

The Effects of Computerized Cognitive Rehabilitation with White Noise on Memory and Attention in Elderly

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Abstract. The purpose of this study was to evaluate the effects of computerized cognitive (COMCOG) rehabilitation training system with white noise on memory and attention in elderly. 28 elderly subjects were recruited and conveniently allocated into experimental and control groups. Experimental group received computer assisted cognitive training using COMCOG rehabilitation training system with white noise for 6 weeks. Control group received computer assisted cognitive training using COMCOG rehabilitation training system for 6 weeks. All subjects were assessed their memory and attention using verbal memory test and continuous performance test at pre and post. After 6 weeks training, the test scores was significantly improved in the both groups ($p<.05$). And the experimental group showed significantly difference from control group in digit span (forward, backward), auditory continuous performance test (sec) ($p<.05$). The results of this study showed that COMCOG rehabilitation training system with white noise may be appropriate for improving memory and attention in elderly.

Keywords: COMCOG, White Noise, Memory, Attention

1 Introduction

Dementia, stating with cognitive function disorder, is a mental disorder, which causes degradation of daily living and social activity ability. However, few studies have been done on specialized treatment or practical application of rehabilitation programs to improve cognitive functions yet. The previous studies on treatment of cognitive function disorder were centered on conventional methods such as regular aerobic exercise [1], treatment of disorientation [2], reminiscence therapy [3] and occupational therapy [4]. Recently, assessment of cognitive function and treatment using computers has been tried more and more [5]. The cognitive treatment using a computer has an advantage that can provide not only structured and standardized training tasks but also accurate and immediate feedbacks so that it is applied to cognitive rehabilitation usefully and its use has increased [6]. Zoltan [7] started cognitive treatment using computers, focusing on attention and memory of patients with brain damage and reported improvement on memory, attention and problem

solving ability. In Korea, a cognitive rehabilitation program using a computer has been spotlighted since 2000. The frequently used programs are COMCOG, RehaCom, Captain's log, and PSS CogRehab etc. [8]. The noise influences human physiology and psychology. White noise is a kind of noise that it is distributed uniformly over the frequency (20~20,000Hz) within audible range [9]. White noise includes natural sound such as waves' sound, rain' sound and wind' sound [10]. The white noise is produce brain alpha wave that it is generated by a stable mind and body and abated brain beta wave that it is generated by diffuse status condition [11]. Few studies have been done on cognitive treatment using a computer in Korea. Some of the studies were about patients with brain damage [12], and patients with schizophrenia [13] and no study has been done with normal healthy elderly. Furthermore, the effect of computerized cognitive rehabilitation with white noise on memory and attention is unclear. Although no organic abnormalities were found in a brain due to normal aging process, cognitive disorder such as memory loss, poor concentration, and inability to coordination of the left and right hemispheres in a brain could occur and this can be serious obstacle to normal daily living. Therefore, the present study aims to determine the effect of computerized cognitive rehabilitation with white noise on memory and attention in elderly people who were not patients but healthy living in a community.

2 Subjects and methods

2.1 Subjects

The present study choose 28 subjects in total, 14 in experimental group and 14 in control group, who consented study participation after hearing the objective of the study among those who attended the elderly welfare center located in Changwon city in Korea and over 70 years old. Experimental group received computer assisted cognitive training using COMCOG rehabilitation training system with white noise. Control group received computer assisted cognitive training using COMCOG rehabilitation training system. The selection conditions for the subjects are as follows: 1) No impairment of corrected vision and hearing. 2) Currently taking no psychotropic drugs. 3) No disease history of head trauma, epilepsy, and cerebrovascular disease. 4) No linguistic problem for everyday life. 5) Having MMSE-K score 19 or more.

2.2 Training program

The present used computerized cognitive rehabilitation training system (COMCOG, Max Medica Inc., 2004, version 1.0, Korea) that it is a tool developed for cognitive function improvement based on Korean Cognitive Therapy Program developed by Kim et al. [14]. The stimulation employed in COMCOG was visual stimulation such as familiar objects that can be experienced in daily living or animal and plants, and auditory stimulation using musical instruments and animal crying. COMCOG is a therapeutic program to train the memory of those stimulations. It also provided

immediate feedbacks to responses of the subjects thereby facilitating the improvement of memory and execution performance. Additionally, it was designed to train various cognitive areas selectively according to the cognitive function disorder degree of the subjects and train the subjects themselves without examiner's assistance. Experimental group trained COMCOG using white noise generator (genius, HDT Inc., Korea) and intensity was adjusted about 60dB. The training frequency for both groups was 3 times per week and once per day for 30 min.

2.3 Outcome assessment

The present used computerized neurocognitive function test (CNT, Max Medica Inc., 2004, version 4.0, Korea) that it is a computerized neurocognitive function assessment tool for a series of neuropsychological tests to assess cognitive functions of adults developed by Ha [15]. This consists of 17 sub-tests and categorized largely into memory test, attention test, higher-order cognitive capacity coordination test, and intelligence test. The subtests were selected mainly to assess memory and attention.

