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Verification of Effectiveness and Satisfaction Survey for the Korean Computer-based Cognitive Rehabilitation Programs(CoTras)

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Abstract

The purpose of this study was to verify the effectiveness of the computerized cognitive rehabilitation program in which areas and to suggest effective ways to utilize the program in the future, being conducted for 20 college students. We lasted this study from May 3 to 23, 2021. As a result of analyzing the groups using the Computer-based Cognitive Rehabilitation Program (CoTras), in terms of the difference in accuracy for the case of visual perception group B was statistically significantly improved than group C($p<0.05$). In the case of attention, memory, and orientation, there was no significant difference between groups($p>0.05$). In the case of reaction time difference, there was no significant difference between groups in visual perception, concentration, memory, and orientation($p>0.05$). And in order to improve attention and visual perception, it is recommended to conduct the program three times with a duration of 20 minutes, and in order to improve orientation and memory, it can be said that it is helpful to conduct one experiment for at least 30 minutes rather than conducting short and frequent experiments. Through this study, we found that it is effective to apply different times according to each area to improve cognitive function. In other words, depending on the purpose of which cognitive function is to be improved, the duration of the program should be applied differently.

Key Words : *Computerized cognitive rehabilitation, Cognitive function, Orientation, Visual perception*

1. Introduction

The problem of population decline and aging in Korea is the biggest problem in the current society of the 2020s where we live in. At the seminar on national strategy for low birthrate and aging, the theme of "The problem of Korea's low birthrate and aging population is the survival and serious issue of the nation" has been mentioned [1].

As such, looking at the aging of Korea, 20.3% of the total population will become the elderly by 2025, so Korea will reach an super-aged society at that time. Therefore, it is suggested that Korea needs to prepare for such a rapidly aging society. As the biggest problem that arises in the aging society of Korea, about 87% of the elderly population suffer from chronic diseases such as dementia and stroke, and many of them have cognitive problems [2].

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Types of human cognitive functions include attention, the beginning and termination of activities, problem solving ability, orientation, recognition, sequencing, and classification. Among them, memory and orientation play an important role in human beings' daily life as cognitive function necessary for human beings to live a basic life. Therefore, people with dementia may suffer from cognitive impairment, which can lead to difficulties in daily life and depression, and therefore, people around them may also suffer from many psychological pains. Therefore, various treatments are required to improve cognitive functions of them. There are several physical treatments in order to improve cognitive functions such as memory training, daily life training, exercise training and treatment, and computer-based cognitive rehabilitation programs [3-4].

Currently, there are several computer-based cognitive rehabilitation programs such as Comcog, Cogrehab, CoTras and Rehacom; and more than 70% of the treatment institutions for cognitive rehabilitation are reported to use computer-based cognitive rehabilitation programs [5, 7,9]. The previous studies that verified the effects of computer-based cognitive rehabilitation program used in rehabilitation programs were mainly focused on Rehacom before 2013 [5-8], but recent studies using CoTras have been reported since 2013 [9-15].

Since the cognitive rehabilitation programs used in the past were made in foreign countries, it was difficult to apply the culture, language, emotion, and educational level to Korean patients [10]. Therefore, in order to compensate for these shortcomings, CoTras developed in Korea has been widely used in recent years.

CoTras, which is applied in Korea, consists of visual perception training, attention intensive training, memory training, orientation training, and others, and is said to be a trend that is widely used in clinical practice because it increases expertise in cognitive therapy [10-12]. However, most of the previous studies conducted to verify the effectiveness were limited to studies that reported changes in cognitive and visual perception functions [14-15] and daily life performance of stroke patients, brain trauma patients, and intellectually disabled people [11-16]. In addition, there have been no researches on the analysis and utilization plan for the composition and contents of the program. In this study, we analyze the contents of CoTras cognitive rehabilitation program and verify the effect of CoTras cognitive rehabilitation program on cognitive function for college students who are good at computer and computer programs, and by investigating the satisfaction with the computer-based program, we are going to present measures to effectively utilize the program in various subjects in future clinical sites.

