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ABSTRACT

Grounded in cognitive neuroscience and social exchange theory, this research evaluated the relationship between changes in cognitive functioning and two psycho-social dimensions of life among healthy adults over the age of 70 (N=12). Specific psycho-social dimensions examined were social interaction and depression. Six females and six males participated in the study. All were white, college-educated individuals residing in a life-care residential retirement community. The participants used the Posit Science® Brain Fitness Program™, an auditory-based computer training program that improves memory and speed of processing, for forty hours over an eight-week period. Pre- and post-tests related to social interaction and depressive symptoms indicated that improvement in cognitive functioning was related to improvement in psychosocial dimensions in later life.

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MEET THE STUDENT-AUTHOR

Desma Hurley

After graduating from Flippin High School in Marion County, Ark., I enrolled at Arkansas State University of Mountain Home, Ark. From this institution, I earned an associate degree in business with an emphasis in computer applications. After graduating, I became Montessori-certified and a lead teacher at the Fayetteville Montessori School, supervising 18 two-year-olds and six teacher assistants. After working with children for several years, I made the decision to earn my bachelor's degree in Human Development, Family Sciences and Rural Sociology with a Lifespan / Family Sciences concentration. Late in my undergraduate work I became fascinated with research focused on improving the overall quality of life of older individuals. This interest afforded me the opportunity to study cognitive functioning as it correlates with psychosocial effects of mature adults. I am now a first-year master's student majoring in Human Development, Family Sciences, and Rural Sociology with an emphasis in Gerontology. I am currently a graduate research assistant working with M. Jean Turner, Ph.D. I would like to give a very special thank you to my research mentor, Dr. Turner, for her support, motivation, and guidance. Her constant positive support has led me to continue my pursuit of academic achievement.

INTRODUCTION

This study examines how changes in age-related cognitive functioning associated with a brain training program affect depressive symptoms and social interaction among older adults. The purpose of the research is to assess the effects of a brain training program on improved psychosocial functioning of healthy aging adults. This study examines how healthy, mature adults' improvements in cognitive functioning, resulting from use of a computer program, relate to psycho-social dimensions of older adults' lives.

Aging adults often experience "age-related cognitive decline" (ARCD) (Park, O'Connell, and Thomson, 2003). According to researchers, an aging individual experiencing ARCD is also susceptible to decline in his or her psycho-social functioning (Biringer et al., 2005; Cumijs, Jonker, Beekman, and Deeg, 2001; Park et al., 2003). These declines can impact an older adult's level of depression, social interactions, and overall well-being. Research has also shown that ARCD decreases one's short-term memory skills, impacting mental and physical health (Park et al., 2003). ARCD can be a contributing factor to increased levels of depression leading to less social activity for older adults (Biringer et al., 2005; Cumijs et al., 2001).

A computer-based software program called the Brain Fitness Program™ (BFP) by Posit Science® Corporation (San Francisco, California) is designed to stop or even reverse ARCD. This program is a computer-based auditory training software program. The BFP was designed by leading scientists to provide the brain with six specific exercises to improve cognitive ability. The goal of the targeted brain exercises is to drive learning, focus on certain areas of ARCD, and stimulate analytical pathways for an overall increase in cognitive ability. Past research has focused only on cognitive gains related to the BFP's training designs and its core applications for older adults (Mahncke, et al., 2006). The current study explores implications of BFP on the number of depressive symptoms and social interaction.

Social exchange theory provides a possible explanation for the decline in social interaction and activity sometimes seen in elders in later life. This theory sug-

gests that decline of social interaction does not result from one's personal choice or social system needs, but rather from an unequal communication process between older adults and other members of society (Hooyman and Kiyak, 2008). The equal balance of social exchange experienced between an older adult and other individuals establishes the older adult's level of personal satisfaction. Because of the changes in social arrangements, roles, and skills that usually accompany aging, an older individual may have fewer commonalities with his or her social environment. This circumstance may lead to a decline in social interaction experiences. With fewer opportunities to exert power in social interactions, mature adults may remove themselves from interactions and thus be forced to accept a decline in their level of social interaction (Hooyman and Kiyak, 2008).

Older adults who feel a sense of declining cognitive functioning often become less confident during social situations (Plehn, Marcopulos, and McLain, 2003). Those who suffer from ARCD often experience less personal independence and a decline in overall quality of life (Plehn et al., 2003). The BFP used in this research may provide gains in cognitive functioning that lead to improvements in social interaction as well as decreases in the number of depressive symptoms participants experience.

Cognitive Functioning. ARCD is the normal progression of memory and cognitive decline among older adults, affecting more than 36% of adults 85 years of age and older (Black and Rush, 2002). The greatest amount of cognitive decline occurs among the oldest-old cohort, the fastest growing population in the United States (Park, et al., 2003). A study of 15,000 participants conducted by Cutler and Grams (1988) found that 40% of individuals over 55 years of age experienced a decline in memory skills.

