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Can Coloring Reduce Stress and Increase Working Memory in the Elderly?

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Abstract

This study explores whether the observed effects of coloring on anxiety and stress apply to the elderly. Two coloring activities were administered to elderly participants to evaluate the effects on stress, anxiety, and working memory. The Mini Mental State Examination was used to establish cognitive level. The Perceived Stress Scale and Brief State Trait Anxiety Inventory were administered to obtain pretest and posttest scores on stress and anxiety levels. Working memory was measured using the Backward Digit Recall to test if the potential calming effects improve working memory. A near significant increase in stress scores was demonstrated in the mandala condition. Also, a significant increase was found in backward digit recall scores in the doodling condition. The mandala difficulty and allotted time may negate the anticipated calming effects. Those wanting to implement art therapy should provide the required materials, then allow participants to self-select the activity, and time to dedicate.

Introduction

With individuals living longer lives and being subjected to the increased stressors of aging, researchers should be concerned with promoting healthy aging outcomes. According to the 2010 United States Census (retrieved from census.gov, 2010) there were over 40 million Americans who were aged 65 and older, which accounts for 13% of the population. This was an increase of over five million individuals or 15.1% from the U.S census conducted in 2000. Primarily based on their age, this group is more susceptible to Alzheimer's disease, whether they have a family history of this disease or not. Due to the fact researchers cannot address an individual's age or hereditary, the focus moves to promoting healthy aging by improving risk factors such as stress and anxiety. Experiences of stress and anxiety have long lasting, detrimental effects on cognition and memory in elderly individuals and are linked to an increased risk for Alzheimer's disease (AD) development.

Alzheimer's disease: An Overview

Alzheimer's disease is the most common form of Dementia among the elderly, accounting for 70 to 80% of Dementia diagnoses. This disorder is highly prevalent among individuals age 65 and older and to date has no cure. The National Institute of Aging (retrieved from nia.nih.gov/Alzheimers) estimates that Alzheimer's affects about 5 million Americans and nearly 44 million individuals worldwide. If no cure is found, the Alzheimer's Association (retrieved from alz.org) anticipates that these numbers will increase, with a projected 16 million Americans affected by 2050.

According to the National Institute on Aging, Alzheimer's disease is an irreversible, progressive brain disorder that slowly destroys memory and thinking skills and will eventually affect the ability to carry out the simplest of tasks. A second definition used by clinicians defines

Alzheimer's disease as a clinical entity typically presenting with characteristic progressive amnestic disorder and the ensuing appearance of other cognitive, behavioral and neuropsychiatric changes that impair social functions and activities of daily living (Dubois et al., 2010). Both definitions point out the main features of Alzheimer's as memory loss with accompanying impairment of social skills and inability to complete daily living tasks.

Alzheimer's is listed as the sixth leading cause of death in the United States and it's listed as the third for elderly individuals (retrieved from alz.org/alzheimers_disease_what_is_alzheimers .asp). The Alzheimer's Association estimates that one in nine Americans, 65 years of age and older is diagnosed with Alzheimer's disease, with the occurrence of Alzheimer's increasing to one in three for those age 85 and older. The majority of these diagnoses occur in women. Those of African American or Hispanic American descent are also more likely to develop Alzheimer's disease than those of Caucasian descent. Typically, Alzheimer's disease develops slowly and becomes more severe over time, with a four to eight year life expectancy after receiving a diagnosis. The occurrence of Alzheimer's may decrease if healthy aging outcomes are increased in the elderly.

AD Causes: Stress and Anxiety

Stress has been shown to act as a risk factor for AD development by impairing areas of the brain and protein activity. Alkadhi and Tran (2014a) found that chronic stress may impair memory and long term potentiation (LTP) in elderly individuals who are cognitively normal but at risk of developing Alzheimer's. The CA1, a subarea of the hippocampus, is also vulnerable to stress even when combined with sub amyloid beta, with suppression of early-LTP magnitude (Alkadhi & Tran, 2014b). Experiencing daily psychosocial stress profoundly effects development of AD due to decreasing basal levels of p-CaMKII in the CA1, leading to the

impairment of learning, memory and synaptic plasticity, and may cause impairment in late-LTP, long term memory and basal levels of pCREB, which affects gene expression. The effects of chronic stress are evident in the significant increase in basal levels of the protein calcineurin, and decrease in basal levels of brain derived neurotrophic factor protein, both of with suggest chronic stress may impair memory and LTP in those who are cognitively normal but at risk for Alzheimer's development.

