REMEMBER TO COLOR:

HOW COLORING IMPACTS ELDERLY MENTAL HEALTH AND WORKING MEMORY

by

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THESIS/DISSERTATION CERTIFICATE OF APPROVAL

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Abstract

In the study of gerontology, mild cognitive impairment (MCI) has received much attention as it is the progressive stage before Alzheimer's disease (AD). According to lifespan studies, people with MCI advance to AD at a much-accelerated pace than people without MCI. In this study, I am investigating whether art activities (coloring versus drawing) has any influence on the elderly's levels of stress and anxiety. More specifically, current research in art therapy points to a significant reduction in participant's stress and anxiety levels after being involved in coloring and drawing activities. In addition to mental health, I am also investigating how these art-related tasks of coloring and drawing can induce a positive change in the elderly's working memory levels. This study seeks to answer the following questions with older adults over the age of 65: To what extent does coloring affect their anxiety and stress levels? To what extent does coloring affect their working memory levels? Are there differential effects between participants with MCI versus non-MCI participants (as measured by the Mini-Mental Status Examination)? Our findings demonstrated that overall, there were no significant changes in their stress and anxiety levels after coloring or drawing. However, analyses revealed a significant increase in working memory trial scores from pretest to posttest for participants with MCI who colored a mandala. This could be because the mandala may have provided a structure and sense of direction that the drawing condition lacked. This finding is especially important as the participants that benefited the most from coloring were participants with MCI.

Remember to Color:

How Coloring Impacts Elderly Mental Health and Working Memory

Mild Cognitive Impairment

Diagnosis

In the field of aging and dementia, there is an increased focus on the transitional stage between cognitive impairment and Alzheimer's disease (AD) known as mild cognitive impairment (MCI). After longitudinal observations, individuals with MCI progress to AD at an accelerated rate compared to healthy, non-MCI individuals. Morris et al. (2001) states that MCI is perceived as a boundary or transitional state between aging and dementia. Memory concern is both the common complaint in individuals with MCI and the cardinal feature of Alzheimer disease (AD). The diagnosis of MCI is established by (1) evidence of memory impairment, (2) preservation of general cognitive and functional abilities and (3) absence of diagnosed dementia (Morris et al., 2001). In the current Diagnostic and Statistical Manual of Mental Disorders (DSMV) (American Psychiatric Association, 2013), dementia is included under the new term *major neurocognitive disorders (NCD)* and also recognizes the less severe level of cognitive impairment *mild neurocognitive disorder* which can be a focus of treatment.

The DSMV (APA, 2013) defines neurocognitive disorders as impaired cognition that has not been present since birth, thus representing a decline from previously attained functioning. Criterion A for Major and Mild Neurocognitive Disorders posits that there must be evidence of significant cognitive decline from the previous level of functioning in one or more cognitive domains (attention, memory, language, etc.) based on concern from the individual or informant about significant decline, and impairment reported by neuropsychological testing. Criterion B states that cognitive deficits interfere with everyday activities and independence, requiring

assistance to pay bills or manage medications. Criterion C states that these deficits do not happen in the context of delirium.

The DSMV (APA, 2013) also explains that at the mild NCD stage, apathy and depression are often seen. The mean duration of survival after being diagnosed with major or mild NCD is 10 years, but this may be due to the advanced age of the individual rather than the course of the disease. In mild NCD due to AD, cognitive impairments increase over time and functional status decreases until symptoms reach criteria for major NCD diagnosis. Younger individuals are likely to live longer with the diagnosis, while older individuals often have medical comorbidities that affect the course and treatment of the disease.

A study by Morris et al. (2001) suggested that individuals currently characterized as having MCI progress steadily to greater stages of dementia severity at rates dependent on the level of cognitive impairment and they almost always have the neuropathologic features of AD. Morris et al. (2001) conclude that MCI generally represents early-stage AD. According to Petersen et al. (1997) in MCI and AD patients, encoding information is defective and the recall of learned information is truly impaired. This may be because Alzheimer's disease creates lesions in the entorhinal cortex, performant pathway, and hippocampal formation of the medial temporal lobe, parts that are important for encoding and retrieving learned information.

Neuropathology

There is a current understanding that hippocampal atrophy in amnestic MCI patients is a predictor of clinical AD conversion (Petersen et al., 2001). In a study of the neuropathology of MCI, all 16 patients with MCI and AD demonstrated neurofibrillary tangles in the hippocampus and entorhinal cortex (Gauthier et al., 2006). Seven of those patients also had senile plaques in the neocortex, as well as additional decay in the nervous system like synaptic markers and neural

loss. Gauthier et al. (2006) found that positive tests of apolipoprotein E4 were a predictor of cognitive decline in patients with memory complaints. Albert et al. (2011) state that the presence of one or two ε4 alleles in the apolipoprotein E gene has been accepted as a sign for increased risk of Alzheimer's disease. A mutation in apolipoprotein E alleles alters cholesterol movement and synaptic plasticity, indicating the progression of MCI to AD (Gauthier et al., 2006).

Research has also pointed to pathological findings correlating with mild cognitive impairments such as intracellular neurofibrillary tangles and tau-positive tangle in mesial temporal structures (Gauthier et al., 2006). Diagnostic markers of AD include cortical atrophy, amyloid-predominant neuritic plaques, and tau-predominant neurofibrillary tangles, which may be confirmed with a postmortem examination (APA, 2013). In early-onset cases, a mutation of known AD causative genes (amyloid precursor protein, presenilin 1, and presenilin 2) may be the cause and genetic testing for these mutations should be done. Other causes of AD include the presence of the beta-amyloid protein (Aβ) and tau in the brain. Current criteria for Alzheimer's disease include Aβ in plaques and tau in neurofibrillary tangles, considering that buildup of these two proteins causes neuronal injury associated with AD. Currently, there is no evidence that MCI can be treated once it is diagnosed, but this largely depends on what the end goal of the treatment is. Some treatments seek to improve the symptoms of MCI while other treatments seek to slow the rate of progression (Petersen et al., 2001).

Testing

A literature review done by Gauthier et al. (2006) found that poor performance in delayed recall during neuropsychological exams is a high predictor of Alzheimer's disease in clinical samples that were followed for two to ten years. Petersen et al. (1997) suggest that memory tasks testing for MCI should include multiple trials of a span list and delayed recall of the items after

15 minutes of an interval, in which participants should be working on other cognitive activities. Two predictors of accelerated progression to AD in MCI patients were reported: Initial memory performance during semantic cues is poor and are carriers of apolipoprotein e4 allele. In a subsequent study, Petersen et al. (1999) compared a group consisting of patients diagnosed with MCI, a group of patients diagnosed with AD, and a group of control participants. Researchers found that memory performance of participants with MCI was similar to the memory performance of participants with AD when compared to healthy participants.