2. Contents of Computer-based Cognitive Rehabilitation Program

Computer-based cognitive rehabilitation program refers to a training program in which a therapist uses a computer in order to improve a person's cognitive ability. In other words, as a training method for improving a person's mental recognition ability. it has been developed and used for the purpose of improving attention, concentration, memory, thinking ability, information processing ability, conversation ability, behavioral ability, and learning and problem-solving ability [10].

It was mentioned that foreign-developed programs such as CNT (computed Neuro-Cognitive Function System), ComCog, Cogrehab, and Rehacom, which are the first generation of computer-based programs, are not suitable for domestic patients because there are many items that do not fit Korean sentiment and culture [10-11].

On the other hand, the program CoTras used in this study has the advantage of being a program made in Korea. CoTras, a Korean computer-based cognitive rehabilitation program, is a computer cognitive rehabilitation program developed by Kim Young-geun of Daegu Health University in 2009 as a joint industry-academic technology development support project. The advantage of the program is that it was developed with contents and structure suitable for Korean culture and environment considering clinical effects, social and economic aspects [10].

This program, developed for the purpose of training, consists of a total of five areas: visual perception training, attention training, orientation training, and others (number and quantity, categorization, and sequencing). Looking at the detailed items for each area, visual perception training includes object recognition, object identity, foreground-background, visual discrimination, visual integration, and spatial perception.

Concentration includes focusing, finding the same shape, finding places, matching colors, focusing on sounds, calculating, and drawing shapes with dots. Memory is composed of items such as location memory, figure memory, breadth of memory training, story memory, planning memory, face memory, recollection of memory, and procedure memory. Finally, orientation consists of matching the seasons, finding places, matching people, and matching the time. In addition, other training consist of number and quantity, sequencing, categorization, social cognition, physical appearance, and situation judgment.

In this study, among the five areas of program contents, we excluded other areas because the number of items was too small and it was impossible to classify them by level.

3. EXPERIMENTS

3.1 Study Subject and Period

This study was conducted with 20 university students from J University in Jeju Island, and those who understood the purpose of the study and agreed to participate were selected for the study. The study period was 3 weeks from May 6 to May 23, 2021. We divided the study subjects into groups as shown in Table 1, and executed the computer-based cognitive program(CoTras) for each individual for one hour a week (60 minutes).

3.2 Research Procedures

In this study, we designed experimental studies by using random sampling of control group. The subjects of this study were 20 college students without cognitive problems. After dividing them into three groups, we explained how to use CoTras to them in the laboratory of the Department of Occupational Therapy at Halla University in Jeju asked them to run it for 60 minutes a week. The number of executions was limited as follows. Each contents area of the program was allowed to be conducted freely.

Since the computer-based program is mainly used in hospitals for patients with cognitive impairment, we suggested that the subjects start the program at a moderate level of difficulty, level 3 or 4.

As shown in Table 1, we divided the participants into three groups and conducted the program for 3 weeks, and then surveyed the satisfaction with the program contents in the 4th week.

Table 1. The difference in the number of times by the groups

	Group A	Group B	Group C
Number of times per week	1	2	3
Time duration	60 minutes	30 minutes	20 minutes

3.3 Data Analysis

To find out the difference between the accuracy and response time of each group, one-way ANOVA was conducted on the data collected in the study using SPSS(Ver 24.0). In order to conduct a post-test between items, a Scheff Post-Hoc test was performed. In addition, satisfaction with the computer-based cognitive program was analyzed using Excel ,after the program processing.