Impairment in short term memory was also established with chronic psychosocial stress, without affecting long term memory in the radial arm water maze, a maze containing spokes that radiate from the center, or learning ability, however longer periods of stress lead to impairment in both short and long term memory (Alkadhi & Tran, 2014b). A study conducted by Tran, Srivareerat, and Alkadhi (2011) demonstrated significant impairment in synaptic plasticity and learning in rat models at risk for AD when combined with chronic stress. They further concluded that molecular alteration induced by chronic stress may accelerate cognitive and synaptic plasticity impairment. Alberini (2009) also found chronic psychosocial stress contributes to accumulation of amyloid beta, a protein linked to AD. Srivareerat, Tran, Alzoubi, and Alkadhi (2009) indicated that along with cognitive insults formed by the onslaught of amyloid beta in the brain of people with AD, there was a co-occurrence in patients with AD where chronic stress further compromised their mental capacities. Chronic stress leads to impairment in the hippocampus, levels multiple proteins in the brain, and gene expression producing the deficits commonly associated with AD.

Impairment in spatial cognitive performance and memory can also be induced by chronic mild stress (Cuadrado-Tejedor et al., 2011). They tested this theory in mice by applying stress to aggravate the AD phenotype to employ the generation of AD murine models that represent the

sporadic forms of AD. Results indicated that chronic mild stress lead to impairment in the Morris water maze test and was correlated with an increase in CDK5-dependent phospho-tau levels in the hippocampus. In a review conducted by Machado et al. (2014), they concluded that chronic stress enhanced damage progression, sensitivity to inflammatory processes of brain areas, and accelerated the rate of aging related to AD onset. They partially attributed this stress response to the individuals' awareness of their age, health status, and the limitations associated with both of these variables (Machado et al., 2014). These results indicate that chronic stress may act as an environmental factor contributing to the development of AD by affecting areas of the brain associated with cognitive decline.

However, other findings indicate that anxiety may act as a marker for the severity of the disease, not as a predictor of AD, due to the increased frequency of occurrence as the clinical severity of AD increases (Gallagher et al., 2011). Ramakers et al. (2013) found an association between anxiety and cognitive decline, as well as an increased risk for developing AD, with state anxiety acting as a predictor for conversion to Alzheimer's disease from mild cognitive impairment (MCI).

The symptomatology of anxiety predicted the progression to AD from MCI with each additional anxiety symptom almost doubling risk (Palmer et al., 2007). Those who experience anxiety are also at least two times more likely to develop AD than those who do not (Burke, Maramaldi, Cadet, & Kukull, 2016). Palmer et al. (2007) established a 30 fold higher risk for the progression from MCI to AD and those with MCI were more likely than those with normal cognitive aging to experience anxiety related symptomatology. They concluded that the predominant predictive feature for the progression from MCI to AD was anxiety. This was possibly attributed to the individual's awareness of memory loss and cognitive disturbances or

that the group in the preclinical phase exhibiting symptoms progress to clinical AD at a faster rate (Palmer et al., 2007). Those with MCI who also experience anxiety may represent a reaction to the initial phases of cognitive deterioration (Palmer et al., 2007). Anxiety symptoms are also associated with quality of life (QoL), functional outcomes, environmental and social variables, as well as an increased prevalence of other behavioral and neuropsychiatric symptoms (Seignourel, Kunik, Snow, Wilson, & Stanley, 2008).

Anxiety is also correlated with morphologic and functional changes in the brain. Tagai et al. (2014) found a significantly negative correlation between anxiety and grey matter volume in the precuneus and the inferior parietal lobule, as well as a significant positive correlation with the rCBF in the bilateral anterior cingulate cortex. Also anxiety was correlated with affective symptoms, atrophy of right PCS and IPL, and hyperfusion of the bilateral anterior cingulate cortex (Tagai et al., 2014). They established a neurobasis for anxiety being associated with the specific degeneration characteristic of Alzheimer's disease (Tagai et al., 2014). Beauquis et al. (2014) found that transgenic mice exhibited increased anxiety when compared to control mice, and those with an anxious phenotype associated with marked c-Fos neuronal activation in the central and basolateral amygdala. Reducing experiences of stress and anxiety in the elderly or those at risk of developing AD could prevent or slow its progression and increase healthy aging outcomes.

Working Memory in AD

Due to the negative effects of stress and anxiety on the brain, another variable of interest is working memory (WM) and its ability to predict cognitive decline. Huntley and Howard (2010) as well as Van eldorp et al. (2015) found that WM is impaired in mild AD and may be affected in the preclinical stage of the disease, and as such could act as a useful diagnostic marker for

early staged AD. In addition, those with Alzheimer's also display dual task impairment involving a deficit in the sufferer's ability to perform two tasks at the same time and to manipulate information maintained in the working memory. Both the ability to perform dual tasks and to manipulate information are functions of the central executive, independent of storage deficits or processing speed. A third deficit was also demonstrated in the ability to divide attention, which typically develops in mild AD and progressively worsens as the disease progressed. These results demonstrate that as AD progresses, different neurological functions become impaired and eventually deteriorate.