Albert et al. (2011) found that many episodic memory tests are helpful in identifying MCI in people who have a high chance of advancing to AD. Word-list learning exams with multiple trials show the amount of learning occurring over time and the highest amount acquired over the course of the learning trials. Researchers also emphasize that since patients with MCI due to AD can have multiple cognitive domains impaired in addition to memory, clinicians must examine and test for executive functions, language, and visuospatial skills. Once the patient's symptoms have been determined to be that of MCI due to AD, it is necessary to rule out other possible reasons for the cognitive decline such as trauma or medical diseases. While a battery of neuropsychological tests measuring learning and delayed recall can give valuable information about one's cognitive function, MCI and AD should not be diagnosed with these tests alone. Neuropsychological exams cannot fully differ from the many different types of dementia and performance on these tasks can be affected by factors such as cultural background, age, and education (Petersen et al., 2001).

Working Memory in the Elderly

Based on memory issues brought on by AD, the present study also focuses on the working memory of the elderly. Working memory can be defined as a system that manages and

manipulates new information to carry out complex tasks involving reasoning, comprehension, and learning (Baddeley, 1992; Cowan, 2008). Most working memory tasks that serve to provide an indication of one's level of working memory, are complex and involve storing and retrieving new material across multiple trials. Lustig et al. (2001) hypothesize that these tasks not only test the handling of new information, but also the ability to manage previously learned information as well. As memory span tasks test for the manipulation of current information, perhaps the ability to suppress the proactive interference of past trials is also tested. To explore this theory, Lustig et al. (2001) conducted a study with young and older adults. All participants were randomly assigned to three conditions. Condition A was a standard working memory span task which started from the smallest trial to the largest trial. Condition B was in descending format, with the working memory span task starting at the largest trial to the smallest trial. Condition C included only young adults that completed the descending sequence but with filler tasks between breaks of trials. Their results showed that for the older participants, working memory span scores improved when proactive inference was reduced by doing the longer trials first. With the young adults, presenting nonverbal filler tasks between trials increased their span scores. Their study confirmed their theory that proactive interference can confound measures of working memory tasks. Their results also suggested that older people may struggle in working memory span tasks because of their inability to overcome proactive interference rather than having a different working memory capacity at an older age.

Working memory has been found to decline in late adulthood and it is considered to contribute to the number of cognitive impairments that afflicts the elderly (Bremer et al. 2012). This issue has given rise to the increasing number of studies regarding the trainability of working memory across the lifespan. Benefits of a cognitive training program can be determined by the

amount of gains in the trained tasks, how generalizable training effects are to other non-trained tasks also known as ‘transfers’, and how training and transfer effects are sustained over time (Hertzog et al., 2009 , as cited in Brehmer et al., 2012).

A study done by Bremer et al. (2012) investigated transfer effects, training gains, and maintenance effects after three months from a computerized working memory training task involving young (20 to 30 years old) and older adults (60 to 70 years old). Researchers were expecting to find benefits of working memory training in both young and old adults, as well as near transfer effects to non-trainer working memory tasks, and maintenance effects after the three-month span in young and older adults.-Study results indicated that young adults displayed a higher performance during training than older adults. For cognitive transfer tasks, results showed that young adults had higher overall performance than older adults. Young adults also showed greater training gains during the first week, with both groups gaining similarly in the second. Young and old adults reported fewer memory issues after working memory training. Finally, there was no significant difference between post-training assessment and the three months follow up, suggesting that working memory training was maintained over time.

Stress in the Elderly

More attention is also being paid to the behavioral component that MCI patients seem to have (Gauthier et al., 2006). The combination of psychological and behavioral signs such as anxiety, depression, irritability, and apathy indicate a likelihood of conversion to dementia. Research suggests that chronic and acute stress, accompanied by alcohol use, tobacco use, and no physical exercise intensifies the effects of stress (McEwen, 1998). Contrarily, stress in positive lifestyle factors, such as physical and mental exercise, can have protective effects against the progression of AD (Pardon, 2011). Accustoming the brain with mild stressors as

opposed to chronic and extreme stressors can ameliorate the effects of stress on the brain. Additional research has found a connection in urinary cortisol concentrations between older patients with and without personal complaints. Gauthier et al. (2006) hypothesize that the increase in cortisol levels, a sign of stress, points to older people being concerned about their increasing deficits in function.

A study done by Wolf et al. (2001) sought to understand the effects of cortisol on attention, working memory, and declarative memory as well as how fast or delayed the effect of cortisol is. The study consisted of nine young and 11 older adult men and used a placebo-controlled, double-blind, and crossover design in which some participants received cortisol in the first session, followed by a second session in which the remaining participants received cortisol a week to two weeks later. Wolf et al. (2001) found that, after being given cortisol, both young and elderly men had impaired recall of a word list that was learned before cortisol was administered. Results also point to cortisol not having an effect on learning word lists or paragraphs and did not affect delayed recall of lists and paragraphs. The digit span task used to test working memory did, however, show differences in performance between young and old participants, with younger participants having lower scores in the digit span task after cortisol administration than the older participants. Similarly, Borroni et al. (2006) found a relationship between adults who carried the apolipoprotein E4 allele, high cholesterol, and advanced to progression to AD. Participants who had both the allele and had high levels of cholesterol were more likely to advance to AD.

Studies have shown that well-being in older adults can be achieved through social support as it can protect against negative physical and mental health outcomes (Cummings, 2002). Research on stress has proposed two models of the relationship between negative life

events and social support (Cutrona et al., 1986). The buffering hypothesis proposes that social support has a primary protective role in times of stress as a coping mechanism. In contrast, the second model states social support has positive effects on health and well-being regardless of stress. This model predicts that there is a relationship between mental and physical health and social support whether stress is present or not.

A study done by Cutrona et al. (1986) focused on a two-phase study investigating social support, stress, and health in the elderly. Researcher's recruited participants between the ages of 60 and 80 to complete a round of interviews and then a second round of interviews following a six-month break. As a result, this study found that participants who had higher self-esteem due to their relationships at the beginning had less declining health. It was also found that stressful life events or initial social support in interview one predicted mental health in interview two. However, an interaction was found between stress and support in situations of high stress and reliable guidance and support to be related to mental health in interview two. This suggests that elderly individuals who feel able to rely on social support during stressful times can use these resources. Elderly individuals whose mental health were better in interview one experienced fewer stressful events and more social support than those who had poor mental health in the beginning. Cognitive decline and AD are a source of stress which produces anxiety about the illness diagnosis, treatment, and disruption in their social life (McEwen, 1998).

Anxiety in the Elderly

Another point of interest in this study is anxiety in the elderly population. Teri et al. (1999) found that anxiety symptoms are well presented in older adults with studies finding that 25% to 60% of elderly participants experienced irritability, agitation, anxiety, and restlessness. To investigate the prevalence of anxiety and depression related to gender and age, Teri et al.

(1999) used cognitive, functional, and behavioral measurements to gather data on 523 community-dwelling patients with Alzheimer's disease. As a result, anxiety was prevalent with 70 percent of AD participants experiencing anxiety symptoms. The study also found that 44 percent of participants exhibited signs of anxiety, fearfulness, and apprehension, 36 percent of participants showed signs of irritation and easily angered, 34 percent were agitated and restless while 33 percent had signs of paranoia and suspiciousness. Participants with two or more anxiety scores (n=298) were compared to participants without symptoms and found an association between those with anxiety and disorderly conduct. Their results also showed a strong relationship between anxiety and their level of cognitive impairment, finding that those with significant impairment in cognitive were more like to have anxiety than those who were mild or moderately cognitive impaired. Teri et al. (1999) also discussed that men displayed more anger and agitation symptoms while women displayed anxiety, fearful and apprehensive symptoms.