4. RESULT AND DISCUSSION

4.1 General Characteristics of Research Objects

Table 2. General characteristic of subjects

Characteristics		Division	Subject (N=20)	%
Gender		Male	7	35
		Female	13	65
Age		22	10	50
		23 to 24	8	40
		Over 25	2	10
Groups	A	Once a week (60 minutes each)	7	35
	B	Twice a week (30minutes each)	7	35
	C	Tree times a week (20minutes each)	6	30
Total				100

As shown in Table 2, in terms of demographic characteristics, the average age of the participants was 23.4 years; 7 males (35%) and 13 females (65%). Group A consisted of 7 people (35%), Group B consisted of 7 people (35%), and Group C consisted of 6 people (30%).

4.2 Differences Between Groups According to the Time and Frequency of Use of the Program Content Areas

As shown in Table 3, this study was conducted to find out which areas in the computer-based cognitive rehabilitation program change cognitive functions and whether the most effective number of times and time are appropriate.

The contents of the Computer-based cognitive rehabilitation program are organized by each content area. Therefore, as a result of analyzing the accuracy for each area, there was a statistically significant difference between groups in visual perception ($p<0.05$), but there was no difference in concentration and memory.

In the case of orientation, the accuracy of group B was significantly higher than that of the other two groups. The average of all items was higher in the group, which was conducted twice a week for 30 minutes, and was statistically significantly higher than that in group C, which was conducted three times for 20 minutes each. However, as shown in Table 4, there was no difference in response time between groups.

Table 3. Differences in contents accuracy between groups

Area/Accuracy	Group A	Group B	Group C	F	P	Scheffe
	M(SD)	M(SD)	M(SD)			
Visual Perception	76.48(8.85)	89.63(1.17)	62.34(5.78)	14.88	0.01*	B>C
Attention	74.07(5.55)	92.27(1.45)	67.23(22.03	13.67	0.35	
Memory	60.89(16.26)	76.42(15.19)	47.03(9.02)	3.67	0.13	
Orientation	50.01(12.81)	79.30(8.51)	53.39(14.43)	6.04	0.06	

*p<0.05

Table 4. Differences in reaction time between groups

Reaction time (in seconds)	Group A	Group B	Group C	F	P
	M(SD)	M(SD)	M(SD)		
Visual Perception	1.65(0.61)	1.14(0.04)	1.18(0.38)	0.82	.53
Attention	2.46(0.38)	2.81(0.37)	2.00(0.74)	1.40	.36
Memory	1.18(0.26	1.51(0.43)	1.14(0.08)	0.92	.49
Orientation	0.65(0.24)	1.08(0.24	0.87(0.14)	2.07	.25

*p<0.05

4.3 Confirmation of the Effective Utilization Time of Each Contents Areas, through Changes in Accuracy and Response time for Each Program Area (Trend Change)

In order to check the effects of the cognitive function of normal people and the changes that appear in each content area as the program progresses, the accuracy average and reaction speed for each area were examined.

The results are as shown in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8.

As shown in the graphs, all the values of all groups are lower in the second week than in the first week and tend to improve again in the third week.

Among the three groups, the average value of contents area was the lowest in the group where the program run-time was short for 20 minutes. In comparison, the average value of B group, which lasted 30 minutes, was the highest in almost all contents areas.

In the case of the change of the average accuracy of each contents, group A showed the greatest improvement in the orientation, and group B showed the greatest change in memory. And in group C, concentration and visual perception were improved.

Next, we looked at the changing trends by content area for each group and found the effective frequency and time for each area.

1) Memory area

As shown in Figure 1 and Figure 2 below, in the case of group A, the accuracy at week 1 was 79%, the accuracy at week 2 was 67%, and the accuracy at week 3 was 76%. in the case of reaction time, the reaction time of the 1st week was 1.44 seconds, the reaction time of the 2nd week was 1.60 seconds, and the reaction time of the 3rd week was 0.92 seconds.

In the case of group B, the first-week accuracy was 91%, the second-week accuracy was 61%, and the third-week accuracy was lowered down to 76%. However, in the case of reaction time, the first reaction time was 2 seconds, the second reaction time was 1.2 seconds, and the third reaction time was increased to 1.33 seconds.