An individual experiencing ARCD requires more time to learn information than his or her counterpart. While conversing, one may have difficulty conjugating words and may often repeat sentences because he or she can recall thinking a statement but not recall expressing it (Insel and Badger, 2002). Mature adults who suffer from ARCD often experience a loss of independence and a decrease in overall quality of life (Plehn, et al., 2003). Cognitive decline is a predictor of functional disability (Doge, Du, Sazton, and Ganguli, 2006). Also, those who suffer from ARCD are more likely to be institutionalized and require more medical services than other individuals (Black and Rush, 2002). Doge et al., (2006) expressed that cognitive decline is coupled with a decrease in instrumental activities of daily life (IADLs). IADLs include money management, cooking, laundry, and simple household cleaning (Plehn, et al., 2003).

Depression. Research suggests that ARCD leads to a decline in mental health and social interaction (Mahncke, et al., 2006). Depression and ARCD are directly correlated with one another. Hofman, et al. (2000) found an inverse association between levels of depression and cognitive functioning. Intervention programs that increase cognitive functioning may also prevent the development of mental illnesses like depression among older adults (Blazer, 2002).

Depressive symptoms include: feelings of sadness and loneliness, sleep disturbance, lack of interest, energy reduction, changes in appetite, and concentration difficulties (Blazer, 2002; Insel and Badger, 2002). Older adults with symptoms of depression often experience a drop in cognitive functioning, a decrease in information processing speed, and declines in memory, abstract reasoning, flexible thinking, and word creation (Biringer, et al., 2005; Blazer, 2002). Depression can be compounded with the onset of ARCD because of a decline in overall self-efficacy (Biringer, et al., 2005).

Social Interaction. ARCD has been reported to be negatively related to social interaction (Nezlek, Richardson, Green, and Schatten-Jones, 2002). A persistent and healthy social life is more beneficial to older adults than it is to any other age group (Caprara and Steca, 2005). It greatly increases the overall life satisfaction of elders (Caprara and Steca, 2005). Adults in late life who report a rewarding, active, high-quality social life also report greater psychological well-being than other individuals. In return, healthy psychological well-being is positively related to the quantity and quality of social interaction (Nezlek, et al., 2002). Engaging in social activity is likely related to better physical and mental health, and may also be a predictor of fewer disabilities and a decrease in overall ARCD (Doge et al., 2006).

A common denominator of social interaction is loneliness. Older adults spend more time alone than individuals of other age groups (Adams, Sanders, and Auth, 2004). Loneliness is defined as a reaction to a difference between desired and achieved social activity (Blazer, 2002). Some characteristics of loneliness include shyness, low self-esteem, self-depreciation, and poor social skills, some or all of which may stem from childhood (Blazer, 2002). A decline in social activity is associated with depression. Further, depressive symptoms may lead to lower levels of overall social activity. Loneliness is not a symptom of depression. However, it may contribute to depression (Adams et al., 2004). Mature adults can relieve or prevent loneliness by enhancing their cognitive functioning (Blazer, 2002).

Brain Fitness Program. The BFP was designed to strengthen brain health and quality of life for older individuals. As people improve their abilities to hear and

process language, they also improve their abilities to remember information and act on what they hear. The BFP guides users away from learned negative behaviors that diminish brain health into new behaviors that positively reinforce improved brain-functioning skills. Each BFP exercise targets specific aspects of cognitive decline, aiming to reduce or even reverse ARCD. Participants who have completed the BFP report improved communication skills, memory, self-confidence, attention, and optimism (Posit Science, 2006).

Components of the Brain Fitness Program. The BFP is composed of six basic exercises that build cognitively on each other. For example, the first exercise, High or Low, is a time-order judgment exercise. The goal of this exercise is to gradually improve one's ability to identify sweeps and bursts that are shorter and close together in time, training the brain to react faster and more accurately to sounds. The fourth exercise, Sound Replay, is a serial memory-span exercise. This exercise is designed to improve the brain's ability to differentiate sounds, store them, and recall increasingly longer series of sounds or syllables in their correct sequence (Posit Science, 2006).

The BFP has been shown to decrease and sometimes reverse the effects of ARCD. As stated previously, ARCD can negatively affect the overall quality of life and sense of well-being for older adults. Recovering from ARCD may lead to an increase in social interactions, mental health, and self-efficacy, and may reduce depressive symptoms. Mahnke, et al. (2006) found the BFP to be effective with adults over 60 years of age. Test results for those scoring below 85% on the initial neurological assessments indicated that the test group experienced increases in the areas measured, showing that the brain plasticity-based program improved cognitive functioning (Mahncke, et al., 2006).

MATERIALS AND METHODS

The objective of this research project was to determine psycho-social changes associated with the use of the BFP among healthy, community-dwelling, mature adults. The relationship between changes in cognitive functioning, depressive symptoms, and sociability is examined using pre- and post-test measures. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998) was used for cognitive evaluation. Dr. Stephen Gemmell, a neuropsychologist, and Ms. Nakia Richter, a testing and measurement technician, conducted the pre- and post-test assessments using the RBANDS to assure consistency and accuracy in cognitive evaluations for the study. Social interaction and depressive symptoms were assessed using the Form 36 HARQoL (Brazier et al., 1992). Participants were also asked about the frequency and extent to which heath problems interfered with social interaction.