Similarly, Ferretti et al. (2001) studied anxiety symptoms in clinic outpatients that had been diagnosed with AD. Participants were given an extensive evaluation consisting of laboratory tests, neurologic, physical, psychosocial, and neuropsychological exams. Participants who were diagnosed with the DSM-III as having AD or primary degenerative dementia and had a full evaluation were included in the study. Results showed that sample one had 66 percent of participants showing two or more anxiety symptoms that clinicians rated as moderate or disabling. Sample two had a similar finding with 40 to 68 percent of participants displaying anxious behaviors. Overall Ferretti et al. (2001) found that 68 to 71 percent of participants displayed anxious and worried appearances while 37 to 57 percent showed signs of tension, fear, restlessness, and fidgeting. Although most participants showed anxiety symptoms, five to six percent of participants met the DSM criteria for generalized anxiety disorder. Consistent with

other research findings, Ferretti et al. (2001) found that anxiety symptoms were closely related to depression, behavioral problems, and cognitive impairment.

Art Therapy

Alzheimer's disease and other dementias cause a loss of identity, disorientation, memory loss and even personality changes (Ehresman, 2014). Art therapy is a way to encourage coping strategies, positive emotions, and acceptance of life changes. Ehresman (2014) provided a review of the benefits that art therapy holds for people with Alzheimer's disease based on existing literature. Ehresman (2014) found that art therapy as a treatment for people with dementia can improve the quality of life through the benefits that come from using the visual arts to communicate inner experience and connect with others. Dementias can be treated as a whole by providing art therapy services that develop and encourage well-being by strengthening support networks and self-expression. There is a lot of potential for art therapy to aid healthy brain functioning; its multisensory and creative processes can reinforce synaptic connections between neurons in the hippocampus and amygdala (Ehresman, 2014). Still, clinical trials are still necessary to establish a correlation between creative activity and a reduction in cognitive decline.

Chancellor et al. (2014) reviewed art therapy literature that explores the hypothesis that art therapy is useful for improving elderly self-esteem and social behavior. Their theoretical framework consisted of three components that explained why art therapy could help people with dementia. First, art therapy uses abilities already learned instead of correcting disabilities. Second, it is a way for patients to express emotional expressions when they have a hard time communicating verbally. Third, they could enter a state of "flow" when creating visual art that is related to well-being. Art therapy addresses the emotional needs of the elderly by providing social connection, the experience of control, and the opportunity to express and manage

emotions. In a study done in the African American community, Johnson and Sullivan-Marx (2006) found that art therapy groups of around five to seven patients are helpful to decrease social isolation, feel a connection to others in their groups and feel supported. They also found that art tasks need to be ones in which patients' feel a sense of success during art making. Using media that is easy to control and allow expression, such as graphite pencils, can reduce frustration and agitation. Art therapy is a nonmedical intervention that can have a direct effect on the health of the elderly (Johnson & Sullivan-Marx, 2006). Chancellor et al. (2014) review found that most of art therapy research was done with weekly one hour sessions with daily art making for 15 minutes. Others have researched the effect of art therapy during four sessions per week for three weeks, which found that improvements in cognition, anxiety, and mood were maintained for three weeks after the treatment. Researchers suggest that benefits could be maintained more over time with frequent art therapy sessions.

Moreover, Pike (2013) sought to address environmental and lifestyle factors such as mood, socialization, and mental stimulation, that can affect cognitive functioning by examining the impact of art therapy on cognitive performance. The study included 91 participants (55% Hispanic, 36% White, 1% American Indian), with 54 in the experimental group and 37 in the control group. Results suggest that the therapeutic approach combined with the duration of the treatment positively affects cognitive performance. Longer sessions such as those averaging 90 minutes, were positively and significantly correlated with cognitive performance when compared to sessions lasting from 45 to 60 minutes. Pike (2013) concluded that 10 weeks of art therapy positively and significantly affected cognitive functioning for older adults but may need extra time to perform cognitive processing. By expanding therapy time, therapists whose session were 90 minutes appeared to have been more effective in providing stimulation.

Studies on aging show that when older people experience control, positive health outcomes are observed. This also applies when older adults are in situations with meaningful social engagement with others. Over two years, Cohen (2006) examined the influence of professionally conducted art programs on the general health, mental health, and social activities on older people over 65 years old. 300 participants were recruited, with half placed in an intervention group and half in a control group. The intervention group participated in art programs and met weekly for nine months for two years. At the end of the study, Cohen (2006) found that the art group compared to control group had better reports regarding health, medication used, memory, heart problems, cholesterol levels, and osteoporosis. Measures of loneliness and increase in activities yielded better results for the art group than the control group. Cohen (2006) concludes that art programs have benefits in health promotion and disease prevention. It shows stabilization and a positive impact on maintaining independence and reducing dependency. Art programs for older adults appear to reduce the risk factors that contribute to the need for long-term care.

Rusted et al. (2006) evaluated the immediate and long-term effects of art therapy for older people with dementia and tested if participating in an art therapy group causes significant improvements in mood and cognition. Using multiple centers, Rusted et al. (2006) gathered a total of 45 patients over the age of 80 with mild to severe dementia, then randomly divided between art therapy and activity groups with a maximum of six participants per group. Group data showed that over the course of 40 weeks of therapy, participants in the art group indicated session-to-session changes in measures of sociability, calmness, and physical engagement. The activity group had short-term improvement with a positive change in the first 10-20 weeks,

followed by a decrease in physical engagement and then a flattened response. Overall, there is evidence that art therapy has subtle yet long term positive effects.

Curry and Kasser (2005) researched the method of "coloring therapy" to examine if coloring helps free individuals from negative thoughts and emotions, therefore reducing anxiety. They collected data from 84 undergraduate students and after a short anxiety inducing experience at the beginning, measured their anxiety levels using the State Anxiety Inventory scale. Participants were then randomly assigned to three conditions, free-form coloring on a blank piece of paper, coloring a mandala, or coloring a plaid design. After 20 minutes of coloring, participants were given the State Anxiety Inventory again. Curry and Kasser (2005) found that coloring a mandala for 20 minutes helped reduce anxiety at a greater scale than free-form coloring. No significant difference in anxiety relief were found between participants who colored a mandala or plaid design. Only participants who colored a blank page for 20 minutes showed no improvement of anxiety levels. All of these results suggest that coloring a structured pattern helps produce a calm state of mind that benefits those with anxiety.