Gagnon and Belleville (2011) found that both those with AD and those with MCI exhibited impaired WM in both sentence and operation span tasks and that forgetting plays a role in WM for both complex span tasks. All normal aging, MCI and AD groups confirmed the classic stimulus order effect exhibited by their sensitivity to the manipulation of interval length and demonstrated the worst performance when the last item was longer and the retention duration was increased. Those with AD also recalled significantly fewer primacy items in sentence and operation span, whereas those with MCI demonstrated impairment with primacy in sentence span when compared to healthy participants. These findings indicate that in both individuals with MCI or AD, WM is impaired for complex tasks and that within WM forgetting plays a role exacerbated by degenerative disease. Also for those with MCI, complex span tasks, especially those with a long interval duration, can be used to distinguish them from healthy aging individuals.

Working memory can also predict the decline in those with MCI to AD. At a 20 month follow up, a discriminant function analysis indicated that a combination of visual episodic memory, verbal episodic memory, visual immediate memory span, visual WM capacity, divided

attention, as well as sustained attention, and target detection accurately classified the possible decline outcome for those with MCI (Summers & Saunders, 2012). This measure set was able to identify accurately 100% of the cases where progression to AD from MCI occurred. This study also found that the presence of amnestic impairment alone was lacking predictive reliability and in order to validly identify individuals at risk for short term development of AD, exhibited a pattern for greater predictive reliability for emergence of AD when multiple subclinical impairments in episodic memory, executive function, attention, short term memory span, and WM capacity occurred. They also showed that differentiating between those participants with MCI who develop AD within 20 months exhibited a pattern of impairments in their episodic memory, short term memory, WM and attentional processing.

Working memory is also impacted by the development of mild cognitive impairment and becomes increasingly impaired in AD. An impairment was demonstrated on the working memory binding task, that required the maintenance of two house face combinations with a short delay between trials, but there was no presence of a floor effect (Van eldorp et al., 2015). These results can be explained due to the task exceeding the participants working memory capacity, so impairment may indicate that working memory capacity is exceeded, whether the maintenance interval used is short or long. Results from Gagnon and Belleville (2011) demonstrate that progressive impairment in working memory occurs from healthy aging to degenerative disease, with impairment in working memory in complex span tasks found in MCI and to a greater extent in AD.

Castel, Balota, and McCabe (2009) found that WM capacity was also related to recall of high value items, those rated as most important to remember, but not low value items, those rated as least important to remember, in older adults and those with AD. This finding indicates that those

with more efficient WM functioning were more effective at directing their attention to encoding higher value items. Alzheimer's disease exhibited a working memory span with profound problems, as well as being consistently compromised when there was an increase in load (Stopford, Thompson, Richardson, Neary, & Snowden, 2010). Baseline performance on measures of working memory and naming, initial behavioral symptoms, and demographic factors predict the rate of cognitive and functional decline in a longitudinal cohort with autopsy confirmed Alzheimer's (Pillai, Bonner-Jackson, Walker, Mourany, & Cummings, 2014). Those with better digit span backward task initial performance were associated with slower rates of functional decline over time. They also concluded that a slower decline rate in both the Mini Mental State Examination and global functioning was associated with relatively preserved frontal lobe functions of attention and working memory. Therefore research indicated that improving working memory performance may decrease functional decline rates in those with Alzheimer's.

Art Therapy for Alzheimer's

Art therapy is commonly used to treat a wide variety of symptoms, both emotional and behavioral, in the elderly or those who are suffering from Alzheimer's(Chancellor, Duncan, & Chatterjee, 2014; Cowl & Gaugler, 2014; Ehresman, 2014). Recent research demonstrates that art improves biological, psychological, and social factors through the promotion of coping strategies, positive emotions, and acceptance of life changes after receiving an Alzheimer's diagnosis. Hattori, Hattori, Hokao, Mizushima and Mase (2011) established that after art therapy, patients in a care facility, exhibited improved attention, interest, emotions of joy, self-respect, and quality of life in Alzheimer's sufferers. An analysis of art therapies for Alzheimer's patients in care facilities demonstrated that creative arts improved patient's quality of life, amelioration of

their behavioral symptoms, and improved their emotional states (Cowl & Gaugler, 2014). Ehresman's (2014) study on art therapy for people with Alzheimer's indicated that art making has a soothing effect that reduces agitation and elevates moods of people with Alzheimer's. Improvements in these areas can help with feelings of loss, change, uncertainty and depression associated with an AD diagnosis. These studies and literature reviews demonstrate the positive benefits of art therapy on emotional, social, and behavioral issues experienced by patients with Alzheimer's disorder by helping them deal with their diagnosis and deteriorating abilities.