In the case of C group, the accuracy of first-week was 57%, the accuracy of the second-week accuracy was 44%, and the accuracy of the third-week accuracy was decreased to 39%. Also in the case of reaction time, the reaction time of the 1st week was 1.21 seconds, the reaction time of the 2nd week was 1.05 seconds, and the reaction time of the 3rd week was increased to 1.13 seconds. In the case of memory, group C started with a lower average in accuracy than the two groups, and the range of change was small.

In the case of reaction time, group A had the fastest reaction time and group C had the slowest reaction time.

Therefore, in the case of memory improvement, it suggests that the program must run for at least 30 minutes at a time rather than running it frequently for 20 minutes in order to help improve memory.

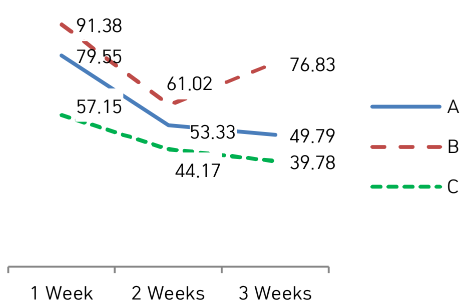

Figure 1. Accuracy of memory

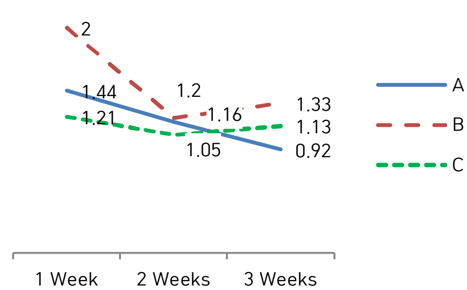

Figure 2. Response time of memory

2) Attention area

As shown in Figure 3 and Figure 4, looking at the change in accuracy in group A, it was 78% at week 1, 67% at week 2, and 76% at week 3. in the case of reaction time, the reaction time gradually increased from 2.16 seconds in the 1st week, to 2.31 seconds in the 2nd week, and 2.89 seconds in the 3rd week.

In the case of group B, the accuracy at week 1 was 93%, the accuracy at week 2 was 92%, and the accuracy at week 3 was lowered to 90%. However, in the case of reaction time, the reaction time in the 1st week was 3.04 seconds, the reaction time in the 2nd week was 2.38 seconds, and the reaction time in the 3rd week was decreased to 2.99 seconds.

In the case of group C, the accuracy at week 1 was 64%, the accuracy at week 2 was 71%, and the accuracy at week 3 was improved to 86%. Also in the case of reaction time, the reaction time of the first week was 1.17 seconds, the reaction time of the second week was 2.2 seconds, and the reaction time of the third week was decreased to 2.60 seconds.

The increase in accuracy and the longer reaction time, in comparison with the increase in accuracy, suggest that concentration has improved. Therefore, in the case of concentration training, it can be said that performing 20 minutes 3 times a week is helpful in improving cognitive function.

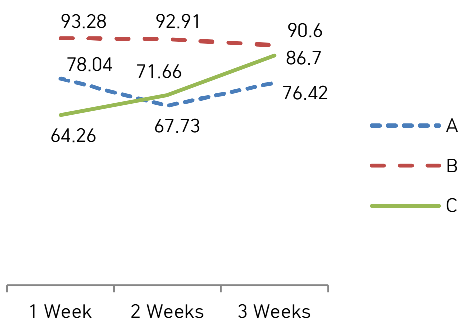

Figure 3. Accuracy of attention

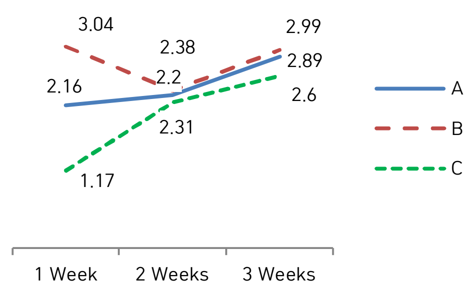

Figure 4. Response time of attention

3) Area of visual perception training

As shown in Figure 5 and Figure 6, in the case of group A, the accuracy of week 1 was 86%, the accuracy of week 2 was 72%, and the accuracy of week 3 gradually decreased 70%. And in the case of reaction time, the reaction time of the 1st week was 1.14 sec, the reaction time of the 2nd week was 1.45 sec, and the reaction time of the 3rd week to 2.33 second, gradually slowed down.

