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The Effects of a Cognitive Training Program for Cognitively Intact Older Adults

Caroline Kinskey
Minnesota State University, Mankato

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By

Caroline Kinskey

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Caroline Kinskey

This thesis has been examined and approved by the following members of the student's committee.

_____
Advisor
Jeffrey Buchanan, PhD

_____
Committee Member
Eric Sprankle, PsyD, LP

_____
Committee Member
Donald J. Ebel, PhD

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Abstract

Cognitive training is a term used to describe programs that provide guided practice on tasks requiring different cognitive abilities such as memory or language. It is assumed that regular practice will improve or maintain functioning in a particular cognitive domain (e.g., memory) and those results will generalize beyond the context of training. Results have been mixed in the existing literature that has evaluated the potential benefits of cognitive training on cognitive and emotional functioning in cognitively intact older adults. This study investigated the effectiveness of a cognitive training program for older adults with no to very minimal cognitive decline. Nine individuals participated in the *Mind Sharpener* program developed by the New England Cognitive Center. Two hour-long training sessions were completed each week for 12 weeks. In each session, participants completed paper and pencil activities that targeted the following cognitive domains: attention, language, perceptual speed, executive function, visual spatial skills, verbal memory, and visual memory. Outcomes assessed included measures of cognitive abilities targeted in the training program, depression, and memory self-efficacy. Measures were completed prior to beginning the *Mind Sharpener* program and after completion of the program. Across participants, ten measures improved following the *Mind Sharpener* program, six showed stability, and one measure declined. The study provides promising results for the efficacy of cognitive training programs.

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Introduction

A common fear adults have is the fear of developing dementia or Alzheimer's disease (Ostergren, 2017). Alzheimer's disease is without a cure, which is often concerning for those who are noticing cognitive decline in themselves or their loved ones. As adults age into older adulthood, many adults begin to notice declines in their memory (e.g., difficulties recalling names of people) and an increased difficulty with problem solving. Although these changes are often a part of normal aging, many adults want to maintain their cognitive abilities for as long as possible. Due to this, many older adults are interested in activities or programs that help maximize cognitive functioning and minimize cognitive decline. To combat age-related cognitive decline and potentially reduce the anxiety surrounding age-related cognitive decline, cognitive training programs have been created that target various cognitive domains that decline with age, with the goal of improving cognitive abilities or preventing them from declining.

Age-Related Cognitive Decline

As everyone ages, they experience "age-related cognitive decline." Minor cognitive decline as adults age is normal. Typically, older adults can expect to experience declines in domains of fluid intelligence, which involves cognitive abilities that are necessary in reasoning, problem-solving, abstract thinking, and decision making. In contrast, crystalized intelligence is a result of learning, and does not usually decline with age. Crystalized intelligence involves knowledge from past experiences, facts, and vocabulary (Horn & Cattell, 1966). Fluid abilities that typically show decline with normal aging include some domains of memory (e.g., recall, source, prospective, episodic memory) executive functions, and processing speed (Dreary et al., 2009; Harada, Natelson Love, & Triebel, 2014).

Processing speed is one of the first and most noticeable cognitive domains to decline during the aging process (Salthouse, 1993; Schiae, 1989, 1994). Processing speed encompasses the time it takes for someone to solve a problem and reaction time (Salthouse, 2000). A decline in speed of processing affects many day-to-day activities. Older drivers with slower speed of processing are more than twice as likely as older adults with intact speed of processing to cause a car crash in the following three to four years (Ball et al., 2006). Furthermore, a decline in processing speed is related to an increased risk of falls, difficulty with balance, and difficulty transitioning from sitting to standing (Owsley & McGwin, 2004; Sims, McGwin, Pulley, & Roseman, 2001; Syaplin, Gish, & Wagner, 2003). The slowing of processing speed can affect other cognitive domains as well, such as verbal fluency (Harada et al., 2014).

Attention is the ability to selectively concentrate on relevant information or specific stimuli, while ignoring irrelevant stimuli. Previous research has found that selective and divided attention decline the most as we age (Carlson, Hasher, Connelly, & Zacks, 1995; Salthouse, Fristoe, Lineweaver, & Coon, 1995). Selective attention is the ability to attend to specific stimuli while ignoring irrelevant stimuli. Divided attention, which involves executive functioning, allows us to process information from different sources at one time and shift our attention accordingly. Divided attention is necessary to multitask. Working memory, a construct related to attention, requires the ability to remember and hold information in the mind, and manipulate that information. Working memory has also been reliably found to decline with age (Salthouse et al., 1989).

There are multiple domains of memory that are impacted at different times in the aging process. For example, declarative memory, which is the ability to recall facts and events, can be divided into semantic and episodic memory. Semantic memory involves facts, information, and

common knowledge. Episodic memory is the memory of past events and their details. Episodic memory declines throughout life, while semantic memory has late-life declines (Harada et al., 2014). Nondeclarative memory, also known as implicit memory, is the memory outside of one's awareness. Nondeclarative memory includes procedural memory, which is responsible for knowing how to do things, such as knowing how to tie shoes or how to ride a bike. Unlike declarative memory, nondeclarative memory is not affected by normal aging (Lezak, Howieson, Bigler, & Tranel, 2012).

Another area of memory that declines with age is the ability to complete delayed recall tasks, which is the ability to retrieve information from memory without a cue (Whiting & Smith, 1997). For example, if someone wrote a grocery list and then left it at home, their ability to remember what items were on the list would involve delayed free recall. On the other hand, recognition memory, which is the ability to remember information when given a cue, does not decline with age. Recognition memory could be tested by asking the person who left their grocery list at home, "Were eggs on your grocery list?" which would provide the person with a cue regarding the items on their grocery list. The ability to remember where you learned information is known as source memory, which also declines with age. Additionally, prospective memory, which involves being able to remember to perform an intended task in the future, also declines with age. This may result in an older adult forgetting to take medication, forgetting why they walked into a room, etc. (Craik & Salthouse, 2008).

The cognitive domain of language consists of both fluid and crystallized abilities, so there is a less noticeable decline in language during the aging process. Since vocabulary is a crystallized ability, it tends to increase with age (Hayden & Welsh-Bohmer, 2011; Salthouse, 2009). Some domains of language do decrease with age, such as confrontation naming (i.e. the

ability to see an object and know the name for it) and verbal fluency (i.e., the ability to think of words that belong to a certain category, such as animals or words that begin with a specific letter). The declines in language usually have minimal impact in an older adult's ability to function in their day-to-day life (Harada et al., 2014).

