The Effects of Art Therapy on Reducing Stress Prior to Presenting a Speech

Lab 601 Group 5

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Abstract

How students use resources to cope with stress is a strong predictor of a student's academic performance. Art therapy has been shown to decrease physiological stress in part due to the introspective mindfulness that art requires. The purpose of this study was to evaluate the effects of art therapy prior to an acute stressor. Coloring was the utilized method of art therapy. The acute stressor was students giving a speech on why they would be the ideal candidate for their ideal job. It was hypothesized that coloring prior to giving a speech would lower the final physiological measures of stress (electrodermal activity, blood pressure, and heart rate) at the end of the speech when compared to the control groups. For one control group, students sat quietly prior to the speech. For another control group, students blew soap bubbles. Blowing soap bubbles does not elicit the mindfulness that coloring does, so it was not expected to have the same benefit. However, our results did not show a significant difference between groups. Thus, blood pressure, heart rate, and electrodermal activity (EDA) all increased by the same amount following the speech. However, it is conceivable that coloring, blowing soap bubbles, and sitting quietly all provide ample opportunity to meditate, and all three groups benefitted from the effects of meditation or art therapy. Further studies are necessary to statistically show that sitting quietly, coloring, and blowing soap bubbles all induce mediation that results in lower physiological measures of stress following a speech.

Introduction

Chronic and acute stress can have detrimental impacts on the body's physiology. Short term implications of the increase in hormones produced from stress includes homeostatic imbalance. According to the Task Force of the European Society of Cardiology, stress plays a role in the activation of the sympathetic nervous system, triggering the release of epinephrine, norepinephrine, and cortisol (1996). Chronic stress led to decreased hippocampal function and increased neuronal degeneration (McEwen et al., 1995; Uno Tarara, Else, Suleman, & Sapolsky, 1989). Acute or chronic stress can also lead to increased cortisol levels in the brain that interfere with the brain's ability to create memory. Ultimately, this suppression and limited memory will only continue the cycle of stress (Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996; McEwen & Sapolsky, 1995). From a cardiovascular perspective, stress can result in an increase in blood pressure (Carroll et al., 2012). It also has been shown to increase heart rate (Bennett, Blissett, Carroll, & Ginty, 2014). Prolonged these effects can cause hypertension and in the severe cases, myocardial infarctions.

In today's society, college is a breeding ground for stress. To thrive, students need to have their brains functioning at full capacity, and minimize the damaging effects of stress as much as possible. How a college student copes with stress is a strong predictor of their academic and professional success (Struthers, Perry, & Menec, 2000). In building a strong resume, it is necessary for college students to juggle school, work, and extracurricular activities. The combination of all of these activities exacerbates the physiological stress felt by students. However, studies have shown that highly resourceful students show greater resilience to stress in academic performance (Kennett & Keefer, 2006).

Public speaking is also important to a student's personal and professional success. However, public speaking can be a great cause of stress for people (Feldman, Cohen, Hamrick, & Lepore, 2004). As part of the body's stress response, public speaking increases a person's heart rate, blood pressure, and electrodermal activity (EDA) (Croft, Gonsalvez, Gander, Lechem, & Barry, 2004; Al'Absi et al., 1997; Westenberg et al., 2009). It has also been shown that public speaking increases both systolic and diastolic blood pressure (Al'Absi et al., 1997). Previous researchers have used the Trier Social Stress Test as a way to increase a person's level of stress in relation to public speaking (Kirschbaum, Pirke, & Hellhammer, 1993). This test has been shown to cause changes in various hormone levels, and can lead to an increase heart rate and blood pressure, making it an effective way to induce stress in a research setting (Childs, O-Connor, & de Wit, 2011; Kirschbaum et al., 1993). It is possible that a person's increase in stress, and subsequently their heart rate, EDA, and blood pressure, can diminish their performance in public speaking.

One aspect that was tested in a treatment group was blowing bubbles. In light of President Trump's controversial election last November, students across the country who were among the devastated flocked to their to their universities for counseling. Many universities responded via different methods including blowing bubbles and coloring. Among these schools was the University of Michigan's Law School who held an event called, "Post-Election Self-Care With Food and Play" (Singman, 2016). These campus post election help groups started their own controversy from Trump supporters, who were upset that the universities were using taxpayer money to fund these programs. One Iowa lawmaker, Bobby Kaufmann, responded with legislation referred to as the suck it up buttercup bill which would prohibit universities from using taxpayer money to bring in extra counseling post election results (Schmidt, 2016). This additional treatment group examined the legitimacy of blowing bubbles as a method of stress reduction.

Another stress management technique that shows promise is art therapy. It has been shown to be highly beneficial in reducing symptoms of distress for individuals suffering from anxiety, post traumatic stress disorders, and even cancer (Monti et al., 2006; Spiegel, Malchiodi, Backos, & Collie, 2006). Art therapy helps to shift mental focus to an introspective and tranquil mindframe. Ultimately this distracts people from their stressors and gives them a peaceful outlet. Specifically, coloring has been found to be an effective form of art therapy in the immediate reduction of anxiety (Curry & Kasser, 2005). Additionally, the president of the American Art Therapy Association has endorsed the use of coloring books for the benefit of stress reduction

(Carolan & Betts, 2015). Due to these findings, college campuses have attempted to utilize this form of stress reduction following major events, such as the presidential election (Singman, 2016).