Older adults (N=12) living in a multi-level retirement community were recruited and trained on the BFP. All potential participants were determined to be free of diagnosable cognitive decline and depression. Participants were instructed to use the BFP once a day for one hour, five days a week, for eight weeks for a total of 40 hours. The student researcher loaded the program onto the study group's personal computers and demonstrated how to use the software. The researcher then remained in contact with the participants as frequently and in the manner each individual chose in order to resolve any problems with the BFP. Some participants requested regular weekly visits, others wanted phone calls on a regular basis, and still others requested e-mail contact as they needed it.

RESULTS AND DISCUSSION

A one-tailed t-test was used to assess positive change between time one and time two. Due to the small sample size and the fact that this project is exploratory research, the acceptable level of significance was set at $p < .10$. Although changes in the participants' levels of cognitive functioning were not statistically significant, the post-test results indicated improvement in several cognitive dimensions measured (see Table 1), as predicted by previous research (Mahncke, et al., 2006). Results also indicated a significant reduction in the participants' perceptions of the extent to which health problems interfered with social activities between time one and time two (see Table 2). However, no significant reduction in their perception of the frequency with which health problems interfered with social activities was found. Only one indicator of depressive symptoms approached significance. Respondents reported fewer instances of feeling down in the dumps following their experience with the BFP (see Table 3).

This study provides important insight into a previously unexplored area of research. However, it does have some limitations. The biggest limitation is the sample size. Because it serves as an exploratory study, the sample was limited to a manageable and conveniently available group. The sample was primarily obtained from a local multi-level living facility by asking for volunteers. The self-selection process combined with the high level of education and SES of the residents and numerous available activities provided by the center make it difficult to generalize the findings of this study to a broader population of older adults. To further explore the issues of the study, future research needs larger, more diverse

samples reflecting both community dwelling and residential elders.

The findings of this study provide a beginning for understanding the relationship between improving cognitive functioning and social interaction and the number of depressive symptoms experienced by older adults. Future research is required if we are to fully understand associations between improved brain fitness and overall well-being for aging individuals.

Individual reports from participants indicated that they perceived more of an increase in cognitive functioning and social interaction as well as a greater decrease in depressive symptoms than the statistical analysis indicated. Anecdotal comments of participants include "I do not have to write down telephone numbers from the phonebook anymore. I can remember the numbers as I walk from the phonebook to the telephone." "Installing the BFP onto my computer early this summer allowed me time to gain the needed confidence to participate in the play at the end of the summer. Both my wife and I are impressed that I remembered 40 lines." Participating in the BFP gave this 92 year-old individual the confidence to pursue being in a play, which he very much wanted to do. However, before participating in this study he had doubted his ability to memorize lines should he join the cast.

This project examines a modern-day application for enhancing older adults' cognitive abilities. The positive effects on cognitive functioning are well documented in previous research (Mahncke, et al., 2006). However, previously only anecdotal evidence supported the expectations of this study—that cognitive improvements would also improve various psycho-social dimensions. Increasing social interaction and reducing the number of depressive symptoms experienced combine for an overall effect of enhancing quality of life among older adults. Combining new technology with the potential to enrich overall well-being for the rapidly growing older adult population will create greater health and fitness opportunities for many future generations. Discovering methods to maintain cognitive ability leading to the reduction of depressive symptoms and loneliness while increasing social interactions and adaptability will improve quality of life for mature adults as well as for the loved ones who care for them.

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Table 1. Cognitive Functioning

BFP Factors	Pre-test mean(SD)	Post-test mean(SD)	t	p-value
List recall	4.83(1.56)	5.25(.329)	-0.959	0.179
Delayed memory	98.25(17.062)	102.33(11.139)	-0.867	0.203
Figure recall	11.33(2.807)	10.92(3.872)	0.302	0.384
Semantic fluency	17.75(2.989)	18.83(3.010)	-1.193	0.129

Table 2. Social Interaction

Perceived Health Interference	Pre-test mean(SD)	Post-test mean(SD)	t	p-value
Extent health problems interfered with social activities	4.58(.669)	4.00(1.044)	2.028	0.034*
Frequency health problems interfered with social activities	4.18(1.25)	4.55(.688)	-0.938	0.186

*Significance level p <.10.

Table 3. Depression

Depressive Symptoms	Pre-test mean(SD)	Post-test mean(SD)	t	p-value
Been very nervous	4.36(.674)	4.27(.647)	0.363	0.362
Felt so down in the dumps that nothing could cheer you up	4.64(.674)	4.82(.182)	-1.491	0.084*
Felt calm and peaceful	3.82(.982)	3.73(1.009)	0.209	0.420
Felt downhearted and depressed	4.45(.522)	4.55(.522)	-0.559	0.294
Been happy	4.00(.447)	3.91(1.044)	0.219	0.416

*Significant level p< .10.