Visuospatial abilities and construction abilities are necessary to understand space in two and three dimensions. The ability to take parts of something and put them together to make a coherent whole, like a puzzle, involves visual construction abilities. Visual construction abilities decline with age (Howieson, Holm, Kaye, Oken, & Howieson, 1993). Visual spatial abilities remain intact with age, which include spatial awareness and the ability to recognize familiar objects and faces (Harada et al., 2014).

Executive functioning involves higher-order thinking, abstract thinking, problem-solving skills, reasoning skills, self-control, and other cognitive abilities that allow people to be mentally flexible and use their resources to achieve a goal. Some types of executive functioning decline with age while others remain stable throughout life. Cognitive flexibility falls under executive functioning, and is defined as the ability to think about something in more than one way. Cognitive flexibility declines with age, and older adults have more concrete thinking compared to younger adults (Harada et al., 2014; Weckner, Kramer, Hallam, & Dellis, 2005). Response inhibition, which is the ability to inhibit a more automatic response for a more novel response, also tends to decline with age (Wecker, Kramer, Wisniewski, Delis, & Kaplan, 2000). Types of executive functioning that do not decline with age include the ability to understand similarities, proverbs, and reason with familiar material (Harada et al., 2014).

Cognitive Impairment

As mentioned previously, age-related cognitive decline is not pathological. Mild cognitive impairment (MCI) is a stage between normal aging and dementia. Those with MCI are at a high risk for developing dementia, with 10-15% of people with MCI receiving diagnoses of Alzheimer's disease each year (Peterson et al., 2009). In comparison, only 1-2% of cognitively intact older adults will receive a diagnosis of Alzheimer's the following year (Petersen et al., 1999). Some people with MCI remain stable or improve cognitively, but over half progress to developing dementia within 5 years (Gauthier et al., 2006). Unlike with normal age-related cognitive decline, the changes that occur are more noticeable to the family and friends of the person with MCI. However, unlike with a more serious form of decline, such as dementia, the changes are usually not severe enough to significantly negatively impact someone's life and ability to function.

Need for Interventions Targeting Cognitive Decline

The older adult population is rapidly increasing each year. The number of Americans that are 65 years of age or older is predicted to double from 46 million today to 98 million in 2060 (Mather, Jacobson, & Pollard, 2015). Currently, the 65-and-older group comprises approximately 14 percent of the United States population, and by 2060 older adults will account for about 24 percent of the population (Mather et al., 2015). Given the fact that there is no cure for Alzheimer's disease and similar forms of dementia, we can expect to also see growth in the number of people diagnosed with these progressive cognitive diseases. With the growing aging population, the need for interventions for cognitive decline and cognitive disorders will continue to increase. More than 5 million Americans currently live with Alzheimer's disease, and this number is estimated to triple to 16 million by 2050 (Alzheimer's Association, 2017).

Currently, there are medications that have been approved by the U.S. Food and Drug Administration (FDA) to treat symptoms of Alzheimer's disease, but none of these medications prevent the progression of cognitive decline (Alzheimer's Association, 2017). Additionally, many of these medications have unwanted side effects. Due to the limited effectiveness of pharmacological treatments, there is an increased interest in non-pharmacological treatments in preventing or slowing the progression of cognitive decline.

Cognitive Training

Cognitive training, sometimes marketed to the public as "brain training," is a type of non-pharmacological intervention that uses guided practice on a set of standardized tasks that are meant to target and improve particular cognitive functions (Bahar-Fuchs, Clare, & Woods, 2013). Cognitive training typically takes place in small groups and is comprised of a standardized, structured program of activities (Belleville, 2008). The goal of cognitive training is to improve cognitive functioning, sustain functioning, or slow cognitive decline. The concept of cognitive training assumes that the brain remains plastic as adults age, and that practice can potentially improve or maintain functioning in a specific cognitive domain (Hertzog, Kramer, Wilson, & Lindenberger, 2008). Additionally, it is assumed that improvements or maintenance will generalize to daily life. In previous research, there has not been evidence that the benefits of cognitive training generalize to daily life (Owen, 2010; Papp, 2009; Ball et al., 2002).

Many products on the market designed to improve cognitive abilities, often referred to as "brain games," exaggerate the positive effects of their programs, and sometimes mislead consumers (Simons et al., 2016). Lumosity, a popular online program that consists of games that target various cognitive domains, was charged by the U.S. Federal Trade Commission for deceptive advertising (FTC, 2016). The FTC stated that Lumosity did not have the scientific

evidence to support the claims their advertisements made, and that Lumosity "preyed on consumers' fears of age-related cognitive decline, suggesting their games could stave off memory loss, dementia, and even Alzheimer's disease." Following the suit, FTC and Lumos Labs, the creators of Lumosity, agreed in a settlement that randomized, controlled, blinded trials were the standard to provide evidence for the efficacy of products.

The demand for products that claim to aid in cognitive functioning continues to grow each year. The research firm SharpBrains (sharpbrains.com) tracks all companies in the "digital brain health market" and publishes market reports. SharpBrains reported that there was an estimated total market sales of $210 million in 2005, $600 million in 2009, and $1.3 billion in 2013. The firm predicts that cognitive training and brain assessment software will have yearly sales of $3.38 billion by 2020 (SharpBrains, 2013, 2015). The brain training industry is large, but how much evidence is there for the efficacy of these cognitive training programs?

The largest and most notable study evaluating the effectiveness of cognitive training for independent older adults began in 1998 and is known as the ACTIVE study (Advanced Cognitive Training for Independent and Vital Elderly; Ball et al., 2002). The study was randomized, single-blind, and had a control group. A volunteer sample of 2,832 older adults in six metropolitan areas in the United States, with ages ranging from 65 to 94 years old, was used to evaluate three cognitive training interventions. Participants were randomly assigned to one of four groups. One group took part in a 10-session group training designed to target verbal episodic memory. The second cognitive training group targeted reasoning abilities, and the third group targeted speed of processing. Additionally, there was a no-contact control group. A random sample of 60% of the three treatment groups received booster training 11 months after the initial intervention. The primary outcomes were aspects of functional activities, both

performance-based and self-reported. Each intervention group improved at the target cognitive ability compared to their baseline performance, and this improvement sustained through the two-year observation period. Those who received booster training in the speed of processing group improved speed, as did the reasoning group. However, the study did not find that training effects generalized to everyday functioning.