Applying the findings of the previous studies on art therapy, it is hypothesized that coloring will help reduce stress when given the Trier Social Stress Test. Coloring will allow students to alleviate their stress and to be mindful before presenting a speech. We hypothesize that there will be a reduction in blood pressure, pulse, and EDA both after coloring and after speech presentation when compared to a control group that simply sits idly and quietly for the time period. Furthermore, it is hypothesized that this stress reduction is coloring specific. That is, the effects that coloring has on reducing stress are specific to coloring and are not generalizable to other forms of children's play. In order to investigate this hypothesis, blowing soap bubbles will be introduced as another experimental group. Blowing soap bubbles is a traditional children's activity that does not require introspective thinking. When coloring, participants reflect about how they are feeling, so they draw whatever comes to their mind. It is this introspection that could potentially produce the beneficial effect that coloring has that the task of blowing bubbles would not.

To test this hypothesis, physiologic measures of EDA, pulse, and blood pressure were recorded. These measures are appropriate because they were deemed the best indicators of stress. EDA measures the current flow between the placement of two electrodes on the skin and is a direct measure of sympathetic nervous system activity (Braithwaite, Watson, Jones, & Rowe, 2013). Further, EDA has been utilized as a measure of stress due to its reliability in detecting changes when stressful stimuli are presented (Sioni & Chittaro, 2015). Increases in blood pressure should also be detected in a stressful event due to increased blood vessel constriction via heightened activation of the sympathetic nervous system. And finally, according to the Task Force of the European Society of Cardiology, heart rate is a strongly influenced by stress through the sympathetic nervous system (1996). Stress regulates the control of heart rate through the release of epinephrine and norepinephrine. Heart rate and blood pressure have also been used to detect stress previously (Vrijkotte, Van Doornen, & De Geus, 2000).

The positive control in this study was the difference in physiologic measurements between a baseline data collection and the induction of stress after giving the speech. This measurement has an importance in displaying that stress induction has occurred in the absence of any treatment. The negative control was the experimental group for which there is no treatment given.

Materials and Methods

Participants

Volunteer participants who were enrolled in Physiology 435 at the University of Wisconsin-Madison were utilized for this study. All participants were informed of the measurements that would be taken and the tests that they would be asked to perform. Furthermore, all participants signed a consent form specified to the study. Participants were randomly assigned to treatment groups.

Equipment and Measurements

EDA was measured with a BSL EDA Finger Electrode Xdcr (SS3LA, #1606004182, BIOPAC Systems, Inc., Goleta, CA, USA) and recorded with BIOPAC software (MP36, #MP36E1204002771, BIOPAC Systems, Inc., Goleta, CA, USA). Two finger electrodes were attached to palmar side of the subject's nondominant hand, one on the upper region of the index finger and one on the middle finger. A small amount of Isotonic Recording Electrd Gel (GEL101, BIOPAC Systems, Inc., Goleta, CA, USA) was utilized between the skin and the electrode. For each EDA measurement, the difference between the highest and lowest peaks were taken within the interval of interest. Blood Pressure and heart rate were measured with an OMRON 10 Series Plus Blood Pressure Monitor with ComFit Cuff (BP791IT, #20150310125L6, OMRON Healthcare, Inc., Lake Forest, IL, USA). The blood pressure cuff was wrapped around the subject's left arm one inch above the elbow. This too was left on throughout the experiment to minimize preparation time between parts of the experiment as well as reduce variation in location of placement. Blood pressure was taken with the best possible exposure to the arm, disallowing sweaters and coats to be worn during the experiment. Students were instructed to sit upright while resting their arm at a 45 degree angle on the table while measurements were taken.

Experimental Design

Prior to participants entering the room, the BIOPAC software, EDA electrodes and OMRON cuff were set up and tested to ensure functioning equipment. Due to the length of the EDA computer cords the computer remained close, with the computer screen not be visible to the participant. To maximize consistency between participants only one member of the research team presented directions. Each participant was brought into the room and sat down across from the proctor. The proctor then handed them a consent form, and instructed them to read and sign it. All other researchers were seated next to the proctor to convey the effect of a review panel. Once the consent form had been signed a second researcher hooked the participant up to the

OMRON cuff and EDA electrodes. The OMRON cuff was placed on the left arm of participants, with the cord pointed towards their forearm. The EDA electrodes were then placed on the index and middle finger of their nondominant hand. To enhance readings, gel was added to the electrodes prior to and cleaned off after every participant. When measurements were taken, participants were asked to sit up straight, have their legs uncrossed and had their arms rest on the table. Baseline measurements were recorded for blood pressure and pulse. Once heart rate and blood pressure were recorded, a third researcher began EDA measurements and continued them for the entirety of the study. The first three seconds served as the baseline measurement for EDA. The researcher monitoring EDA also noted the time intervals of when blood pressure and heart rate were measured. Following the baseline measurements, the participant was put through a modified version of the Trier Social Stress test in order to induce stress (Birkett, 2011). Participants were provided with a paper and pen and instructed with the following prompt:

- "This is the speech preparation portion of the task; you are to mentally prepare a five-minute speech describing why you would be a good candidate for your ideal job. Your speech will be videotaped and reviewed by a panel. You have five minutes to prepare and your time begins now."