Current Study

In this study, I am investigating whether coloring has any influence on the elderly's levels of stress, anxiety, and working memory. While simply coloring or drawing does not encompass every component from art therapy sessions, current research in art therapy point to a significant reduction in participant's stress and anxiety levels after being involved in coloring and drawing activities. This may be because participants experience a sense of control and independence that may no longer be found in aspects of their life. Research has also shown that art-making in groups is beneficial as it encourages them to meet new people and engage in socialization. The feeling of being independent, capable, and enjoy the company of others

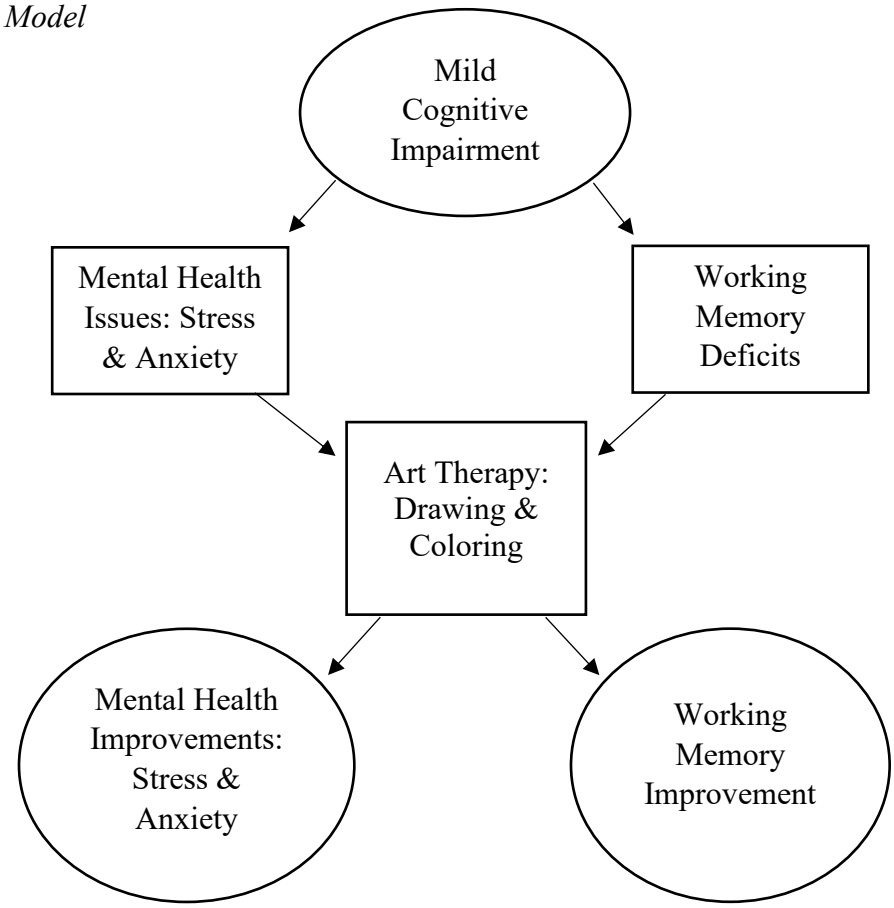
impacts their mind frame which in turns, influences their body by decreasing feelings of anxiety and stress. Furthermore, I also theorize that these art related tasks of coloring and drawing can induce a positive change in their working memory levels. If participants feel less anxious and stressed after coloring and drawing, then perhaps this will benefit them cognitively and improve working memory levels.

Theoretical Model

Present literature suggests that due to mild cognitive impairment, older adults experience working memory deficits as well as mental health issues like stress and anxiety. With art therapy such as coloring and drawing, it could result in overall improvements in their working memory, stress, and anxiety.

Figure 1

Theoretical Model



Research Objective

With this knowledge in mind, this study seeks to answer the following questions: To what extent does coloring affect working memory? To what extent does coloring change anxiety levels? To what extent does coloring change stress levels? How do participants with cognitive impairments differ from participants without cognitive impairment? This study will examine the influence of coloring on older adults over the age of 65 and the changes in their working memory, stress, and anxiety levels.

Hypothesis

H_1: Compared to drawing, coloring should result in decreased anxiety, decreased stress, and increased working memory.

Method

Participants

For this study, a total of 48 participants over the age of 65 were recruited from a local assisted living facility. Only participants who completed both sessions of treatment were included in the study, as attrition was caused mainly by illness and in some cases, death. The final sample included 38 participants which were between the ages of 65 and 98 (M= 79.6; SD= 10.4). Additionally, the final sample consisted of 29 females and nine males with all participants being Caucasian. According to the MMSE, 45% of participants had scores indicative of MCI while 55% of participants had scores reflecting non-MCI.

Measures

Mini-Mental Status Exam. The first measure of the study was the Mini-Mental Status Examination (MMSE). Compared to other mental examinations which are lengthy and require a long time to grade, the MMSE assesses cognitive aspects of mental functions with eleven

questions which take about five to ten minutes to administer. Folstein (1975) found that the MMSE is a reliable tool on a 24 hour and 28 day retest with a correlation coefficient of .88. Concurrent validity was also tested with the Weschler Adult Intelligence Scale and received a correlation coefficient of .77 for verbal IQ and .66 for performance IQ. The mini-mental status examination begins with testing elderly orientation, registration, attention, recall, language, and obeying instructions. In the MMSE, a perfect score is 30 points. There are cutoff points: 0-17 severe cognitive impairment, 18-23 mild cognitive impairment, and 24-30 no cognitive impairment (Tombaugh & McIntyre, 1992). Tombaugh and McIntyre (1992) suggest that the MMSE is used as a screening tool and not the single source of diagnosing dementia or varying forms of dementia.

Brief State-Trait Anxiety Inventory. Following the MMSE, the Brief State-Trait Anxiety Inventory (STAI) (Marteau & Bekker, 1992) six-item short form was conducted. In this study, the short form STAI survey was used since the complete STAI is 40 questions long and would take longer to administer. This survey consisted of six anxiety-present (I am tense) and anxiety-absent (I am relaxed) items from the full-form STAI. Marteau and Bekker (1992) concluded that the six-item STAI to have a Cronbach's alpha of .82. As far as validity, the survey results in similar scores to scores received when taking the full-form STAI. Its questions are rated on a four-point Likert scale ranging from 1=Not at All to 4=Very Much. Scores were obtained by reverse scoring all positive items, summing up all six items and multiplying the total score by 20/6. The STAI short form scores range from 20-80 with lower scores indicating less anxiety and higher scores indicating more anxiety.

Perceived Stress Scale. The Perceived Stress Scale (PSS) (Cohen et al., 1983) is used to measure and obtain one's perception of stress. Each question asked the participants about their

current levels of stress and their feelings and thoughts during the last month. Cohen et al. (1983) obtained a Cronbach's alpha of .85 indicative of good validity. Cohen et al. (1983) also state that predictive validity is expected to taper off after four to eight weeks. The PSS used in this study consisted of 10 questions rated on a zero to four Likert scale, 0 being never and 4 being very often. Scores were obtained by reverse scoring positive items, and then summing across all items. A higher score was indicative of more stress, and a lower score was indicative of less stress.

Automated Working Memory Assessment. Finally, the Automated Working Memory Assessment (AWMA) was conducted which is a modified version of the Backwards Digit Recall working memory test (Alloway, 2007). The AWMA consisted of a total of four tests each with nine spans and sixteen number trials. Each number trial was read to the participants, who were instructed to recall them in backwards order. Alloway (2007) found test-retest reliability of .83 on the AWMA which represents good reliability. Trial and span scores were obtained by grading each correct trial that was recalled in backwards order. Participants must have had at least one correct trial in each span to count as having that span correct. Means from each test were obtained to consider how much working memory differs from test to test.