A five-year follow-up of the previously mentioned study was also completed (Willis et al., 2006). Booster training was provided to a random subsample at 11 and 35 months after the initial training sessions. The booster training consisted of four 75-minute sessions which were meant to help maintain the initial improvement of the targeted cognitive ability. At the five-year follow-up, the reasoning group reported significantly less difficulty in ADLs compared to the control group. A nonsignificant difference in self-reported difficulty with ADLs was found in the speed of processing and memory training group compared to the control group. The booster training for the speed of processing group had a significant effect on a performance-based functional measure of everyday speed of processing. The other two groups did not have any significant booster effects regarding everyday problem-solving or self-reported difficulties with completing ADLs. However, the booster training resulted in significant improvement for the reasoning group on reasoning performance, and the speed of processing group on processing speed performance. The effects of the interventions were maintained through the five years since the beginning of the initial study.

Additionally, there was a 10-year follow-up of the ACTIVE study (Rebok et al., 2014). The reasoning and speed of processing group maintained their effects from the interventions at the 10-year follow-up. However, the memory cognitive training group no longer maintained the

effects in memory performance. This long-term study provides support for the efficacy of cognitive training in cognitively intact older adults.

Another randomized controlled study examined the effects of a six-week memory training program involving education on dementia, memory, memory performance, relaxation skills, and specific memory skills (Rapp, Brenes, & Marsh, 2002). The control condition did not receive any education or memory training. The participants met criteria for mild cognitive impairment (Petersen et al., 1999), and did not have any difficulties in completing ADLs. Following completion of the memory training program, the treatment group perceived their memory to be better compared to the control group. Additionally, the treatment group perceived that their memory had improved since prior to the training. At the six-month follow-up, the treatment group still reported higher memory appraisals than the control group. However, the groups did not differ on quantitative measurements of memory performance.

A novel training program targeting executive functioning in the elderly used a multitasking cooking task (Wang, Chang, & Su, 2011). Participants in the study were all healthy older adults who lived in the community. The treatment group cooked four to six foods while setting as many tables as possible. The task gradually increased in speed and difficulty. The intervention was brief, with only five sessions lasting an hour each. The training resulted in a short-term increase in executive control processing, as measured by WAIS sub-tests. This study is unique in how the training involved a real-world task, and the researchers conducted quantitative measures of cognitive domains to determine if there was a transfer of skills. Most other studies do the opposite, where the cognitive training involves structured paper and pencil activities, and then based on self-report, the researchers look to see if the skills acquired transferred outside of the structured training activities.

A meta-analysis conducted in 2012 examined the results of memory training interventions for community-dwelling, cognitively intact older adults (Gross et al., 2012). The review identified 402 publications, but only 35 met inclusion criteria for the review. To be included in the review, the publications had to report original data on memory training, involve randomization, all participants had to be at least 60 years of age, and the intervention had to be non-pharmacological and target memory. The review found that memory gains in treatment groups were larger than retest effects in the control groups. Additionally, training multiple strategies resulted in larger training gains. Treatment gains did not appear to be influenced by training of a particular strategy, the ages of the participants, or session length.

Purpose of Current Study

The purpose of the current study is to add to the literature examining the effectiveness of cognitive training programs for cognitively intact older adults. Based on previous literature, we expected to see significant improvements in executive functioning, processing speed, and self-reports of memory self-efficacy. Minimal improvement in memory was expected. Additionally, it was hypothesized that there would be a decline in depressive symptoms (Brum, Forlenza, & Yassuda, 2009).

Method

Subjects

Participants for this study were recruited by administrators and staff at a convent located in a small Midwestern metropolitan area. Staff were asked to identify and approach residents that had minimal or no cognitive decline and may be interested in taking part of a cognitive training program. To meet inclusion criteria for the study, participants had to have a score of 78 or above on the Modified Mini-Mental State Exam (3MS; E. L. Teng & H. C. Chui, 1987) indicating mild

cognitive decline to intact cognitive abilities. Potential participants were excluded from the study based on the following criteria, which were assessed via self-report, report of facility staff, or cognitive testing:

1) The presence of a serious health problem that could compromise their ability to participate in the cognitive training classes.

2) Significant disabilities that could prevent the individual from participating (e.g., visual or hearing deficits, impaired motor skills, significant language impairment).

3) An individual's level of cognitive decline was too severe based on the 3MS (i.e., a score below 78).

Ten women met criteria and consented to participate in the study (see Appendix for the full consent form). One participant dropped out prior to completing the program; staff reported that she was having difficulty with the activities and requested to drop out. All of the participants were Caucasian women with at least a bachelor's degree. Ages of the subjects ranged from 72 to 93 years old (M = 82.22, SD = 7.53). The average 3MS score prior to beginning the program was 92.00 (SD = 4.92), and scores ranged from 81 to 96 (out of a possible score of 100).

Additionally, each participant's face sheet in their medical chart was reviewed with a nurse or staff member present. Information collected from medical charts included medical diagnoses and medications taken by the participant for anxiety, depression, or pain. These variables were tracked because these conditions and medication could affect the ability of participants to engage in the *Mind Sharpener* program.

Six of the nine participants that completed the study had a diagnosis of depression. Four of the six participants took at least one antidepressant. One participant with depression took 50 mg of Zoloft and another participant took 30 mg of Cymbalta daily. One of the participants with

a diagnosis of depression also had a diagnosis of Alzheimer's disease, and took 300 mg of Wellbutrin and 15 mg of Remeron for depression, and 21 mg of Namenda for Alzheimer's disease. Another participant with depression also had a diagnosis of dementia, and took 50 mg of Trazadone and 1 mL of cyanocobalamin. Two of the participants with depression did not take an antidepressant; one of the participants was prescribed 1.0 mg of Lorazepam and the other took no medications. One participant had Parkinson's disease and was prescribed 1mL of cyanocobalamin. Another participant had a diagnosis of mild cognitive impairment and took Lexapro. One of the nine participants did not have any diagnosis nor took any medications that may have impacted her ability to complete the study. Despite some of the participants having a diagnosis of dementia and MCI, the participants still scored above a 78 on the 3MS and met inclusion criteria for the study. The participant who dropped out of the study passed away following the study and we were unable to access her medical information.

Procedure

A pre-post quasi-experimental design was employed. After recruitment and receiving consent from the participants, the author and research assistants administered the cognitive tests and other measures with each participant individually. Shortly after pretesting, the participants began the *Mind Sharpener* program, which was developed by the New England Cognitive Center (NECC). *Mind Sharpener* is designed for older adults that are cognitively intact or have minimal cognitive decline. The program consists of 24 classes, with two 1-hour sessions occurring per week. Activity staff at the convent who were trained by the NECC implemented the program. Throughout the study, NECC staff were available to consult for questions or if further training appeared necessary.