Art therapy also engages individuals' attention, provides pleasure, affects brain areas and improves neuropsychiatric symptoms, social behavior, and self-esteem (Chancellor, Duncan, & Chatterjee, 2014). Findings indicate that quality of life (QoL) is also improved by the introduction of art therapy, and that several brain regions are simultaneously stimulated, such as the hippocampus, amygdala, and right posterior region, promoting plastic brain processes and promoting a healthy brain (Ehresman, 2014). Findings from a creative arts therapy study demonstrated that behavioral symptoms, such as aggression and agitation, as well as emotional symptoms, such as depression and hope, associated with Alzheimer's disease improved (Cowl & Gaugler, 2014).

While there are many forms of art therapy, coloring has specifically been shown to significantly decrease anxiety levels. In a study conducted with adults with intellectual disabilities, researchers indicated that a significant decrease in participants' systolic and diastolic blood pressure in the mandala condition existed. Results demonstrate that mandalas can be used to effectively reduce stress by reducing the arousal of the sympathetic response and increasing the parasympathetic or relaxation response. For individuals with intellectual disabilities mandala making was to be cognitively appropriate, simple, and may have a calming effect in periods of

stress or anxiety (Schrade, Tronsky, & Kaiser, 2011)). A study conducted by Sandmire, Gorham, Rankin, and Grimm (2012) found that those in the coloring group exhibited significant decreases in scores of state and trait anxiety. Carsley, Heath, and Fajnerova (2015) also showed that free coloring and the coloring of mandalas was linked to a significant reductions in anxiety scores. In one study, researchers found that coloring a mandala was a more effective stress reducer than free form coloring in college aged students (Curry and Kasser, 2005). The researchers believed this result was due to the structured coloring of complex geometric patterns which may induce a meditative state that benefits anxiety sufferers. This pattern of results was replicated with college students by van der Vennet and Serice (2012).

This meditative state may be induced through mindfulness, though this has not been directly investigated. Marciniak et al. (2014) define mindfulness as the ability to focus on the present moment and to perceive current internal or external impulses, which emerge in consciousness at any given moment, without judgment or choice. A pilot study conducted by Wells, Yeh, Kerr, and Wolkin (2014) indicated that a trend existed after 8 weeks of mindfulness, with patients with MCI exhibiting reductions in atrophy of the hippocampus. Functional connectivity between the posterior cingulate cortex and hippocampus, as well as the hippocampus and the medial prefrontal cortex, also exhibited improvement. Mindfulness has demonstrated an ability to preserve hippocampal function through increased connectivity and reduced atrophy.

Mindfulness may also be used to reduce adverse risk factors, and increase memory, attention and cognition. Larouche, Hudon, and Goulet (2015) suggest that modifiable adverse factors, such as stress, that may lead to MCI or AD may potential be reduced through the introduction of mindfulness interventions. Research on mindfulness also shows increases in memory, attention, executive functions, and processing speed (Gard, Holzel, & Lazar, 2014).

They also found a trend toward improved cognition after mindfulness interventions in patients with MCI. Newberg, Wintering, Khalsa, and Roggenkamp (2010) demonstrated that enhanced memory performance was exhibited in those with subjective memory impairment, MCI, or mild Alzheimer's after participating in a mindfulness activity.

Present study

While art therapy has been widely investigated in individuals with Alzheimer's disease (Chancellor et al., 2014; Ehresman, 2014), relatively few studies have explored the potential benefits of coloring, specifically. Based on the emerging coloring research in college students, the primary aim of the present study was to ascertain whether coloring can decrease stress and anxiety, and improve working memory in an elderly sample. Results from previous research indicates that coloring the mandala with exhibit a greater benefit than doodling. Coloring may be an effective intervention by engaging the participant's attention, providing a pleasurable, and calming activity for individuals to take part in.

As a comparison art therapy, participants were asked to free color or doodle. Doodling is an unstructured form of art therapy, whereas the mandala is structured. This difference allows for the comparison of the two art types to see which may provide the benefits found in art therapy. This task was, also, chosen based on the Andrade (2009) study, as well as its use in the study conducted by Curry and Kasser (2011). Anxiety scores in the Curry and Kasser (2011) study exhibited no significant differences between anxiety scores before and after the doodling activity. In the Andrade study, she found that participants who were doodling while monitoring a task were able to recall 29% more information in a surprise memory test than those who did not doodle. Andrade attributed these results to the possibility that doodling reduces daydreaming which, in turn, may aid in cognitive performance. We believe that doodling will increase the

working memory scores of elderly patients but that there will not be a decrease in anxiety scores. By reducing daydreaming in participants, they will exhibit an increase in their cognitive performance attributable to an increase in attention to the task.