Procedure

Participants were recruited for two sessions one week apart. During the first day, participants were given the informed consent form. It was read to for those who could not see well. It was ensured that the participants understood the study and signatures were obtained.

In the first session, participants were administered the Mini-Mental Status Exam to test for cognitive impairment. This was followed by the Brief State-Trait Anxiety Inventory scale, the Perceived Stress Scale, and the Automated Working Memory Assessment. To counterbalance

art treatment between sessions, participants were instructed to either color or draw and were given a blank page or mandala on an 8.5” x 11” sheet of paper, a pack of 12 coloring pencils, and were allowed to color or draw for 20 minutes. After the art treatment, participants were again given the Brief State-Trait Anxiety Inventory scale, Perceived Stress Scale and Automated Working Memory Assessment with some demographic questions at the end.

A second session took place one week apart from the first, this time no mini mental was administered. Participants again received the Brief State-Trait Anxiety Inventory scale, the Perceived Stress Scale, and the Automated Working Memory Assessment before and after the treatment. In session two, the art treatment again consisted of drawing on a blank page or coloring a mandala on an 8.5” x 11” piece of paper with 12 coloring pencils for 20 minutes. If participants had been assigned to the coloring condition in the first session, then they were assigned to the drawing condition in the second session and vice versa. Table 1 below demonstrates the layout of each session.

Table 1

Study Procedures

Day 1/Week 1	Day 2/Week 2
Informed Consent/Mini-Mental Status Exam	No Mini-Mental Status Exam
Brief State-Trait Anxiety Inventory Scale	Brief State-Trait Anxiety Inventory Scale
Perceived Stress Scale	Perceived Stress Scale
Automated Working Memory Assessment	Automated Working Memory Assessment
Mandala Coloring/Drawing	Mandala Coloring/Drawing
Brief State-Trait Anxiety Inventory Scale	Brief State-Trait Anxiety Inventory Scale
Perceived Stress Scale	Perceived Stress Scale
Automated Working Memory Assessment	Automated Working Memory Assessment

Results

Data Analysis

To investigate the effects that coloring, or drawing had on anxiety, stress, and working memory levels, pretests and posttests scores were averaged and a 2(pretest and posttest) x2(coloring and drawing) repeated measures ANOVA was conducted for each of the measures. Participants were also divided into MCI and non-MCI groups according to their Mini-mental score and tested as a mixed measures ANOVA. This was done to further analyze changes in anxiety, stress, and working memory levels according to their mental status. Significant ANOVA results were followed up by split filing the data, which is used to separate SPSS outputs for specific cases, between MCI and non-MCI participants and using a *t*-test for pairwise comparison of group means. Using SPSS, post-hoc power analyses resulted in a moderate observed power of .71 for the function of time and a moderate observed power of .49 for the interaction between time and MCI/Non-MCI groups.

Preliminary Analyses

After inspecting data for normality deviations and accounting for missing values, descriptive analyses were conducted to inspect data of the means and standard deviations of pretests and posttest for each measure across both art treatments (see Table 2). Pretest and posttest anxiety levels seem to have been maintained in both coloring and drawing. Stress levels also display similar results of maintenance across art treatments. Working memory levels show an increase from pretest to posttest in the coloring treatment, but not for the drawing treatment.

Table 2

Whole Group Means

Measure	Coloring M (SD)		Drawing M (SD)	
	Pretest	Posttest	Pretest	Posttest

Brief State-Trait Anxiety Inventory Scale	34.2 (10.0)	34.1 (11.4)	34.6 (11.0)	34.2 (11.5)
Perceived Stress Scale	11.9 (6.0)	12.2 (5.5)	12.3 (5.9)	12.7 (6.5)
Automated Working Memory Assessment	5.3 (4.1)	6.3 (3.7)	6.1 (4.0)	6.5 (3.7)

Anxiety Analyses

A repeated measures ANOVA was done on anxiety levels as a function of Art (Coloring vs. Drawing) and Time (Pre- and Post). There was not a significant effect of Art [F (1, 37) < 1.00, p=.78] or Time [F (1, 37) < 1.00, p=.78]. A mixed measures ANOVA was conducted on anxiety scores as a function of Art (Coloring vs. Drawing) with MMSE (Mini-Mental Status Exam; MCI and non-MCI) groups as the independent variable (MCI ≤ 23; Non-MCI ≥ 24). There was not a significant interaction effect of Art and MMSE groups [F (1, 36) < 1.00, p=.85]. Again, a mixed measures ANOVA was conducted on anxiety scores as a function of Time (Pre- and Post) with MMSE (Mini-Mental Status Exam; MCI and non-MCI) groups as the independent variable (MCI ≤ 23; Non-MCI ≥ 24). There was not a significant interaction effect of Time and MMSE groups [F (1, 36) < 1.00, p=.80].

Stress Analyses

To test stress levels, a repeated measures ANOVA was again done as a function of Art (Coloring vs. Drawing) and Time (Pre- and Post). There was not a significant effect of Art [F (1, 34) <1.00, p=.16] or Time [F (1, 34) < 1.00, p=.42]. A mixed measures ANOVA was conducted on stress scores to examine Art (Coloring vs. Drawing) with MMSE groups (MCI ≤ 23 and non-MCI ≥ 24) as the independent variable. Again, results showed no significant interaction effect between Art and MMSE groups [F (1, 33) < 1.00, p=.70]. Again, a mixed measures ANOVA was conducted on stress scores to examine Time (Pre- and Post) with MMSE groups (MCI ≤ 23

and non-MCI ≥ 24) as the independent variable. There was not a significant interaction effect between Time with MMSE groups [F (1, 33) < 1.00, p=.93].

Working Memory Analyses

Finally, to test the last variable of working memory, a repeated measures ANOVA was done as a function of Art (Coloring vs. Drawing) and Time (Pre- and Post). Although there was not a significant effect of Art [F (1, 37) =2.08, p=.15], there was a significant main effect of Time [F (1, 37) =5.29, p <.02, partial η^2 =.053]. A mixed measures ANOVA was done on working memory trial scores as a function of Art (Coloring vs. Drawing) with MMSE groups (MCI ≤ 23 and non-MCI ≥ 24) as the independent variable. Results yielded no significant interaction effect between Art and MMSE groups [F (1, 36) < 1.00, p=.96]. Again, a mixed measures ANOVA was done on working memory trial scores as a function of Time (Pre- and Post) with MMSE groups (MCI ≤ 23 and non-MCI ≥ 24) as the independent variable (see Table 3). There was a significant interaction effect between Time and MMSE groups [F (1, 36) =3.99, p <.05, partial η^2 =.10]. Post-hoc analysis after split filing the data by MMSE groups showed no significant pretest to posttest difference for working memory scores for either group in the drawing condition, but displayed a significant increase in working memory trial scores from pretest to posttest for the MCI group in the coloring condition [t (16)= -2.74, p < .05, d=-.66] (see Figure 2).