The cognitive training classes consisted of varied pencil and paper activities that targeted the following specific cognitive domains: reaction time/psychomotor speed, attention/concentration, memory (with emphasis on short-term memory), visual spatial acuity, language, and problem solving/executive function. *Mind Sharpener* is designed to be appropriate for adults, challenging, enjoyable, and the activities increase in difficulty over time. The activities involved repetition and reinforcement to promote learning. The activities required minimal instruction, therefore allowing the class time to be primarily dedicated to having the participants engage in the activities. In order to be included in data analysis, a participant needed to complete 75% of the classes. Overall, nine individuals completed over 75% of the classes, excluding the aforementioned participant that dropped out of the study.

Materials

The measures used in this study evaluated various cognitive domains that are targeted by the *Mind Sharpener* program. In addition, participants completed measures regarding subjective complaints of memory functioning and mood. Participants were tested within one week prior to beginning the *Mind Sharpener* program, with half of the tests being completed on one day and the rest of the tests completed on a different day. Assessment was also completed within one week of completing the program, which was approximately 12 weeks later. The measures took approximately 60 minutes to complete.

Global Functioning

Modified Mini-Mental State Exam **(**3MS; E. L. Teng & H. C. Chui, 1987)

The 3MS is a measure of global cognitive functioning that is used to screen for dementia. It is a standardized assessment that is widely used to evaluate individuals with cognitive impairment. The 3MS measures multiple cognitive domains (e.g., attention, orientation, short-

term memory, verbal reasoning, etc.). The measure is highly reliable for assessing individuals with dementia (α = .88), and has high sensitivity (.93) in differentiating between individuals with and without dementia. (Tombaugh, McDowell, Kristjansson, & Hubley, 1996). Scores can range from 0 to 100 with lower scores indicative of greater cognitive impairment.

Attention

The Forward and Backward Digit Span (Wechsler, 2008)

These two tests measure simple attention (forward digit span) and working memory (backward digit span). This test requires participants to listen to a list of numbers read aloud, and then repeat them exactly as heard or in reverse order. Two digits are presented on the first trial, and the length of digit strings increases as the trials progress until the participant is unable to successfully complete two trials of the same length.

This is a subtest in the Wechsler Adult Intelligence Scale- Fourth Edition (WAIS-IV; Wechsler, 2008) and correlates highly with the WAIS-III digit span.

Brief Test of Attention (BTA; Schretlen, 1997)

The BTA is a measure of auditory divided attention. Participants listen to a voice recording of numbers and letters being read aloud. The participant is to keep track of only how many numbers (or letters) they heard in each string. To prevent participants from counting on their fingers, they are asked to place their hands on the table where the researcher can see them. The BTA has good reliability, equivalence of forms, and construct validity (α = .82-.91) (Schretlen, Bobholz, & Brandt, 1996).

Language

Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1989)

The COWAT is designed to measure verbal fluency. Participants are given one minute to say as many words that begin with a specific letter. Proper nouns and variations of the same word do not count (e.g., bed, beds, bedding). In the pretest, the letters are F and S. In the posttest, participants must name as many words that begin with the letters A and P. The COWAT correlates with other neuropsychological tests and has good test-retest reliability (Benton & Hamsher, 1989; Ruff, Light, Parker, & Levin, 1996).

Bosting Naming Test (BNT; Kaplan, Goodglass, & Weintraub, 1983)

The BNT is a commonly used measure of confrontation naming. It is sensitive to early cognitive changes in Alzheimer's disease (Williams, Mack, & Henderson, 1989). In this test, a series of 30 pictures of objects are displayed one at a time, and the participant is asked to name what each picture represents. If the participant is unable to name the object, semantic and/or phonemic cues are given by the person administering the test.

Perceptual speed

Trail Making Test Part A (Reitan & Davison, 1974)

Trail Making Test Part A assesses cognitive processing speed. Participants are given a piece of paper with the number 1 through 25 contained in circles scattered across the paper. Participants are asked to connect the numbers as fast as they can. Participants are told to "draw a line from 1 to 2, 2 to 3, 3 to 4, and so on until you reach the end." Trail Making Test Part A and Part B are sensitive to detecting brain damage and cognitive impairment (Reitan & Davison, 1974; Aschendorf et al., 2008).

Executive functioning/Working memory/Cognitive flexibility

Trail Making Test Part B (Reitan & Davison, 1974)

Trail Making Test Part B is used to examine executive functioning. Part B is similar to Trail Making Test Part A, but Part B requires participants to alternate between numbers and letters as fast as they can. They are told to "draw a line from 1 to A, A to 2, 2 to B, B to 3, and so on until you reach the end." Part B of the Trail Making Test has been found to have better specificity and sensitivity to cognitive dysfunction at any level compared to Part A (Rasmusson, Zonderman, Kawas, & Resnick, 1998).

Visual Spatial Skills

Visual Puzzles (Wechsler, 2008)

This test assesses visual spatial reasoning and requires mental transformation, manipulation, and the ability to analyze dimensional objects. Participants are shown a completed puzzle with a display of six figures, and asked to select three of six figures that could create the completed puzzle. Visual puzzles are part of the Perceptual Reasoning Index in the WAIS-IV (Wechsler, 2008).

Verbal Memory

Hopkins Verbal Learning Test - Revised (HVLT-R; Brandt & Benedict, 2001)

The HVLT-R is a measure of verbal memory. Participants are read a list of words and then asked to say aloud as many of the words as they can remember from the list in any order. This is done three times back-to-back to assess immediate recall abilities, and then 20 minutes later to assess delayed verbal recall. Finally, there is a recognition trial where participants are read a longer list of words, and asked to identify whether a word was on the original list. The HVLT-R is highly correlated with other measures of verbal memory and is highly predictive at classifying those with dementia versus controls (Shapiro, Benedict, Schretlen, & Brandt, 1999).

Visual Memory

Brief Visuospatial Memory Test-Revised (BVMT-R; Benedict, 1997)

The BVMT-R is a measure of visual memory. Participants are shown a display of six figures for 10 seconds, and then asked to draw as many of the figures as they can remember in their correct location on the page. This is done three times back-to-back to assess immediate visual recall, and then there is a delayed recall portion of the test 20 minutes later. Additionally, there is a recognition trial where participants are shown figures and asked to identify if a figure was on the original display. This measure has high construct and criterion-related validity (Benedict, Schretlen, Groninger, Dobraski, & Shpritz 1996).

Additional Measures

The Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001)

The PHQ-9 is a 9-item self-report instrument which assesses the frequency and severity of depressive symptoms. It has high internal reliability ($\alpha = .89$), and sensitivity of 88% and specificity of 88% for major depression (Kroenke, Spitzer, & Williams, 2001). The PHQ-9 has been validated with older adults (Ell et al., 2005), including those with cognitive impairment (Boyle et al., 2011).

Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982)

The CFQ is 25-item measure that assesses the participant's perception of their memory. Participants were asked to estimate how frequently they have common memory problems (e.g., forgetting appointments, forgetting why you went from one part of the house to the other, forgetting whether you have turned off a light or locked a door, etc.). The measure is positively correlated with other self-report measures of memory, absentmindedness, or slips of action (Broadbent, Cooper, FitzGerald, & Parkes, 1982).

Results

Due to the small sample size, inferential statistics were not used to detect differences between pre-treatment and post-treatment measures. Instead, the effect size statistic (Cohen's d) was used to estimate the magnitude of difference between pre- and post-treatment measures. According to Cohen, $d = 0.2$ is a small effect size, 0.5 is a medium effect size, and anything over 0.8 is a large effect size (Cohen, 1988). Effect sizes provide a measure of clinical significance as opposed to evaluating solely the statistical significance (i.e., rareness of a result).

Global Functioning

Modified Mini-Mental State Exam

There was a small effect size indicating improvement in global cognitive functioning from pretesting ($M = 92.0$, $SD = 4.92$) to posttesting ($M = 94.0$, $SD = 4.09$), $d = .30$, CI 95% [-.63, 1.23].

Attention

Forward Digit Span

The Forward Digit Span requires participants to listen to a series of numbers, and repeat the numbers in the same order. There was a negligible difference between pretesting ($M = 8.33$, $SD = 2.00$) and posttesting ($M = 8.44$, $SD = 2.60$), $d = .11$, CI 95% [-.81, 1.04] indicating stability (i.e., no change) in this measure of simple attention.

Backward Digit Span

The Backward Digit Span requires participants to listen to a series of numbers, and say the numbers they heard in reverse order. There was a small positive effect size in this measure of working memory from prior to beginning the cognitive training program ($M = 7.89$, $SD = 2.52$) to after completing the program ($M = 8.22$, $SD = 2.05$), $d = .22$, CI 95% [-.70, 1.15].

Brief Test of Attention

The BTA measures selective attention by requiring participants to keep track of how many numbers are presented in a list of both letters and numbers. There was a negligible difference between pretesting (M = 6.22, SD = 2.28) and posttesting (M = 6.44, SD = 2.07), d = .12, CI 95% [-.81, .1.04] indicating stability in this measure.

Language

Controlled Oral Word Association Test

Verbal fluency was measured by the COWAT. The test requires participants to state as many words that begin with a specific letter in one minute. A medium negative effect size was observed from pretesting (M = 27.44, SD = 7.53) to posttesting (M = 24.0, SD = 8.37), d = -.48. CI 95% [-1.41, .46], indicating decline occurred in this specific cognitive ability.

Bosting Naming Test

The BNT is a measure of confrontational word retrieval. Participants are shown pictures one at a time and asked to name the object in each picture. Stability was observed in the BNT from pretesting (M = 24.44, SD = 2.92) to posttesting (M = 24.11, SD = 2.98), d = -.13, CI 95% [-1.05, .80].

Perceptual speed

Trail Making Test Part A

Trail Making Test Part A measures perceptual speed by requiring participants to connect the numbers 1-25 on a piece of paper as quickly as they can. It is measured in the seconds it takes for the participant to complete the task. A small improvement was observed from pretesting (M = 46.89, SD = 14.39) to posttesting (M = 42.22, SD = 16.35), d = -.32, CI 95% [-1.25, .91].

Executive functioning/Working memory/Cognitive flexibility

Trail Making Test Part B

Trail Making Test B requires participants to alternate between connecting letters and numbers on a piece of paper as quickly as they can. Stability in scores was observed from pretesting (M = 115.0, SD = 42.24) to posttesting (M = 113.11, SD = 60.40), d = -.10, CI 95% [-1.02, .83].

Visual Spatial Skills

Visual Puzzles

Visual puzzles measure visual spatial skills by requiring participants to select three figures from an array of six figures that can make the completed puzzle presented. There was a small positive effect size from pretesting (M = 10.44, SD = 1.74) to posttesting (M = 11.22, SD = 3.02), d = .43, CI 95% [-.52, .1.35].

Verbal Memory

Hopkins Verbal Learning Test

Immediate Recall

Immediate verbal recall abilities were measured by the HVLT. Participants are read aloud a list of words and then asked to list as many words as they can remember. This is done three times consecutively. There was a large improvement from pretesting (M = 19.56, SD = 5.03) to posttesting (M = 23.56, SD = 4.64), d = 1.03, CI 95% [.05, 2.02].

Delayed Recall

The HVLT has a delayed recall trial approximately 20 minutes after the initial trials. There was a small improvement from pretesting (M = 6.78, SD = 2.44) to posttesting (M = 7.56, SD = 2.01), d = .27, CI 95% [-.66, 1.20].

Recognition Discrimination Index

Following the delayed recall trial, recognition abilities were tested by having participants identify whether a word was on the original list. The recognition score is the number of words accurately identified as being on the list minus words incorrectly identified. There was a small improvement from pretesting (M = 9.44, SD = 1.67) to posttesting (M = 9.89, SD = 1.83), d = .47, CI 95% [-.47, 1.41].

Visual Memory

Brief Visuospatial Memory Test-Revised

Total Recall

Immediate visual recall was tested with the BVMT-R. Participants study a display of six figures for 10 seconds, and then asked to draw as many of the figures as they can remember in their correct location on a blank page. This is done three times consecutively. There was a small improvement from pretesting (M = 13.44, SD = 7.28) to posttesting (M = 14.78, SD = 7.29), d = .33, CI 95% [-.60, 1.26].

Delayed Recall

Delayed visual recall was measured by asking participants to draw as many of the figures as they can remember from the original display of six figures 20 to 25 minutes after the initial trials. Stability was observed from pretesting (M = 5.33, SD = 2.35) to posttesting (M = 5.44, SD = 3.17), d = .09. CI 95% [-.84, 1.01].

Recognition Discrimination Index

The recognition trial of the BVMT-R requires participants to identify whether a figure was part of the original display of six figures or not. Figures are shown to participants one at a time, and participants are asked to say “yes” if a figure was on the original display or “no” if it

was not. There was a small improvement in the recognition discrimination index score from pretesting (*M* = 4.77, *SD* = 1.64) to posttesting (*M* = 5.11, *SD* = 1.54), *d* = .25, CI 95% [-.68, 1.18].

Additional Measures

The Patient Health Questionnaire-9

The PHQ-9 is a measure of depressive symptoms. Higher scores indicate more frequent symptoms of depression or more severe depression. There was small improvement from pretesting (*M* = 6.44, *SD* = 4.82) to posttesting (*M* = 5.33, *SD* = 5.45), *d* = -.31, CI 95% [-1.24, .62]. This indicates that depressive symptoms slightly decreased following the completion of the *Mind Sharpener* program.