The decision to focus on the elderly, more generally, rather than those with Alzheimer's is because individuals who are 65 and older have an increased risk of AD development. This risk is further increased for those who experience increased levels of stress and anxiety. By focusing on risk factors, such as stress and anxiety, which are more easily addressed than an individual's age, the prevalence of AD development may decrease or development may be delayed allowing for a longer, healthy life.

Method

Participants

We used a sample of 17 elderly individuals recruited from care facilities in the Jacksonville area, as well as through personal contacts. All patients in our study were between the ages of 65 and 92 (M=72.933, SD=9.106), and our sample consisted of 14 females and three males.

The majority of participants were Caucasian (n=16), with one participant identifying as Hispanic. All participants took the Mini Mental State Examination to obtain their cognitive level, results showed a range of scores from 16 to 30 (M=26.294, SD=4.647), 82.35% of the sample had a score of 24 or greater, which is indicative that they had no cognitive impairment.

Materials

Mini-Mental State Examination. The Mini-Mental State Examination (MMSE) (Folstein, Folstein, & Mchugh, 1975) was administered first, to establish scores for participants' cognitive ability. This examination includes 11 questions and is divided into two sections for a

combined maximum score of 30. The first section requires vocal responses and covers orientation, memory and attention for a maximum score of 21, the second section tests the ability to name, follow verbal and written commands, write a sentence spontaneously and copy a complex polygon for a maximum score of nine. A score of 24 or above indicates normal cognition. Lower scores indicate that the individual is suffering from a cognitive impairment with lower scores associated with greater deficits. MMSE has retest reliability on a 24 hour or 28 day time line when administered by one or multiple examiners. Tombaugh and McIntyre (1992) found that test retest reliability for administration within two months ranged from 0.80 to 0.95. Folstein, Folstein, and McHugh (1975) established that Cronbach's was between 0.82 and 0.84 indicative of good internal consistency.

Brief State-Trait Anxiety Inventory. The Brief State-Trait Anxiety Inventory (Tluczek, Henriques, & Brown, 2009; Marteau & Bekker, 1992) was administered to assess state anxiety levels. This inventory consists of six items with the highest item to item correlations from the 20 question original inventory. All questions are measured on a four-point Likert Scale, where one is equivalent to almost never and four is equal to almost always. Higher scores are indicative of a higher level of state anxiety. There is good internal consistency for this inventory with Cronbach's alphas ranging between .82 and it was also found to be highly correlated with the full 20-item state portion of the State-Trait Anxiety Inventory.

Perceived Stress Scale. We administered the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) to measure to what degree the individuals appraised their life situations as stressful. It is suggested for use to study nonspecific appraised stresses role in disease etiology and behavioral disorders. This scale consists of 10 questions in two areas, psychological competency and psychological vulnerability. Each question is rated on a five-point scale with

zero being equal to never and four equaling very often. Higher scores are indicative of a greater degree of perceived stress. Cronbach's alpha coefficients for this scale was between .82 indicating the good validity exists (Ezzati et al., 2015).The correlation between this measure and measures of similar symptoms was between .52 and .76. Test retest reliability evaluated at two days and four weeks was higher than 0.70 in the four studies assessed (Lee, 2012; Cohen, Kamarck, & Mermelstein, 1983).

Automated Working Memory Assessment. Working memory was measured using a modified version of the Backward Digit Recall Task from a standardized assessment, the Automated Working Memory Assessment (Alloway, 2007). The individual recalls a sequence of spoken digits in the reverse order. The test begins with recalling two numbers in backward order and increases by one item in each block, up to nine numbers per block. There were two trials in each block and the number stimuli were randomized for the different testing phases. Scoring was calculated based on the highest block (span) where they correctly recalled one of the two trials and a trial score was obtained based on the number of correct trials obtained. Test reliability is reported as .86 (Alloway, 2007).

Procedure

Participants were recruited through care facilities in the Jacksonville area, as well as through the personal connections of the researchers. All testing for the groups, which consisted of between two and four participants, were conducted in the same environment for each activity. Testing locations included rooms at care facilities, a classroom at the University of North Florida, and a community room in a library.

Each participant completed the paper and pencil testing in both art making conditions (mandala and doodling) approximately one week apart. The experiment was a within participants

design. The procedures for both sessions were the same, other than the different coloring activities. Regardless of the coloring activity, all participants colored for an uninterrupted 20 minutes, chosen based on the Curry and Kasser (2011) study, in the presence of a researcher and were provided with 12 colored pencils. The researcher provided direction and guided participants back to the task when they became distracted.