Table 3

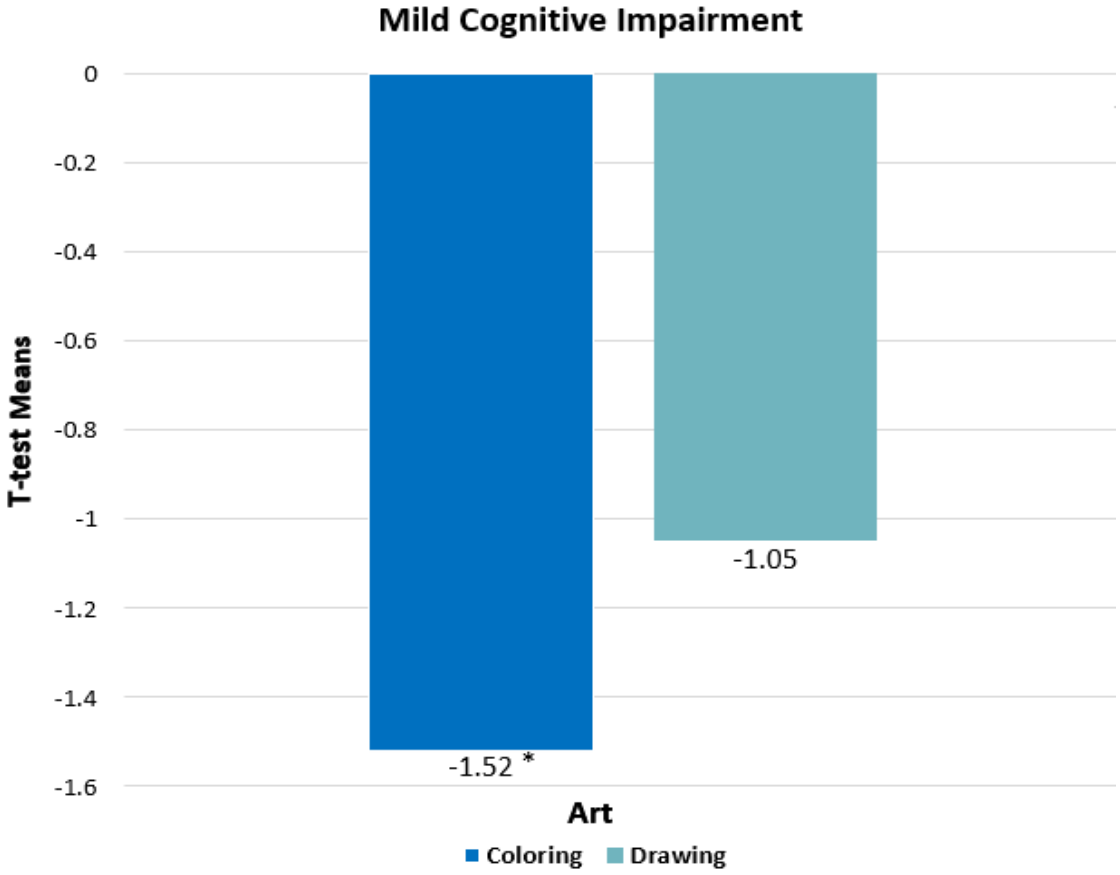
Working Memory Means by MMSE Groups

Measure	MCI M (SD)		Non-MCI M (SD)	
	Pretest	Posttest	Pretest	Posttest
Coloring Automated Working Memory Assessment	2.5 (2.2)	4.0 (2.2) *	7.7 (3.8)	8.1 (3.7)

Drawing Automated Working Memory Assessment	3.2 (3.0)	4.4 (3.4)	8.5 (3.2)	8.3 (3.0)

Figure 2

T-test mean of working memory scores from the MCI group. Asterisk indicates significant results.



Discussion

In the present study, I sought to investigate the effects of coloring and drawing in the elderly population, specifically how art affects anxiety, stress, and working memory performance. These results will be discussed in turn.

Anxiety

Looking first at anxiety, there was no significant change in anxiety levels from pretest to posttest in either art (coloring or drawing) conditions. Further analyses also failed to yield significant interaction effects of art therapy when groups were divided as a function of cognitive functioning (MCI/Non-MCI groups). These results do not support our hypothesis of anxiety posttest scores being significantly lower than anxiety pretest scores after the coloring treatment. This is contrary to the findings of Curry and Kasser (2005) who found significant lower levels in anxiety when using the State-Trait Anxiety Inventory scale after instructing their participants to color a mandala for 20 minutes. However, Curry and Kasser's (2005) study also found that drawing resulted in no relief from anxiety, a result found in our study as well. Interestingly, baseline means in Curry and Kasser's (2005) study were slightly higher than the present study's baseline means, with a baseline of 39 in their mandala condition, and a baseline of 41 in their free form drawing condition. Our baseline was a mean of 34 in both coloring and drawing conditions. This pattern suggests that college students have higher self-reported anxiety levels and may be more prone to anxiety than older adults. As a result, college students have greater opportunities for anxiety reduction.

Furthermore, the STAI scale, which was used to measure anxiety, may have contributed to the null effects found. It is important to note that the STAI scale is a validated measure in a community sample of older adults, which measures the state of anxiety, or how people are feeling at the moment, and trait anxiety, or how people feel in general. Significant clinical symptoms of anxiety for older adults have a cutoff score of 40. However, our sample had average pretest total scores of 34 and remained in the low 30 range, therefore our participants did not endorse significant clinical symptoms of anxiety. Future studies could explore other scales of

anxiety as there are low to moderate correlations between the STAI and other scales measuring anxiety (Balsamo et al., 2018).

There are several possibilities for why participants did not show a reduction in anxiety. First, participants may have been worried about peer feedback if the other residents were to see their artwork as it was done in a group setting. Although coloring tends to be meditative and generally takes less cognitive load than trying to come up with something to draw, the thought of peer evaluation may have made participants nervous and therefore suppressed coloring's reported meditative effects on anxiety levels. Second, participants in the drawing condition may have been anxious over not knowing what to draw. In support of this possibility, most participants expressed concern regarding their coloring and drawing abilities as it was something they had not done since a very young age. Third, many of our participants reported feeling uncomfortable after small periods of sitting due to surgery or other health ailments. Indeed Balsamo et al. (2018) reported that anxiety and medical issues have a reciprocal influence so the greater the disability, the greater the comorbidity, even in high-functioning elderly.

Stress

Results for stress levels also did not yield a significant change from pretest to posttest during art (coloring or drawing). No significant interaction was found between coloring or drawing and MCI/non-MCI participants. Our results did not support our hypothesis and were not in line with the findings of Rodak, Alloway, and Rizzo (2017) who studied the effects of mandala coloring and free drawing on the stress levels of veterans with and without PTSD and found that both coloring a mandala and drawing lead to stress relief.