At the conclusion of five minutes, researchers withdrew the paper and pen. Blood pressure and heart rate were then recorded. Time range of when blood pressure and heart rate were taken was noted to discard any peaks in the EDA to eliminate any artifact. Following these measurements, the participants proceeded to one of three randomly assigned treatment groups. Ten participants were in each group. Group 1 was given crayons and paper to color with for three minutes. Group 2 was given bubbles to blow for three minutes. Group 3 was the control group and was instructed to sit quietly for three minutes. At the conclusion of three minutes, blood pressure and heart rate were recorded. Following this, subjects were instructed with the following prompt:

- "This is the speech portion of the task. You are to deliver a speech describing why you would be a good candidate for your ideal job. You should speak for the entire the five-minute time period. Your time begins now."

Throughout this period, the panel appeared to be videotaping the individual to increase stress (Note: Video footage of subjects was not actually recorded). If the subject stopped talking during the five minute speech, they were instructed with the following prompt.

- "You still have time remaining, please continue talking for the remainder of the time."

At the conclusion of the speech, the "filming" and EDA measurements were stopped and blood pressure and heart rate were recorded for a final time. A timeline of the experimental design is included in Figure 1.

0 minutes	5 minutes	8 minutes	13 minutes
Measure Heart Rate and Pulse. Take EDA for 3 seconds before instruction. Instruct subject to prepare a speech about why they are the ideal candidate for a job or graduate school.	Take away pen and paper. Measure Heart Rate, Pulse, EDA. Split subjects in 3 groups. 1 group blows bubbles. 1 group colors on paper. A control group will sit and wait.	Measure Heart Rate, Pulse and EDA. Instruct participants to begin speech. Encourage them to continue talking for the entire 5 minutes.	End EDA measurement. Measure Heart Rate, Pulse and EDA.

Figure 1: Approximate timeline of events that each participant will experience.

Data Analysis

For EDA, data was collected on the maximum, minimum, mean, and amplitude during set intervals. The first interval occurred during the initial 3 seconds after the baseline blood pressure and heart rate were measured. The second interval began when instructions were given to prepare for the speech and ended when the paper was taken away. The third interval began after the paper was taken away and ended with the completion of treatment. The last interval began from the start to the end of the speech. The percent change and mean were observed between the differences in EDA recorded for each time interval compared to the baseline. Then intervals were compared with the respective intervals of the other treatment groups. For blood pressure and heart rate, the measurements were taken at the beginning of each interval. The statistical test that was determined to be most appropriate for this experiment was an ANOVA, as it compared the averages between treatment groups. Finally, in the conduction of statistical data analysis, Systolic (SP) and diastolic (DP) blood pressure as measured were calculated into Mean Arterial Blood Pressure (MAP), using the equation MAP= DP + ⅓ PP, where PP= SP-DP.

Results

Heart Rate

Initial heart rate of the control group ranged from 57-105 beats per minute ($\bar{x}$=76.4, SD=17.97) (figure 5). After preparation, this range increased (57-122, $\bar{x}$=79.1, SD=19.72). The post-treatment measurement resulted in the smallest range (57-102, $\bar{x}$=80.6, SD=15.98) while the final range after the speech task was greatest (55-115, $\bar{x}$=79.1, SD=16.56). The percent change from the mean initial heart rate to the mean final heart rate in this group was 3.5%, while percent change between mean post-treatment completion and mean final heart rates was -1.86%.

Heart rate of the coloring group in the initial measurement ranged from 52-115 beats per minute ($\bar{x}$=70.9, SD=19.09) (figure 5). After preparation of a speech, this range was 55-89 beats per minute ($\bar{x}$=70.4, SD=13.0) and this increased after the treatment (54-99, $\bar{x}$=69.6, SD=15.1). The final range was again the greatest (49-111, $\bar{x}$=70.2, SD=17.01). Percent change from mean initial to mean final and mean post-treatment to mean final were -.99% and .86%, respectively.

Initial range of heart rate for the bubbles treatment group was 36-97 beats per minute ($\bar{x}$= 64.4, SD= 18.69) (figure 5), with a post-preparation range of 37-96 beats per minute ($\bar{x}$=70.2, SD=18.98). After the treatment, the greatest range was observed (34-102, $\bar{x}$=67.56, SD=22.2), with an extremely similar range after speech presentation (35-100, $\bar{x}$=67.2, SD=18.86). For this treatment, percent change between initial mean heart rate and final mean heart rate was 4.35% and percent change between after the treatment and after the speech was -.53%.