On day one participants completed the informed consent form and a demographic questionnaire. Those recruited from care facilities also provided consent forms from their families before testing began. Phase one (Pre-test) comprised paper and pencil versions of the Mini Mental State Examination, a Perceived Stress Scale, the Brief State-Trait Anxiety Inventory-S and the Backward Digit Recall task. The Backward Digit Recall task involved the researchers verbally listing a sequence of numbers and instructing participants to write them in reverse order. This task starts with two trials with two numbers and increases to three numbers and continues to increase until two consecutive trials for a number are missed.

In phase two (Coloring Condition), the researcher provided either a mandala-coloring sheet or a blank sheet of paper (8.5”x11”) to the participant. The researcher directed the participants with written and verbal directions to use the provided colored pencils to fill in the following image (mandala in one condition, free draw for another with these being counterbalanced.) In the mandala condition, participants were told to choose any colors they want and color for 20 minutes. In the doodling condition, participants were provided with supplies, a blank 8.5”x 11” sheet of paper and a 12 pack of colored pencils, and asked to draw whatever they could think of for the allotted twenty minutes. All participants stayed seated for the full 20 minutes, and when they lost focus were immediately redirected to the task.

The conditions were counterbalanced so that every participant in group an odd numbered group was administered the mandala first and everyone in an even numbered group received the doodling condition first. Analysis indicated that there was no significant difference in scores for those who received the mandala first and those who doodled first. Following the coloring activity, the participants completed the scales from phase one (phase 3; Post-test).

On the second visit the procedures followed the same order as they did on the first day. The participants completed the same measures as they did phase one (Pretest). In phase two (Coloring Condition), the researcher provided the coloring activity that was not completed in the first visit. The participants completed the same measures in phase three (Posttest) as they did in phase one (Pretest). The experiment concluded with the debriefing of the participants.

Results

Coloring Type

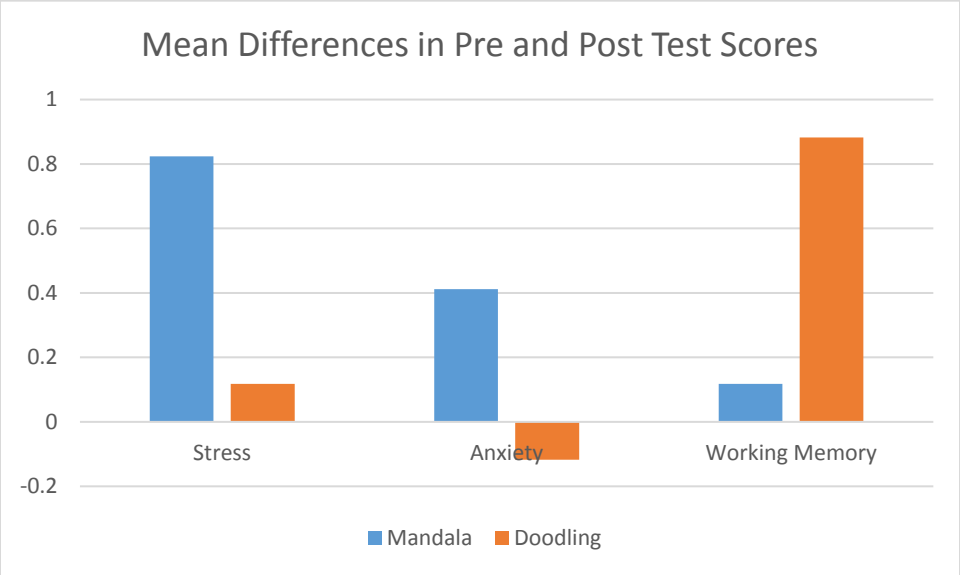
Descriptive statistics are provided in Table 1 for all variables of interest. Difference scores were calculated by subtracting the pre-test scores from post-test scores for stress, anxiety, and the trial scores for backward digit recall, so that positive scores showed increases in stress, anxiety, and working memory (Graph 1).

Table 1. Descriptive Statistics of pre and posttest stress, anxiety, and backward digit recall trials scores

Mandala	Mean	Standard Deviation
Pretest Stress	11.529	6.587
Pretest Anxiety	9.706	3.138
Pretest Working Memory	7.411	3.163
Posttest Stress	12.353	6.528

Posttest Anxiety	10.118	4.136
Posttest Working Memory	7.529	2.552
Doodling	Mean	Standard Deviation
Pretest Stress	12.882	6.873
Pretest Anxiety	10.177	3.450
Pretest Working Memory	6.588	3.063
Posttest Stress	13.000	8.155
Posttest Anxiety	10.059	3.508
Posttest Working Memory	7.471	2.875

Graph 1. Mean of difference scores for stress, anxiety, and working memory based on coloring condition



There was a non-normal distribution on difference scores of stress, anxiety and working memory scores without controlling for Mini Mental State Examination scores indicating that a Kruskal Wallis test should be used. The grouping variable for this analysis was the coloring

condition (mandala vs. doodling) and the testing variables were the difference scores for the pre and posttest measures of stress, anxiety, and backward digit recall trial. Analysis of the two coloring types demonstrated that there was no significant difference between the two art making forms in stress (χ^2 (1) =1.371, p=.242) and anxiety (χ^2 (1) =.273, p=.601). Backward digit trial difference scores were not significantly different, however they did approach significance (χ^2 (1) = 2.599, p=.107) indicating that there may be a difference in coloring types effect on working memory.