As previously discussed with the anxiety results, these unchanging levels of stress could have similar explanations. In the coloring condition, most participants expressed concern over

peer feedback and asked if others would be seeing their colorings. Some participants were likely concerned with adherence to the instructions of the experimenter, similar to the Trier Stress Social Test, in which participants are likely to feel more stressed if they are being evaluated. These worries seem to have countered the stress relieving effects of the mandala in the coloring condition. Another reason could be because participants might have felt stressed when being instructed to draw freely in the drawing condition. Many participants finished drawing in approximately five minutes and did not know what to do with the remainder of the 20 minutes allotted. This may have caused their stress levels to stay the same as reflected in posttests. It's important to note that the PSS has been validated in community sample of older adults over 65 (Ezzati et al., 2014)

Working Memory

Regarding the working memory measure, there was a significant main effect of pretests and posttest for coloring but not drawing. Further analyses demonstrated that there was a significant interaction effect between pretest and posttest and MCI/Non-MCI groups. Post-hoc analyses suggested a significant increase in working memory scores from pretest to posttest for participants with MCI who colored a mandala. While coloring improved working memory for participants with MCI, it did not benefit participants without MCI. This finding is especially important because the people that benefited significantly from coloring were participants with mild cognitive impairment as determined by the MMSE.

As previously stated, people with MCI mainly suffer from memory impairments and in this study, coloring helped increase the working memory trials of participants with MCI. One possibility as to why coloring only improved working memory may be because coloring is a cognitive activity and participants had to plan what colors to pick and used working memory to

execute their coloring. Since coloring can be a low-level cognitive task, people without MCI may not involve the same amount of cognitive attention and planning that participants with MCI might have utilized while coloring. It only helped participants with MCI since their working memory is so impaired, they had to use all their working memory resources to color and think of all of those planning steps which in turn boosted their working memory scores. During the drawing condition, there may have been an overload of planning, to the point that it caused stress and anxiety, therefore reversing the effects of the condition. The mandala may have provided a structure and sense of direction that the drawing condition lacked. Overall, this is a novel finding because there is a lack of extensive research focused on art therapy with the MCI population.

Limitations

The main limitation in our study was low power. The observed power for the function of time was moderate at a .71 while the observed power for the interaction between time and MCI/Non-MCI groups was low at a .49. Attrition was an issue during data collection as some (N=10) participants could not participate in the second session because of sudden illnesses, and in some cases, participants passed away between sessions.

Most participants were not able to color or draw for the full 20 minutes due to body injuries and discomfort. In future studies, it may be beneficial to shorten the time allotted to color or draw, and hopefully reduce physical discomfort that participants had. This could in turn further impact and benefit their stress and anxiety levels.

Another constraint in this study was that most of our participants were women and all were Caucasian. This limits our ability to generalize our results, but there is evidence in previous research about the generalizability of coloring in elderly populations. For example, a study in Korea done by Im and Lee (2014) explored ways to prevent depression and cognitive impairment

in the elderly population (aged 60 and older) with music and art therapy. After 12 weeks of hourly weekly treatments with music and art therapy, participants showed a decrease in depression and a significant difference in cognitive function. Researchers stated that art therapy gave patients a sense of autonomy and responsibility which helped their depression and cognitive levels. Although there were positive benefits with short-term coloring, long-term benefits of coloring could be a topic for future research. Future research can also be applied to different cultural contexts so that results can generalize to other populations.

Although art activity did not decrease stress levels, social support could have a mediating role. One explanation is the buffering hypothesis which states that having social support or a support system lessens the effect of stressful situations. Some participants had never really spoken to each other before until the art session where they made plans to do things together again. For example, another participant got to know their room neighbor during a session and made plans to have lunch together. Though there were no significant changes in anxiety and stress levels, it is possible that art making is impactful for social interactions which could further impact working memory.

A factor that may be influencing results is participant's cognitive reserve. Cognitive reserve serves as a protective factor against cognitive decline in that older adults with higher cognitive reserve take longer to show cognitive deficits as opposed to older adults with a low cognitive reserve (Esiri & Chance., 2012). High levels of education and stimulating careers aid in attaining high cognitive reserve, although many older adults are past this stage in their lives. However, research suggests that participating in cognitive leisure activities, such as art making, is a way to stimulate neurogenesis and compensate for low cognitive reserve and performance (Mistridis et al., 2017).

Conclusion

There is a growing interest in research regarding the transitional stage of MCI, which often leads to Alzheimer's disease. This study focused on art methods that could be used to reduce the effects of stress and anxiety and improve working memory in those with mild cognitive impairment. Although coloring and drawing did not affect stress and anxiety levels of participants with and without MCI, coloring significantly improved the working memory of elderly participants with MCI. The results of this study are a good indicator that coloring can produce positive effects on the elderly's cognitive levels and future studies should pursue coloring to be done as a collaborative effort.

References

Albert, M. S., DeKosky, S. T., Dickson, D., Dubois, B., Feldman, H. H., Fox, N. C., Gamst, A., Holtzman, D. M., Jagust, W. J., Petersen, R. C., Snyder, P. J., Carrillo, M. C., Thies, B., & Phelps, C. H. (2011). The diagnosis of mild cognitive impairment due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer's & Dementia*, *7*(3), 270–279. https://doi.org/10.1016/j.jalz.2011.03.008

Alloway, T. P. (2007). *Automated Working Memory Assessment (AWMA)*. Pearson Assessment.

American Psychiatric Association, & American Psychiatric Association (Eds.). (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed). Washington, D.C: American Psychiatric Association.

Baddeley, A. (1992). Working memory. *Science*, *255*(5044), 556–559. https://doi.org/10.1126/science.1736359

Balsamo, M., Cataldi, F., Carlucci, L., & Fairfield, B. (2018). Assessment of anxiety in older adults: A review of self-report measures. *Clinical Interventions in Aging*, *13*, 573–593. https://doi.org/10.2147/CIA.S114100

Borroni, B., Grassi, M., Costanzi, C., Archetti, S., Caimi, L., & Padovani, A. (2006). APOE Genotype and Cholesterol Levels in Lewy Body Dementia and Alzheimer Disease: Investigating Genotype–Phenotype Effect on Disease Risk. *The American Journal of Geriatric Psychiatry*, *14*(12), 1022–1031. https://doi.org/10.1097/01.JGP.0000225088.29353.08

Brehmer, Y., Westerberg, H., & Bäckman, L. (2012). Working-memory training in younger and older adults: Training gains, transfer, and maintenance. *Frontiers in Human Neuroscience*, *6*. https://doi.org/10.3389/fnhum.2012.00063

Chancellor, B., Duncan, A., & Chatterjee, A. (2014). Art Therapy for Alzheimer's Disease and Other Dementias. *Journal of Alzheimer's Disease*, *39*(1), 1–11. https://doi.org/10.3233/JAD-131295

Cohen, G. (2006). *Research on Creativity and Aging: The Positive Impact of the Arts on Health and Illness*. American Society on Aging.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*, *24*(4), 385. https://doi.org/10.2307/2136404

Cowan, N. (2008). Chapter 20 What are the differences between long-term, short-term, and working memory? In *Progress in Brain Research* (Vol. 169, pp. 323–338). Elsevier. https://doi.org/10.1016/S0079-6123(07)00020-9

Cummings, S. M. (2002). Predictors of Psychological Well-being among Assisted-Living Residents. *Health & Social Work*, *27*(4), 293–302. https://doi.org/10.1093/hsw/27.4.293