Mean Arterial Blood Pressure

The initial range in mean arterial blood pressure for the control group was 73-103 mmHg ($\bar{x}$=86.4, SD=9.57) (figure 6), while after preparation, the range was between 77-105 mmHg ($\bar{x}$ =87.8, SD=9.53). After treatment, there was the smallest observed range (73-97, $\bar{x}$= 87.0, SD=6.99), in contrast to the greatest range which was noted in the final measurement (81-117, $\bar{x}$ =98.0, SD=13.54) (figure 6). Percent change in mean MAP between initial and final measurements was 13.43%, while percent change in mean MAP between after treatment and final measurements was 12.64%.

Initial MAP range of the coloring treatment was the smallest recorded (73-96, $\bar{x}$=85.2, SD=6.71) (figure 6), with a larger range noted after the preparation task (69-108, $\bar{x}$=87.1, SD=12.68). The largest range of MAP came from the recording after the treatment (66-107, $\bar{x}$=87.1, SD=10.99), followed by a much smaller range in the final measurement (81-109, $\bar{x}$=93.4, SD=10.99). Percent change between mean initial measurement and mean final measurement was 9.62%, and this percent between mean after treatment and final measurements was 7.23%.

In the treatment involving blowing bubbles, MAP ranged in baseline measurements from 73-95 mmHg ($\bar{x}$=85.3, SD=7.83) (figure 6). After preparation, after treatment, and final MAP ranges were 75-98 mmHg ($\bar{x}$=86.9, SD=7.67), 74-94 mmHg ($\bar{x}$=83.3, SD=6.57), and 81-105 mmHg ($\bar{x}$=91.8, SD=7.13), respectively. The percent change between mean initial and mean final MAP (7.6%) was less than the percent change between mean MAP after treatment and final MAP (10.2%).

Electrodermal Activity

The baseline differences in EDA of the control ranged from .18-8.88 ($\bar{x}$=4.82, SD=3.0) (figure 7). This range was .43-10.2 ($\bar{x}$=6.40, SD=3.70) after preparation in this group, 2.65-11.81 ($\bar{x}$=6.76, SD=3.01) after treatment, and 4.35-14.92 ($\bar{x}$=8.29, SD=3.53) in the final measurement. Percent change between mean difference of the initial readings and mean difference of the final readings was 71.99%, compared to a percent change of 22.63% between mean difference after treatment and mean difference of final readings.

In the coloring group, the range of initial differences in EDA readings was 2.20-14.23 ($\bar{x}$=7.01, SD=3.89) (figure 7), while the range of EDA differences after preparation of the speech task was 3.15-16.03 ($\bar{x}$=8.51, SD=4.16). These ranges were 4.4-16.07 ($\bar{x}$=9.29, SD=3.83) and

4.05-17.26 ($\bar{x}$=10.39, SD=4.76) for the differences in EDA after treatment and in the final readings, respectively. Percent change observed between mean difference in baseline EDA and final EDA (48.22%) was larger than that of mean difference in EDA after treatment and final EDA (11.84%).

For the group blowing bubbles, the baseline range of differences in EDA recorded were 1.87-9.85 ($\bar{x}$=6.09, SD=2.75) (figure 7), the range of differences after preparation were 2.53-11.99 ($\bar{x}$=7.87, SD=3.48), the range of differences after treatment were 2.07-12.01 ($\bar{x}$=7.49, SD=3.24), and the range of differences in the final EDA were 3.25-14.09 ($\bar{x}$=9.33, SD=3.78). Again, percent change was larger when calculated between the measurements of mean difference in baseline EDA and final EDA (53.2%) than the percent change calculated between the mean difference in EDA after treatment and final EDA (24.57%).

ANOVA test for significance

To attain data for evidence of a positive control, ANOVA tests for statistical significance were run between means of the control. This displayed that there was a significant induction of stress because there was a significant increase in EDA in the control group from the baseline measurements to after speech presentation (p=.001) and from after treatment to after speech presentation (p=.03). MAP also increased over these time points in the control group (p=.04, p=.03). Surprisingly, however, heart rate did not significantly increase over these time points in the control group (p=.73, p=.84).

To analyze the hypothesis stated, an ANOVA test was run comparing means of the coloring and control conditions at each time point data was collected, for each physiologic measure. The p-values between these two conditions at the initial time point were not significant at a level of .05 for heart rate (p=.52), MAP (p=.75), or EDA (p=.07). Further, there was not significance noted between these variables at time points after preparation (p=.26, p=.89, p=.43), after treatment (p=.14, p=.68, p=.66), or in the final measurement (p=.25, p=.42, p=.87).

ANOVA tests were also run comparing the means for treatment groups of coloring and bubbles. For the baseline measurements of heart rate (p=.45), MAP (p=.98) and EDA (p=.15), there was no statistical significance between the two variables. Again, this was consistent throughout data analysis of these treatment groups with no significance found after preparation (p=.98, p=.97, p=.83), after treatment (p=.75, p=.63, p=.86), or after speech presentation (p=.71, p=.70, p=.68).

Means of the dependent variables for control and bubble-blowing groups were also run in an ANOVA test. For the initial measurements of heart rate (p=.16) and MAP (p=.78), p-values were not statistically significant at a level of .05. The p-value for EDA (p=.04) was statistically significant, however this value did not provide significance in the context of this experiment, and thus was thrown out, as noted later. After preparation (p=.32, p=.82, p=.44), after treatment (p=.13, p=.24, p=.66), and final measurements (p=.15, p=.22, p=.77) did not yield statistically significant results.