Cognitive Failures Questionnaire

The Cognitive Failures Questionnaire provides self-report information on the perceived frequency of common memory problems. Higher scores indicate more frequent problems in memory. There was no change from pretesting (*M* = 35.44, *SD* = 11.71) to posttesting (*M* = 35.44, *SD* = 12.20), *d* = .00, CI 95% [-.92, .92].

Discussion

In summary, after completing the cognitive training program, most of the participants showed improvement or stability in the majority of the cognitive domains that the *Mind Sharpener* program was designed to target. Ten of the measures showed improvements (Nine measures had small improvement and one measure had a large improvement), six measures showed stability, and one measure (COWAT) had a small decline following training. The overall results of this study are encouraging, especially considering that the participants already had high levels of cognitive functioning prior to beginning the *Mind Sharpener* program. Several of the

participants had very high scores on some of the cognitive measures prior to beginning the cognitive training program, leaving relatively little room for improvement. The majority of the measures had a maximum score possible. This is important to note because the high pretesting scores may have resulted in a ceiling effect, which may explain why most of the tests had small improvements rather than medium to large improvements.

Based on previous literature with similar populations, we expected to see improvements in executive functioning, perceptual speed, depressive symptoms, and self-reports of memory self-efficacy, with minimal improvements in objective tests of memory. As hypothesized, there was an improvement in perceptual speed, which was measured by Trail A. In the cognitive domain of executive functioning, there was stability, as measured by Trail B. Unlike most previous cognitive training research, this study found improvements in both verbal and visual memory.

Based on previous literature (Rapp et al., 2002), the researchers also had hypothesized that there would be a decrease in the subjective cognitive failures that participants reported, but there was no change in the Cognitive Failures Questionnaire following the program. Although *Mind Sharpener* is not designed to target symptoms of depression, participants reported fewer symptoms of depression following the completion of the program. This result was hypothesized and similar results have been found in previous research (Brum et al., 2009). The positive interactions in the group setting and feelings of accomplishment from taking part in the class may have resulted in reduced feelings of depression in the participants.

Due to limited research evaluating how cognitive training affects the cognitive domains of attention and visual spatial skills, the researchers made no specific hypotheses for these cognitive domains. Attention was measured with the BTA, and Forward and Backward Digit

Span. The BTA and Forward Digit Span showed stability, and there was improvement in the Backward Digit Span following the completion of *Mind Sharpener*. Additionally, there was improvement in visual puzzles scores which was used to measure visual spatial skills.

As stated in the results, small declines on the COWAT were observed from pretesting to posttesting. This decline was seen in six of the nine participants. This decline was very unexpected and it is unclear what accounts for this finding. As mentioned previously, language abilities usually do not decline with age, and often increase over time. The COWAT was used in this study as a measure of language abilities (although it is also a measure of executive functioning), so stability or improvement in this measure was expected. Due to these unusual results, the researchers believe that the COWAT should not solely be relied upon to measure language abilities. More specifically, "language" actually involves a broad set of abilities (e.g., verbal comprehension, expressive language abilities), only some of which are assessed by the COWAT. Stability was observed on the BNT, which is a more traditional measure of language (i.e., confrontation naming) was also used to measure language abilities. Overall, these mixed findings with regard to language abilities may be due to: 1) the program is ineffective for modifying language abilities, 2) the measures used in the current study were insensitive to changes in language abilities, or 3) the measures are not appropriate in that they assess constructs that are not targeted in the *Mind Sharpener* program. Future research may require the use of language measures that are more comprehensive in order to determine which (if any) language abilities are impacted by the program.

Limitations and Future Directions

As with any study, this study was not without limitations. The sample for this study was very homogenous; every participant was a nun who identified as a Caucasian female and was

highly educated (bachelor's degree and above). This limits the generalizability of the study since the participants were so similar. Additionally, only nine participants completed the study. Future research should utilize a more heterogeneous population with a larger sample size to increase the generalizability of the results.

Furthermore, a significant limitation of the study was the lack of a control group. A control group would allow researchers to differentiate between changes that occurred due to the cognitive training program and changes in cognitive domains that naturally occur over time in cognitively intact older adults without the cognitive training program intervention. Without a control group, we cannot conclude that the cognitive training intervention was responsible for the changes observed on the outcome measures. Unfortunately, the researchers in this study only had a limited number of volunteer participants, making it impossible to have an experimental group and a control group.

Additionally, there were no follow-up assessments with the participants, so the researchers are unable to report how the cognitive training program impacts participants over time. Future research should include follow-up assessments with participants to see if and/or how long the improvements from the cognitive training program last. Using follow-up assessments in future research could also inform researchers what the ideal "dose" of cognitive training is (e.g. a month of intense training, a year of training, etc.) and the best delivery method (e.g. group, individual, via computer, etc.).

Conclusions

The results of this study provide encouraging results for the efficacy of a cognitive training program for cognitively intact older adults. The majority of measures showed improvement or stability, while only one measure declined. There was an improvement in global

functioning, as measured by the 3MS. This is especially noteworthy because the participants had very high 3MS scores prior to beginning the cognitive training program. The largest improvement was seen in immediate verbal recall/memory, which was measured by the HVLT.

Overall, the results of the *Mind Sharpener* program are encouraging, but more cognitive training research is necessary to make strong conclusions about the efficacy of cognitive training programs. Future research should use a larger and more heterogeneous sample to increase the generalizability of results, and have a waitlist control group to be able to make stronger conclusions about the effectiveness of a cognitive training program.

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Table 1.

Pre- and post-training means and standard deviations

	Pre Mean (SD)	Post Mean (SD)	Cohen's d	Effect size & direction
3MS	92.00 (4.92)	94.00 (4.09)	0.33	Small +
Forward digit span correct	8.33 (2.00)	8.44 (2.60)	0.09	No effect
Backward digit span correct	7.89 (2.52)	8.22 (2.05)	0.25	Small +
BTA total	6.22 (2.28)	6.44 (2.07)	0.12	No effect
COWAT Letter Fluency Total	27.44 (7.53)	24.00 (8.37)	-0.45	Small -
BNT Total	24.44 (2.92)	24.11 (2.98)	-0.13	No effect
Trail making test A (seconds)	46.89 (14.39)	42.22 (16.35)	0.30	Small +
Trail making test B (seconds)	115.00 (42.24)	113.11 (60.40)	0.06	No effect
Visual Puzzles	10.44 (1.74)	11.22 (3.07)	0.28	Small +
HVLT total recall	19.56 (5.03)	23.56 (4.64)	1.07	Large +
HVLT delayed recall	6.78 (2.44)	7.56 (2.01)	0.29	Small +
HVLT recognition	9.44 (1.67)	9.89 (1.83)	0.44	Small +
BVMT total recall	13.44 (7.28)	14.78 (7.29)	0.33	Small +
BVMT delayed	5.33 (2.35)	5.44 (3.17)	0.07	No effect
BVMT recognition	4.77 (1.64)	5.11 (1.54)	0.25	Small +
PHQ-9	6.44 (4.82)	5.33 (5.45)	.29	Small +
Cognitive Failures Questionnaire	35.44 (11.71)	35.44 (12.20)	0.00	No effect

Table 2.