2.4 Statistical method

For the statistical analysis of this study, SPSS 12.0 ver. for window[®] was used. The results of all experiments were expressed as a mean and standard deviation. Independent t-test was used for the comparison between experimental group and a control group. The comparison on change of memory and attention value in accordance with the lapse of time and paired t-test was used for the comparative verification on pre and post of exercise programs in each group. If 'p' value is less than 0.05, statistical significance level was used.

3 Results

3.1 General characteristics of each group

The number of subjects participated in the study was 28 elderly persons (4 males and 24 females) whose average age was 79.21±5.69 year's old. Experimental group had two males and 12 females whose average age was 81.79±5.64 year's old while control group had two males and 12 females whose average age was 76.64±4.59 year's old. (Table 1)

3.2 Changes of verbal memory test

The verbal memory test (VMT) for memory test revealed that both group showed increased and significantly different between pre and post of COMCOG in digit span forward and backward tests ($p < .05$). The experimental group showed significantly

different from control group at post of COMCOG in digit span forward and backward tests ($p < .01$). (Table. 2)

Table 1. General characteristics of each group

Group	Gender(male/female)	Age	MMSE-K(score)
Experimental group (n=14)	2/12	81.79±5.64	25.07±2.84
Control group (n=14)	2/12	76.64±4.59	24.86±2.77

3.3 Auditory continuous performance test

The auditory continuous performance test (ACPT) for auditory attention test revealed that both group showed increased. The experimental group showed significantly different between pre and post of COMCOG in ACPT number and second ($p < .01$) and control group showed significantly different between pre and post of COMCOG in ACPT second ($p < .05$). The experimental group showed significantly different from control group at post of COMCOG in ACPT second ($p < .01$) (Table. 2)

Table 2. Changes of computerized neurocognitive function test(CNT) in each group

Test	Experimental group		Control group	
	Pre	Post	Pre	Post
VMT digit span forward	3.88±0.71	4.85±0.60***	4.02±0.67	4.54±0.63**
VMT digit span backward	3.00±0.55	3.73±0.54*	2.93±0.66	3.53±0.53**
ACPT number	12.14±1.66	14.36±1.01***	12.57±1.65	13.93±1.20
ACPT second	0.74±0.10	0.55±0.09**	0.69±0.08	0.51±0.08*#

All values showed mean±SD

Test by paired t-test (*; $p < .05$, **; $p < .01$, ***; $p < .001$)

VMT : verbal memory test performance test

Test by independent t-test (#;

ACPT : auditory continuous

4 Discussion

Aging is accompanied with various cognitive deficiencies similar to brain function decline caused by accidents or strokes. McDougall [16] reported that memory decline was one of the most complained problems in relation to aging by elderly persons. Thus, aging may incur normal cognitive change but the problem of such cognitive function does not result from damage of brain or memory deficiency mostly. As a result, it is reported that even if decline in cognitive function occurs, cognitive function can improve through learning via efficient cognitive strategy or steady

intellectual stimulation and activities [17]. So, this study subject selected elder in health living a community people instead stroke patients or traumatic brain injury patients.

Computer-assisted cognitive treatment has advantages that it can reduce an intervention time of patient's family member and therapists since patients can apply and learn treatment by themselves. It can also maintain accurate and continuous information regarding the results of patient's performance. White noise contained characteristics of the noise sound, but white noise covered general noise environment by constant frequency of waveform [18]. Stanchina et al [19] reported that white noise is increase exciting threshold in noise-exposed human because decreased difference between maximal noise and white noise. Effectively, white noise applied in various places associated with academic and attention. Also proved effects of white noise by recently studied. This study selected COMCOG and white noise that it is the most commonly used program. The cognitive function refers to capability to distinguish, select, accept and understand appropriate information, and respond appropriately to situations where the information is required by searching suitable information. Thus, once cognitive disorder occurs, efficiency of such information processing declines as well as speed and continuity of cognitive functions so that functions for daily living degrades and an appropriate response to problems occurred could be difficult [20]. So, this study assessed memory and attention by CNT. In this study, both group showed improve in the most tests. This finding could be attributed to the fact that COMCOG are to maintain psychological stability of elderly and help them to adapt to daily living so as to develop and maintain functional capabilities of elderly as much as possible as well as memory and attention level which are effective for their physical health. Our results are similar to the study by Kim et al. [14] and Shim et al. [12] that the computerized cognitive rehabilitation is effective to improve cognition. The experimental group showed different from control group at post of COMCOG. This finding could be attributed to the fact that white noise is to assist attention and increase accuracy during COMCOG program. Our results are similar to the study by Soderlund et al. [21] and Soderlund [22] that the white noise is improved to task-oriented performance.

5 Conclusion

The application of computerized cognitive rehabilitation with white noise improved the cognitive function in elderly. Because the experimental group showed greater improvements, the use of white noise for the management of improve to task-oriented performance to be more effective. The cognitive functions of elderly persons are closely related to interrelationship formation and social cognitive ability so that more studies are required for cognitive treatment in the future. Moreover, the effect found in the present study will be applied not only for normal elderly persons but also for degenerative brain disease causing cognitive impairment and children with developmental cognitive disability by developing more systematic computerized cognitive function training program as various environmental factors are taken into

consideration thereby expanding the application scope of the computerized cognitive rehabilitation treatment in the future.

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