ANOVA tests were also run comparing the mean percent changes between the coloring and control groups at four different time intervals. The first interval, between the baseline measurement and the measurement after the speech preparation period, did not yield statistically significant values for heart rate (p=.64) (figure 3) or MAP (p=.97) (figure 2). Again, EDA (p=.03) (figure 4) did yield p-value below .05, however this was not deemed “statistically significant” for this experiment and was not used in data comprehension. The second time interval, between the initial measurement and measurement post-treatment yielded identical results to the first time interval percent change mean results (p=.18, p=.80, p=.03). The third time interval for percent change was between initial data collection and final data collection, and this also resulted in statistical insignificance (p=.41, p=.37, p=.05). The final interval for which percent change was calculated was between post-treatment measurements and post-speech measurements, however once again not of these p-values were statistically significant (p=.87, p=.60, p=.56).

Mean percent change ANOVA tests were also run between for the same intervals for the treatment groups comparing coloring and bubbles. The first percent change mean interval tests for heart rate (p=.26) (figure 3), MAP (p=.99) (figure 2), and EDA (p=.39) (figure 4) resulted in insignificant findings. For the second (p=.44, p=.54, p=.33), third (p=.27, p=.74, p=.23), and fourth (p=.84, p=.91, p=.24) time intervals as discussed previously, there was again no statistical significance.

A final round of ANOVA testing was completed for the mean percent changes in the four intervals between the control group and the group blowing bubbles. Heart rate (p=.36) (figure 3) and MAP (p=.97) (figure 2) for the first interval were not statistically significant, with the low value EDA (p=.002) (figure 4) p-value again thrown out. This was mimicked for the second (p=.78, p=.26, p=.04) and third interval (p=.92, p=.29, p=.02). The fourth interval did not display any statistical significance for heart rate (p=.76), MAP (p=.66), or EDA (p=.42).

Discussion

Concluding data analysis, the research produced no significant results supporting the proposed hypothesis. We hypothesized that art therapy, via coloring, before an interview, would decrease the participant's blood pressure, heart rate and EDA at the end of the interview, in comparison to a control group and a group blowing bubbles. Although the data had no statistically significant p-values, we still maintain its practical significance.

Because it was hypothesized that both the control group and the group blowing bubbles would yield different results from the coloring group, it was necessary to only analyze two variables together at a time. In this fashion, it was possible to create an equal comparison that was "unweighted" so-to-speak by two treatments that were predicted to not to have the impacts of coloring, rather than the utilization of an ANOVA statistic comparing means between all three treatment groups.

Even in the absence of non-significant p-values, it is difficult to note any trends in the data collected. If successful, it would be predicted that all physiologic measurements should increase from baseline to speech preparation, decrease with treatment or control, and increase in the final measurement after speech presentation. This is because it is in the intention of the stress test tasks of speech preparation and speech presentation to increase stress, while the treatment or control should serve as relaxation. The greatest changes, should coloring have proved to be more beneficial in reducing stress than the other tasks, would have been in decreased physiologic measures in the coloring group alone either after the treatment, after the speech, or both. However, no differential results were observed, as noted in the presence of high p-values. While the positive control data did hold true that we were successful in the induction of stress in these physiologic measures, there was not a large enough difference in data collected at the different time points for each treatment group to come to any reasonable conclusion.

The setup of the study may have limited its ability to reflect accurate p-values between the control and experimental groups. The experiment was designed so that participants in the control group were asked to sit for a total of three minutes between the preparation portion and speech portion. Although intended to produce no response and be reflective of “no treatment,” this activity may have been an accidental treatment. In fact, sitting quietly is the basis of mindful meditation. Mindful meditation is a practice where one brings their attention to the present moment. It has been proven to reduce systolic and diastolic blood pressure and heart rate (Barnes, Davis, Murzynowski & Treiber, 2004). If the control group’s lack of treatment did function as meditation, then the control group results would provide similar results to the coloring treatment, and no longer function as a true control. The basis of our hypothesis was in finding a significant difference between the final physiological coloring values compared to the other treatment groups. It is possible that if all three treatments decrease heart rate, blood pressure and EDA activity, the p-values should not be significant, which is consistent with our results. Further, because it is expected that the control group acted as a manipulated variable and did not differ in its findings from that of the bubbles group, it is possible that bubbles may have also been effective in the reduction of these physiologic measures.

However, it is not possible to determine if these measures did reduce said physiologic measures, as there is not an accurate control comparison. It is therefore also possible that none of the treatment groups were effective at the intended task of stress reduction. To have an accurate representation of a control group, future studies should have participants go straight to the speech from the preparation portion. Moreover, heart rate may not have been the best measure for our study because participants remained physically inactive throughout our study. This measure of stress may have been too coarse of a measure to actually see an increase in stress when giving a speech. This could explain why there was no statistically significant increase in heart rate following the speech in the control data.