Pre- and post-training data for participant OJX101

	Pre Mean	Post Mean	Change
3MS	89.00	86.00	-3.00
Forward digit span correct	12.00	14.00	+2.00
Backward digit span correct	11.00	11.00	0.00
BTA total	9.00	10.00	+1.00
COWAT Letter Fluency Total	34.00	20.00	-14.00
BNT total	27.00	27.00	0.00
Trail making test A (seconds)	39.00	21.00	-18.00*
Trail making test B (seconds)	74.00	63.00	-11.00*
Visual Puzzles	9.00	11.00	+2.00
HVLT total recall	24.00	26.00	+2.00
HVLT delayed recall	8.00	5.00	-3.00
HVLT recognition	7.00	9.00	+2.00
BMVT total recall	10.00	10.00	0.00
BMVT delayed	3.00	5.00	+2.00
BMVT recognition	6.00	5.00	-1.00
PHQ-9	1.00	1.00	0.00*
Cognitive Failures	21.00	12.00	-9.00*

Note: Participant OJX101 showed improvement on nine measures, stability on four measures, and decline on four measures.

* = Decrease in score indicates improvement

Table 3.

Pre- and post-training data for participant FCX102

	Pre Mean	Post Mean	Change
3MS	96.00	96.00	0.00
Forward digit span correct	7.00	6.00	-1.00
Backward digit span correct	7.00	6.00	-1.00
BTA total	7.00	6.00	-1.00
COWAT Letter Fluency Total	23.00	27.00	+4.00
BNT total	25.00	27.00	+2.00
Trail making test A (seconds)	48.00	43.00	-5.00*
Trail making test B (seconds)	101.00	98.00	-3.00*
Visual Puzzles	14.00	17.00	+3.00
HVLT total recall	19.00	22.00	+3.00
HVLT delayed recall	4.00	5.00	+1.00
HVLT recognition	10.00	11.00	+1.00
BMVT total recall	6.00	15.00	+9.00
BMVT delayed	4.00	6.00	+2.00
BMVT recognition	6.00	6.00	0.00
PHQ-9	5.00	3.00	-2.00*
Cognitive Failures	50.00	41.00	-9.00*

Note: Participant FCX102 showed improvement on 12 measures, stability on two measures, and decline on three measures.

* = Decrease in score indicates improvement

Table 4.

Pre- and post-training data for participant HCX103

	Pre Mean	Post Mean	Change
3MS	96.00	90.00	-6.00
Forward digit span correct	9.00	9.00	0.00
Backward digit span correct	13.00	11.00	-2.00
BTA total	7.00	5.00	-2.00
COWAT Letter Fluency Total	43.00	40.00	-3.00
BNT total	29.00	27.00	-2.00
Trail making test A (seconds)	49.00	30.00	-19.00*
Trail making test B (seconds)	72.00	59.00	-13.00*
Visual Puzzles	11.00	13.00	+2.00
HVLT total recall	25.00	28.00	+3.00
HVLT delayed recall	9.00	11.00	+2.00
HVLT recognition	11.00	12.00	+1.00
BMVT total recall	10.00	10.00	0.00
BMVT delayed	3.00	5.00	+2.00
BMVT recognition	6.00	6.00	0.00
PHQ-9	3.00	1.00	-2.00*
Cognitive Failures	26.00	24.00	-2.00*

Note: Participant HCX103 showed improvement on nine measures, stability on three measures, and decline on five measures.

* = Decrease in score indicates improvement

Table 5.

Pre- and post-training data for participant HBX104

	Pre Mean	Post Mean	Change
3MS	81.00	95.00	+14.00
Forward digit span correct	7.00	6.00	0.00
Backward digit span correct	7.00	8.00	+1.00
BTA total	3.00	6.00	+3.00
COWAT Letter Fluency Total	27.00	20.00	-7.00
BNT total	29.00	27.00	-2.00
Trail making test A (seconds)	70.00	60.00	-10.00*
Trail making test B (seconds)	187.00	254.00	+67.00*
Visual Puzzles	9.00	10.00	+1.00
HVLT total recall	13.00	24.00	+11.00
HVLT delayed recall	3.00	9.00	+6.00
HVLT recognition	9.00	9.00	0.00
BMVT total recall	4.00	4.00	0.00
BMVT delayed	2.00	0.00	-2.00
BMVT recognition	1.00	2.00	+1.00
PHQ-9	8.00	3.00	-5.00*
Cognitive Failures	29.00	29.00	0.00*

Note: Participant HBX104 showed improvement on nine measures, stability on four measures, and decline on four measures.

* = Decrease in score indicates improvement

Table 6.

Pre- and post-training data for participant GMX106

	Pre Mean	Post Mean	Change
3MS	95.00	93.00	+3.00
Forward digit span correct	8.00	9.00	+1.00
Backward digit span correct	7.00	10.00	+3.00
BTA total	8.00	9.00	+1.00
COWAT Letter Fluency Total	25.00	34.00	+9.00
BNT total	25.00	26.00	+1.00
Trail making test A (seconds)	21.00	34.00	+13.00*
Trail making test B (seconds)	80.00	66.00	-14.00*
Visual Puzzles	10.00	7.00	-3.00
HVLT total recall	27.00	28.00	+1.00
HVLT delayed recall	10.00	7.00	-1.00
HVLT recognition	10.00	11.00	+1.00
BMVT total recall	22.00	16.00	-6.00
BMVT delayed	6.00	7.00	+1.00
BMVT recognition	5.00	3.00	-2.00
PHQ-9	16.00	9.00	-7.00*
Cognitive Failures	46.00	42.00	-4.00*

Note: Participant GMX106 showed improvement on 12 measures and decline on five measures.

* = Decrease in score indicates improvement

Table 7.