Curry, N. A., & Kasser, T. (2005). Can Coloring Mandalas Reduce Anxiety? *Art Therapy*, *22*(2), 81–85. https://doi.org/10.1080/07421656.2005.10129441

Cutrona, C., Russell, D., & Rose, J. (1986). Social support and adaptation to stress by the elderly. *Psychology and Aging*, *1*(1), 47–54. https://doi.org/10.1037/0882-7974.1.1.47

Ehresman, C. (2014). From rendering to remembering: Art therapy for people with Alzheimer's disease. *International Journal of Art Therapy*, *19*(1), 43–51. https://doi.org/10.1080/17454832.2013.819023

Esiri, M. M., & Chance, S. A. (2012). Cognitive reserve, cortical plasticity and resistance to Alzheimer's disease. *Alzheimer's Research & Therapy*, *4*(2), 7. https://doi.org/10.1186/alzrt105

Ezzati, A., Jiang, J., Katz, M. J., Sliwinski, M. J., Zimmerman, M. E., & Lipton, R. B. (2014). Validation of the Perceived Stress Scale in a community sample of older adults: Perceived Stress Scale in older adults. *International Journal of Geriatric Psychiatry*, *29*(6), 645–652. https://doi.org/10.1002/gps.4049

Ferretti, L., McCurry, S. M., Logsdon, R., Gibbons, L., & Teri, L. (2001). Anxiety and Alzheimer's Disease. *Journal of Geriatric Psychiatry and Neurology*, *14*(1), 52–58. https://doi.org/10.1177/089198870101400111

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*(3), 189–198.

Gauthier, S., Reisberg, B., Zaudig, M., Petersen, R. C., Ritchie, K., Broich, K., Belleville, S., Brodaty, H., Bennett, D., Chertkow, H., Cummings, J. L., de Leon, M., Feldman, H., Ganguli, M., Hampel, H., Scheltens, P., Tierney, M. C., Whitehouse, P., & Winblad, B. (2006). Mild cognitive impairment. *The Lancet*, *367*(9518), 1262–1270. https://doi.org/10.1016/S0140-6736(06)68542-5

Im, M. L., & Lee, J. I. (2014). Effects of art and music therapy on depression and cognitive function of the elderly. *Technology and Health Care*, *22*(3), 453–458. https://doi.org/10.3233/THC-140803

Johnson, C. M., & Sullivan-Marx, E. M. (2006). Art Therapy: Using the Creative Process for Healing and Hope Among African American Older Adults. *Geriatric Nursing*, *27*(5), 309–316. https://doi.org/10.1016/j.gerinurse.2006.08.010

Lustig, C., May, C. P., & Hasher, L. (2001). Working memory span and the role of proactive interference. *Journal of Experimental Psychology: General*, *130*(2), 199–207. https://doi.org/10.1037/0096-3445.130.2.199

Marteau, T. M., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State—Trait Anxiety Inventory (STAI). *British Journal of Clinical Psychology*, *31*(3), 301–306. https://doi.org/10.1111/j.2044-8260.1992.tb00997.x

McEwen, B. S. (1998). Protective and Damaging Effects of Stress Mediators. *New England Journal of Medicine*, *338*(3), 171–179. https://doi.org/10.1056/NEJM199801153380307

Mistridis, P., Mata, J., Neuner-Jehle, S., Annoni, J.-M., Biedermann, A., Bopp-Kistler, I., Brand, D., Guevara, B., Decrey-Wick, H., Demonet, J.-F., Hemmeter, U., Kressig, R., Martin, B., Rampa, L., Savaskan, E., Stuck, A., Tschopp, P., Zekry, D., & Monsch, A. (2017). Use it or lose it! Cognitive activity as a protec-tive factor for cognitive decline associated with Alzheimer's disease. *Swiss Medical Weekly*, *147*(0910). https://doi.org/10.4414/smw.2017.14407

Morris, J. C., Storandt, M., Miller, J. P., McKeel, D. W., Price, J. L., Rubin, E. H., & Berg, L. (2001). Mild Cognitive Impairment Represents Early-Stage Alzheimer Disease. *Archives of Neurology*, *58*(3). https://doi.org/10.1001/archneur.58.3.397

Pardon, M.-C. (2011). Therapeutic potential of some stress mediators in early Alzheimer's disease. *Experimental Gerontology*, *46*(2–3), 170–173. https://doi.org/10.1016/j.exger.2010.09.006

Petersen, R. C., Doody, R., Kurz, A., Mohs, R. C., Morris, J. C., Rabins, P. V., Ritchie, K., Rossor, M., Thal, L., & Winblad, B. (2001). Current Concepts in Mild Cognitive Impairment. *Archives of Neurology*, *58*(12), 1985. https://doi.org/10.1001/archneur.58.12.1985

Petersen, R. C., Smith, G. E., Waring, S. C., Ivnik, R. J., Kokmen, E., & Tangelos, E. G. (1997). Aging, Memory, and Mild Cognitive Impairment. *International Psychogeriatrics*, *9*(S1), 65–69. https://doi.org/10.1017/S1041610297004717

Petersen, R. C., Smith, G. E., Waring, S. C., Ivnik, R. J., Tangalos, E. G., & Kokmen, E. (1999). Mild Cognitive Impairment: Clinical Characterization and Outcome. *Archives of Neurology*, *56*(3), 303. https://doi.org/10.1001/archneur.56.3.303

Pike, A. A. (2013). The Effect of Art Therapy on Cognitive Performance Among Ethnically Diverse Older Adults. *Art Therapy*, *30*(4), 159–168. https://doi.org/10.1080/07421656.2014.847049

Rodak, J., Alloway, T. P., & Rizzo, M. (2018). PTSD's true color: Examining the effect of coloring on anxiety, stress, and working memory in veterans. *Mental Health & Prevention*, *12*, 50–54. https://doi.org/10.1016/j.mhp.2018.09.007

Rusted, J., Sheppard, L., & Waller, D. (2006). A Multi-centre Randomized Control Group Trial on the Use of Art Therapy for Older People with Dementia. *Group Analysis*, *39*(4), 517–536. https://doi.org/10.1177/0533316406071447

Teri, L., Ferretti, L. E., Gibbons, L. E., Logsdon, R. G., McCurry, S. M., Kukull, W. A., McCormick, W. C., Bowen, J. D., & Larson, E. B. (1999). Anxiety in Alzheimer's Disease: Prevalence and Comorbidity. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *54*(7), M348–M352. https://doi.org/10.1093/gerona/54.7.M348

Tombaugh, T. N., & McIntyre, N. J. (1992). The mini-mental state examination: A comprehensive review. *Journal of the American Geriatrics Society*, *40*(9), 922–935.

Wolf, O. T., Convit, A., McHugh, P. F., Kandil, E., Thorn, E. L., De Santi, S., McEwen, B. S., & de Leon, M. J. (2001). Cortisol differentially affects memory in young and elderly men. *Behavioral Neuroscience*, *115*(5), 1002–1011. https://doi.org/10.1037/0735-7044.115.5.1002