Another potential explanation of why heart rate did not increase following the speech in the control data is the timing of data collection. In order to avoid introducing an additional stress during the task, measurements were taken during time periods when the participant was not being asked to perform a task. However, due to the delay in measurement, the heart rate might have already decreased to baseline when the measurement was taken. This could also show that heart rate returns to baseline more quickly than blood pressure and EDA.

In addition to altering the control group, the data could be more reflective of the population with a larger sample size. Ten participants in each group is not likely to yield an accurate distribution, however due to the length of our study per participant and the amount of time allotted, this was the largest possible amount of data capable of being collected. Another limitation was inability control the physiological states of participants prior to our study. Due to the nature of the class, in order to get participants, groups had to reciprocally give up members of their team to be the participants in other groups' studies. Toward the end of the study, we discovered that other experiments required more physical activity than our study. If a participant did not have enough recovery time between studies, their baseline measurements would not be representative of normal physiological levels.

It is important to note that at a statistical level of significance of .05, there were multiple findings that met these standards. However, in every situation in which this was the case, this significance was noted in the baseline data. It is the goal of data collection to obtain baseline data that is not causally different from one another; before any stress induction or treatment was given, it was necessary for all participants to have similar physiologic values, so as to accurately compare the impacts of an independent variable. In these cases where significance was noted, this data could not be used not only in the baseline measurement, but also throughout chronologic measurements that followed this because the initial groups being compared did not have differences in EDA due to chance.

When comparing the quality of presentations, some participants seemed more prepared than others. The quality of speech may be reflective of a student's year in school since many graduating senior participants are preparing for graduate school and job interviews. Some participants even concluded their participation in the study by acknowledging the amount of practice they had for our task from previous interviews. Graduating senior participants' preparedness may have given them an advantage in answering this particular question, affecting their results. This experiment did not take into account the demographic of participants, so it is suggested that future studies take this into consideration.

Overall, the results of data collected did not show statistical significance between the control and experimental groups, however changing the control group may more accurately reflect the effectiveness of art therapy. Since heart rate and blood pressure data significance contradicted other art therapy studies, further research on this topic is necessary to further understand the relationship between speech and art therapy (Monti et al., 2006; Spiegel, Malchiodi, Backos, & Collie, 2006). This experiment highlights the importance of collecting demographic information to control baseline data. Additionally, we may have underestimated the power of sitting for a couple minutes a day.

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Figures and Legends

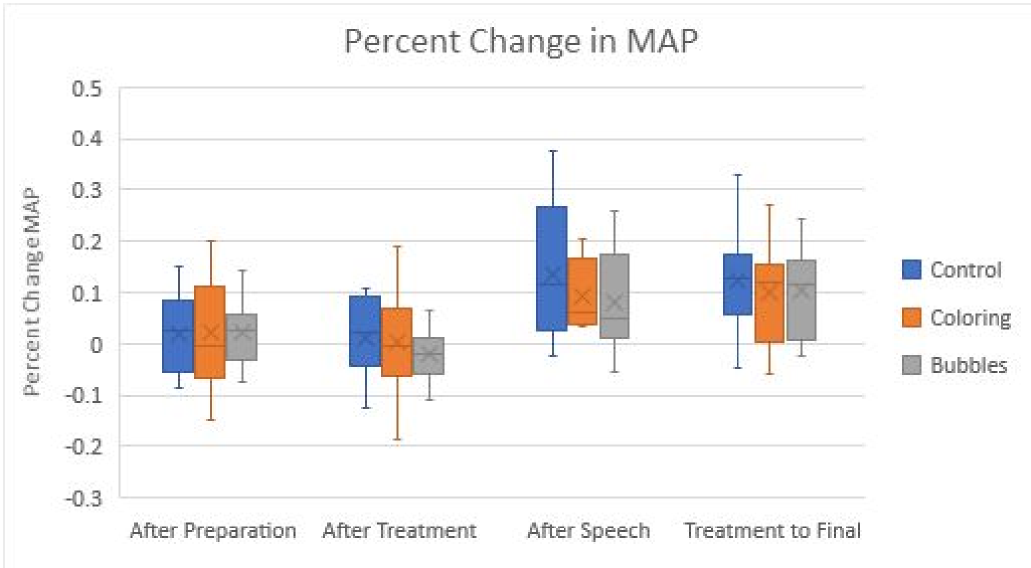

Figure 2: Average percent change in Mean Arterial Blood Pressure (MAP), shown for control group, coloring group, and bubbles group. Data is shown at four different timepoints: percent change MAP from initial MAP to after speech preparation, from initial MAP to after treatment, from initial MAP to after giving their speech, and the percent change MAP from treatment to final.