Stress

To investigate whether a significant difference existed in pre and posttest stress scores, a Wilcoxon Signed Rank test was used, due to the same number of participants in our sample. The file was split based on coloring types with pre and posttest scores on the Perceived Stress Scale used as the test pair. Results demonstrated that doodling showed no significant difference in pre and post test scores (Z=-.191, p=.849), however stress scores in the mandala condition approached significance, with an increase in stress found only the mandala condition (Z=-1.760, p=.078).

Anxiety

A Wilcoxon Signed Rank test with the file split based on coloring type was also used to determine if a change in pretest and posttest Short State Trait Anxiety Inventory scores occurred. There was no significant change in anxiety scores in either the mandala (Z=-.079, p=.937) or doodling conditions (Z=-.352, p=.725).

Working Memory

Finally a split file Wilcoxon Signed Rank test was used to determine if a change in pretest and posttest Backward Digit Recall trial scores occurred. Working memory scores were

significantly different only in the doodling condition (Z=-2.124, p=.024). Results indicated that doodling significantly increased working memory. There was no significant change in working memory trial scores in the mandala condition (Z=-.122, p=.903).

Discussion

The general pattern of findings demonstrated a near significant increase in stress scores in the mandala condition, as well as a significant increase in working memory for the doodling condition. There is an overlap for art therapy and stress in the hippocampus (Alkadhi & Tran, 2014b; Cuadrado-Tejedor et al., 2011; Ehresman, 2014) and for art therapy and anxiety in the amygdala (Beauquis et al., 2014; Ehresman, 2014). Based on prior readings, there is no overlap between art therapy and working memory in the areas of the brain that they affect. We will examine the effects of art therapy as it refers to each measurement in turn.

Stress

Stress scores in the mandala condition approached significance, exhibiting an increase only in the mandala condition. For both conditions, participants exhibited hesitation when presented with the task and instructions. When participants were presented with the mandala and asked to color for 20 minutes, every participant expressed concern about whether they would be expected to finish the design and concern they would not be able to finish in the allotted time. These concerns were addressed and participants were assured they only had to do the best they could and were not expected to color the entire design. This initial moment of stress may have contributed to the increases shown in the post-test scores.

There was no significant difference in pre and posttest stress scores in the doodling condition. In this condition, participants drew any image that they wanted and did not exhibit any concern about the time limit. Participants, however, demonstrated difficulty staying on task for

the full 20 minutes, with the majority only being fully engaged in the activity for about 10 minutes before they became sidetracked or bored with the task, whereas in the mandala condition they were fully engaged for the entire 20 minute session. This condition was not well received, most participants had no idea where to begin, or what to draw. It is likely that this is attributable to the lack of guidance and structure in this condition.

Schrade, Tronsky, and Kaiser (2011) attributed the decreases in systolic and diastolic blood pressure in those in the mandala condition to decreases in the activity of the sympathetic system and increases in the response of the parasympathetic or relaxation system. The participants' experiences of frustration and boredom with both conditions could negate these findings. The nonsignificant findings in the doodling condition may be caused by the experience of boredom, disengaging participant's attention so they are unable to experience decreased sympathetic and increased parasympathetic activation. Frustration in the mandala condition may have led to the nearly significant increase in stress due to increased sympathetic and decreased parasympathetic activation. Either explanation indicates that the mechanism between stress and art therapy in the hippocampus may not have been tapped into (Alkadhi & Tran, 2014b; Cuadrado-Tejedor et al., 2011; Ehresman, 2014).

Anxiety

There was no significant change in pre and posttest anxiety scores for either the mandala or the doodling condition, possibly because the conditions were unable to tap into the mechanism between anxiety and art therapy in the amygdala (Beauquis et al., 2014; Ehresman, 2014). There are several possibilities for this finding. Participants did not chose the design of the mandala, and were verbal about the difficulty level of the given mandala. The time constraint was also a concern for the mandala condition, even with assurances that they were not expected to finish the

design participants were initial concerned and this may have negated the anticipated decrease in anxiety scores. The opposite was seen in the doodling condition. Participants started to lose interest and become distracted about half way through the 20 minute session. Also, the lack of structure was an issue in the doodling condition with participants struggling to think of designs to draw. Overall concerns about the structure and time limit in both conditions may be responsible for the lack of a calming effect. In a meta-analysis conducted by Chancellor et al. (2014), they point out that art therapy research has been conducted with time limits ranging from 15 minutes to one hour and with a wide range of activities. The amount of time to complete each activity should be indicative of the degree of difficulty, so that participants have more time to color the mandala and less time to doodle. The time constraints and task difficulty may have also prevented participants from achieving mindful states. Curry and Kasser (2005) attributed the decreases seen in anxiety scores in the mandala condition to mindfulness.