Pre- and post-training data for participant CMX105

	Pre Mean	Post Mean	Change
3MS	89.00	96.00	+7.00
Forward digit span correct	7.00	9.00	+2.00
Backward digit span correct	7.00	8.00	+1.00
BTA total	25.00	19.00	-6.00
COWAT Letter Fluency Total	27.00	19.00	-8.00
BNT total	25.00	26.00	+1.00
Trail making test A (seconds)	38.00	29.00	-9.00*
Trail making test B (seconds)	113.00	98.00	-15.00*
Visual Puzzles	9.00	11.00	+2.00
HVLT total recall	18.00	26.00	+8.00
HVLT delayed recall	7.00	8.00	+1.00
HVLT recognition	5.00	6.00	+1.00
BMVT total recall	14.00	18.00	+8.00
BMVT delayed	7.00	7.00	0.00
BMVT recognition	5.00	6.00	+1.00
PHQ-9	4.00	7.00	+3.00*
Cognitive Failures	28.00	40.00	+12.00*

Note: Participant GMX106 showed improvement on 12 measures, stability on one measure, and decline on four measures.

* = Decrease in score indicates improvement

Table 8.

Pre- and post-training data for participant KJX107

	Pre Mean	Post Mean	Change
3MS	94.00	99.00	+5.00
Forward digit span correct	8.00	7.00	-1.00
Backward digit span correct	6.00	6.00	0.00
BTA total	4.00	6.00	+2.00
COWAT Letter Fluency Total	16.00	20.00	+4.00
BNT total	21.00	23.00	+2.00
Trail making test A (seconds)	64.00	42.00	-22.00*
Trail making test B (seconds)	119.00	107.00	-12.00*
Visual Puzzles	11.00	8.00	-3.00
HVLT total recall	14.00	13.00	-1.00
HVLT delayed recall	7.00	9.00	+2.00
HVLT recognition	9.00	9.00	0.00
BMVT total recall	16.00	17.00	+1.00
BMVT delayed	5.00	3.00	-2.00
BMVT recognition	4.00	6.00	+2.00
PHQ-9	6.00	4.00	-2.00*
Cognitive Failures	48.00	49.00	+1.00*

Note: Participant KJX107 showed improvement on ten measures, stability on two measures, and decline on five measures.

* = Decrease in score indicates improvement

Table 9.

Pre- and post-training data for participant FEX108

	Pre Mean	Post Mean	Change
3MS	93.00	94.00	+1.00
Forward digit span correct	11.00	10.00	-1.00
Backward digit span correct	8.00	8.00	0.00
BTA total	9.00	7.00	-2.00
COWAT Letter Fluency Total	28.00	23.00	-5.00
BNT total	26.00	25.00	-1.00
Trail making test A (seconds)	44.00	48.00	+4.00*
Trail making test B (seconds)	110.00	130.00	+20.00*
Visual Puzzles	12.00	10.00	-2.00
HVLT total recall	17.00	21.00	+4.00
HVLT delayed recall	5.00	6.00	+1.00
HVLT recognition	7.00	6.00	-2.00
BMVT total recall	17.00	19.00	+2.00
BMVT delayed	8.00	7.00	-1.00
BMVT recognition	6.00	6.00	0.00
PHQ-9	3.00	2.00	-1.00*
Cognitive Failures	25.00	33.00	+8.00*

Note: Participant FEX108 showed improvement on five measures, stability on two measures, and decline on ten measures.

* = Decrease in score indicates improvement

Table 10.

Pre- and post-training data for participant ALX109

	Pre Mean	Post Mean	Change
3MS	95.00	92.00	-3.00
Forward digit span correct	6.00	6.00	0.00
Backward digit span correct	5.00	6.00	+1.00
BTA total	5.00	6.00	+1.00
COWAT Letter Fluency Total	24.00	13.00	-11.00
BNT total	20.00	22.00	+2.00
Trail making test A (seconds)	49.00	73.00	+24.00*
Trail making test B (seconds)	179.00	143.00	-36.00*
Visual Puzzles	9.00	14.00	+5.00
HVLT total recall	18.00	24.00	+6.00
HVLT delayed recall	7.00	8.00	+1.00
HVLT recognition	1200	11.00	-1.00
BMVT total recall	7.00	6.00	-1.00
BMVT delayed	4.00	3.00	-1.00
BMVT recognition	4.00	6.00	+2.00
PHQ-9	3.00	2.00	-1.00*
Cognitive Failures	25.00	33.00	+8.00*

Note: Participant ALX109 showed improvement on nine measures, stability on one measure, and decline on seven measures.

* = Decrease in score indicates improvement

Appendix

Consent Form

Informed Consent for Participation in the Research Study

Purpose
I understand that the purpose of the research study is to evaluate the effects of a cognitive training program.

Participants
I understand that I have been asked to participate because I am not experiencing cognitive decline, but may have some minor complaints about declines in my memory or thinking.

Procedure
I understand the experimenter will administer a series of tests which will take about 60 minutes. These tests will assess my memory and other abilities and will be given before starting the classes as well as immediately after completion of the classes.

I understand that I will participate in a series of cognitive training classes (2-3 classes per week for 8-12 weeks and each class will last about 1 hour). These classes involve a number of activities that are meant to "exercise" various skills such as memory, language, and problem solving. The content of the activities is designed to be appropriate for adults, challenging, and enjoyable. The classes are conducted in groups, with about 10 people participating in each group. Classes will be led by activities staff working at my place of residence.

Risks
I understand that there are minimal risks associated with participation in this study. It is possible that I may become frustrated because I do not enjoy participating in the classes. If this occurs, I may leave the class or stop attending classes altogether.

Benefits
I understand that I will not be compensated for my participation. The results of this study may yield useful information about how to improve or maintain cognitive functioning in older persons.

Confidentiality

I understand that the findings of this study will be completely confidential. Confidentiality will be protected in that no identifying information will be included on any records collected during this study. All information will be kept in a locked cabinet in researcher's office located in the Psychology Doctoral and Clinical Center at Minnesota State University, Mankato.

Right to Refuse or Withdraw

I understand that my participation in this research is voluntary. I understand that I may refuse to participate or withdraw from the study at any time without penalty. I understand that I will not be penalized or jeopardize my relationship with Minnesota State University as a result of withdrawal from the study.

Questions

I have been informed that if I have any questions, I am free to ask them. I understand that if I have any additional questions later, I may contact the office of the principal investigator Jeffrey Buchanan, Ph.D. at (507) 389-5824 or if you have questions or concerns about the treatment of human subjects, please contact the IRB Administrator and Associate Vice President of Research and Dean of Graduate Studies, Dr. Barry Ries at (507) 389-1242.

Closing Statement

My signature below indicates that I have decided to participate in a research study; that I have read this form; that understand it; that I have had all my questions answered; and that I have received a copy of this consent form.

_____ _____

Signature of Participant Date

_____ _____

Signature of Investigator Date

MSU IRBNet LOG # 868952