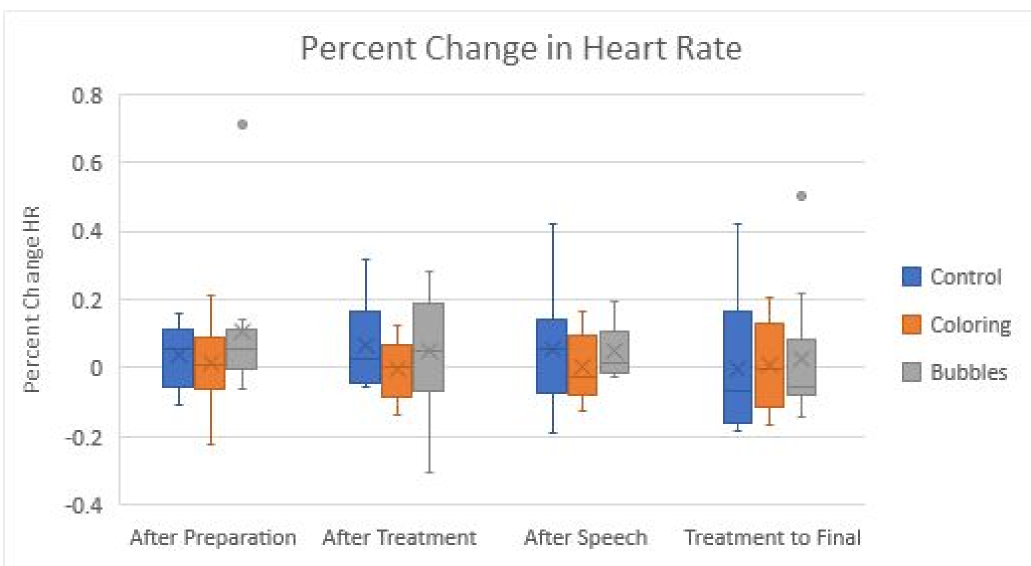

Figure 3: Average percent change in Heart Rate (HR), shown for control group, coloring group, and bubbles group. Data is shown at four different timepoints: percent change HR from initial

HR to after speech preparation, from initial HR to after treatment, from initial HR to after giving their speech, and the percent change HR from treatment to final.

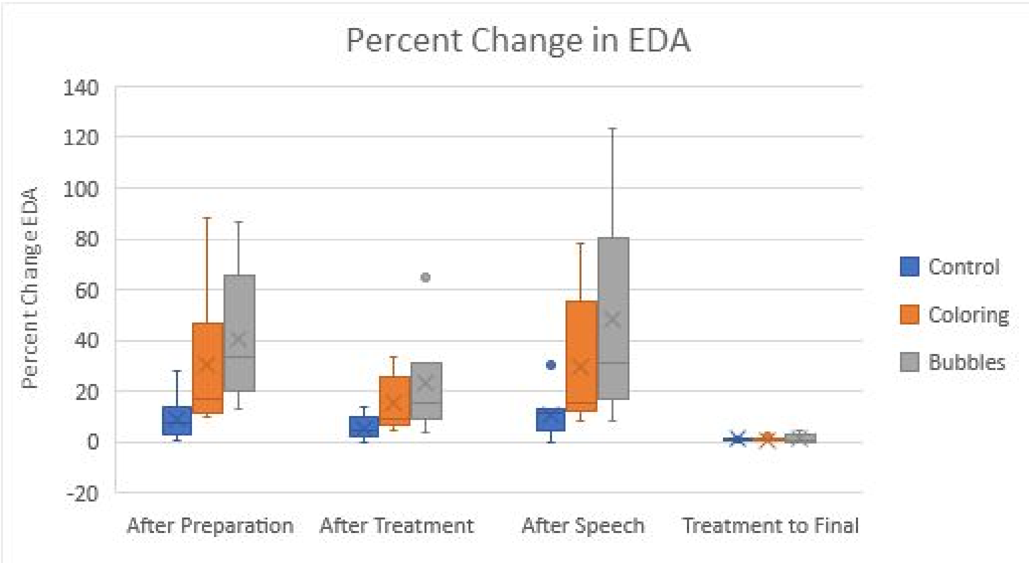

Figure 4: Average percent change in Electrodermal Activity (EDA), shown for control group, coloring group, and bubbles group. Data is shown at four different timepoints: percent change EDA from initial EDA to after speech preparation, from initial EDA to after treatment, from initial EDA to after giving their speech, and the percent change EDA from treatment to final.