Working Memory

Results indicated that doodling significantly increased working memory. This provided further evidence in line with the results from the Andrade (2009) study. Andrade attributes this finding to a decrease in day dreaming. Decreasing the amount of day dreaming allows the participants to pay more attention to what is happening around them and being more aware of the information presented. Participants in this study, however, did not exhibit increases in attention during the entirety of the doodling activity. Although engaged for part of the allotted time, eventually they become bored and had difficulty paying attention to the task indicating that increased attention may not be the underlying mechanism for increases in working memory. The frontal lobe is affected by working memory (Pillai, Bonner-Jackson, Walker, Mourany, & Cummings, 2014), however research shows that art therapy does not affect this brain region

(Ehresman, 2014). These findings demonstrate that the mechanism underlying the increases found in working memory cannot be attributed to either frontal lobe changes or increases in attention but through some third mechanism.

The mandala condition may not affect day dreaming, indicating the locus of focus is not on what is going on around them. Participants are thought to enter a state of mindfulness which requires an inner focus (Curry & Kasser, 2005). They simply had to color a predesigned mandala which did not require any focus on the task itself, whereas in the doodling condition they were responsible for focusing on the task and creating images. The emphasis on inner focus instead of focus on the task at hand may explain the lack of significant results in this condition. Possible evidence of a lack of outer awareness was evidenced by surprise when time was called and such intense focus that time needed to be called multiple times in order to regain the participants focus.

Limitations

There are a few limitations that need to be addressed in future research. First, the sample size used was small, G power was used to conduct a power analysis and suggests that a study like this should be conducted with at least 54 participants, however due to time constraints only 17 participants were able to be recruited. Secondly, as mentioned before participants were concerned with the complexity of the chosen mandala. The design was intricate and involved small pieces that may have been too complex or intimidating given the 20 minute time constraint. In future research, a range of mandalas should be selected for the study and then allow participants to select the design they feel most comfortable working on in the allotted time.

Another concern in our sample was the participant's fine motor control. The intricate mandala design and the use of colored pencils may have posed a problem for some of the

participants, especially those suffering from arthritis. It was noticed that participants were having difficulty staying within the lines and at times even gripping the pencils. Colored pencils were chosen based on suggestions that art therapists and researchers provide age and cognitively appropriate materials, (Chancellor et al., 2014) as well as their use in the Curry and Kasser (2011) study. Even though colored pencil are age appropriate, using markers may have been easier to use for participants with motor control deficits or arthritis.

Also as mentioned before the structure of both conditions presented their own issues. This leads into the final limitation is the time limit. It is possible that by increasing the time limit for the design in the mandala condition, allowing for adequate time to complete the task, a calming effect may have been found. Along the same lines, by decreasing the time limit in the doodling condition we could have possible observed a calming effect by preventing the boredom that was observed. The level of difficulty in the structure of the task and the allotted time limit are two integrated aspects of art therapy implementation. Tasks with a more difficult structure tend to have longer time limits and those that are less structured have smaller time limits (Chancellor et al., 2014).

Future Research

These results indicate that art therapy needs to be individualized. Participants all reported enjoying both coloring activities to differing degrees. Individuals should be allowed to self-select into an art form that they enjoy most. Also in art therapy, the time limit which concerned all participants should be addressed. Allowing individuals to color or doodle for as long as they chose could benefit participants and possible produce the anticipated results. Those concerned they would not be able to finish would have all the time they want on the activity, and those who had difficulty staying on task would be able to leave when they became bored. I suggest that

facilities who implement art therapy provide all necessary instruments in a common area allowing residents free access to choose an activity and dictate for themselves how long they want to participate.

Another interesting avenue for future research is the use of the new coloring apps on the market. This could allow individuals with motor control or impaired vision more control over the mandala designs. They would not only be able to choose a design they like, but to blow up portions of the design that would otherwise cause distress, or to increase the size of the entire design for those with vision impairments. These apps make the coloring process easier by just tapping the desired color and then tapping the area they would like the color to go in.

Summary

Both coloring conditions exhibited no significant difference between stress and anxiety profiles. In the doodling condition working memory demonstrated a significant increase, which is consistent with past findings. Those who want to implement art therapy should provide all of the necessary supplies, then allow participants to self-select the activity, design, and amount of time they would like to devote to the task.

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