approximately 20 min per session), and setting (i.e., a quiet environment with reasonable expectation of no/low distractions).

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