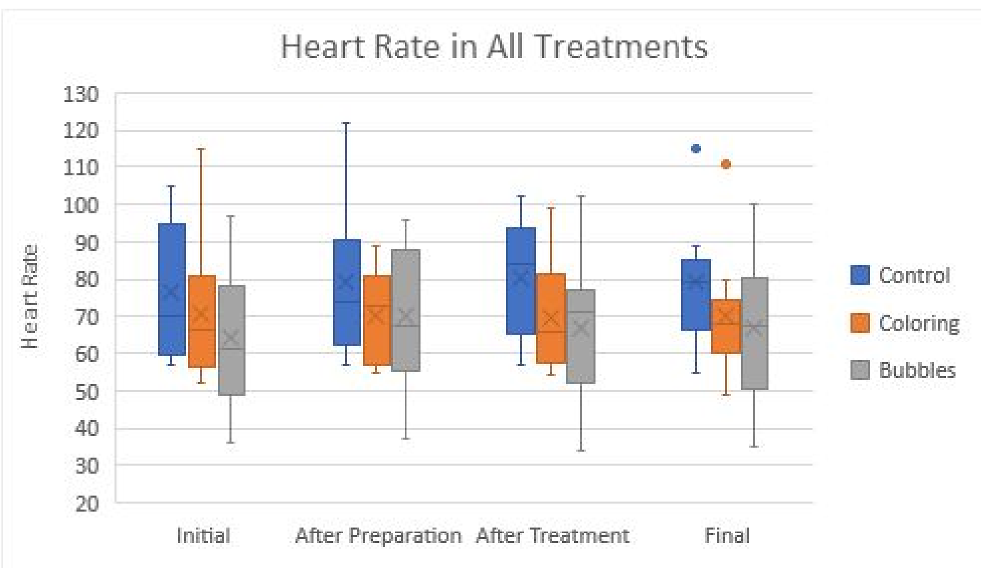

Figure 5: Heart Rate (HR) for all treatments shown at four timepoints: initial HR, HR after speech preparation, HR after treatment, and final HR.

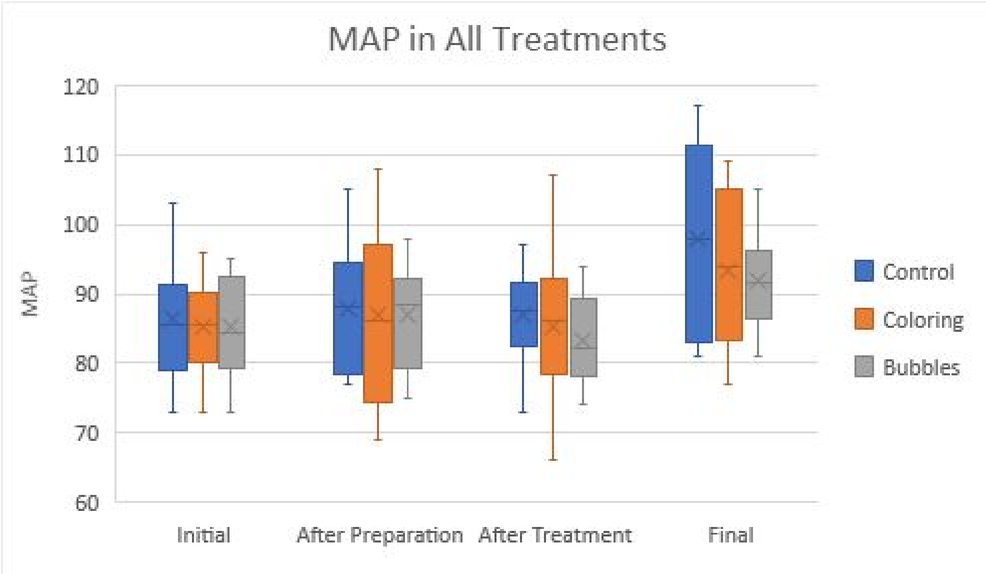

Figure 6: Mean Arterial Blood Pressure (MAP) for all treatments, shown at four timepoints: initial MAP, MAP after speech preparation, MAP after treatment, and final MAP.

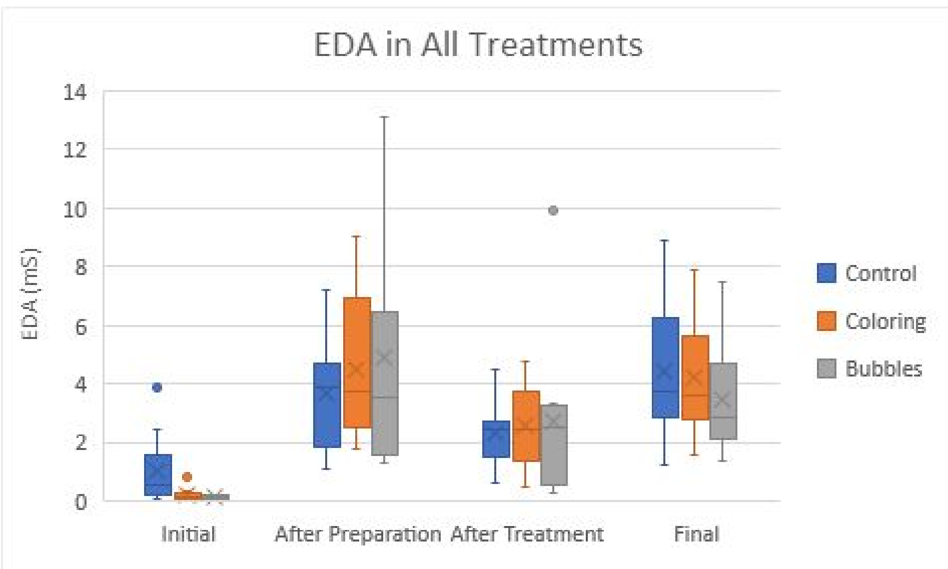

Figure 7: Electrodermal Activity (EDA) for all treatments, shown at four timepoints: initial EDA, EDA after speech preparation, EDA after treatment, and final EDA. Final readings for one participant who received bubble treatment had an outlier at a value of 18.66 mS, which is excluded in this figure.