In the case of group B, the accuracy at week 1 was 90%, the accuracy at week 2 was 89%, and the accuracy at week 3 to 88%, gradually decreased. In addition, in the case of reaction time, the reaction time of the 1st week was 1.18 seconds, the reaction time of the 2nd week was 1.11 seconds, and the reaction time of the 3rd week was 1.11 seconds.

In the case of group C, the accuracy of week 1 was 64%, the accuracy of week 2 was 55%, and the accuracy of week 3 was 66%, gradually improved. And in the case of reaction time, the reaction time of the 1st week was 1.46 seconds, the reaction time of the 2nd week was 0.75 seconds, and the reaction time of the 3rd week was 1.31 seconds. The group that showed the greatest change was group C, Figure 5 and Figure 6.

Therefore, in the case of visual perception training, it suggests that it may be effective to proceed from 20 to less than 30 minutes rather than to proceed more than 30 minutes.

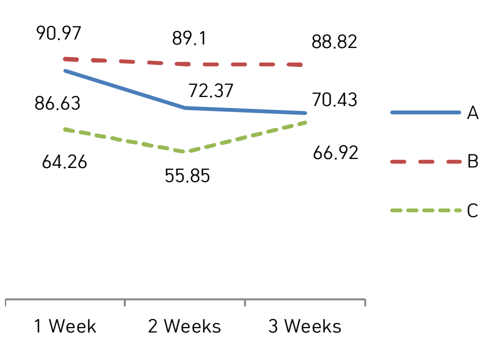

Figure 5. Accuracy of Visual Perception

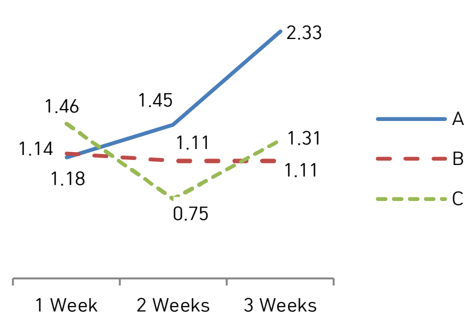

Figure 6. Response time of Visual Perception

4) Area of orientation

As shown in Figure 7 and Figure 8, in the case of Group A, the accuracy of week 1 was 36%, the accuracy of week 2 was 62%, and the accuracy of week 3 was 51%. And the reaction time was gradually slowed down; the reaction time of week 1 was 0.37 seconds, the reaction time of week 2 was 0.74 seconds, and the reaction time of week 3 was 1.82 seconds.

In the case of group B, the accuracy of the 1st week was 89%, the accuracy of the 2nd week was 73%, and accuracy of the 3rd week was 75%. And the reaction time gradually increased; the reaction time of the 1st week was 1.34 seconds, the reaction time of the 2nd week 1.02 seconds, and the reaction time of the 3rd week was 0.87 seconds.

In the case of group C, the accuracy of the first week was 46%, the accuracy of the second week was 69%, and the accuracy of the third week was 19%, showing a large range of change. In the case of reaction time, the reaction time of the 1st week was 0.82 sec, and the reaction time of the 2nd week was 1.02 sec. The reaction time at week 3 was increased to 0.75 seconds, but it was the lowest in accuracy.

In the case of orientation, the group that showed a positive change was group A, and group C showed the lower accuracy. In the case of reaction time, the reaction time of group B was faster, and in the case of accuracy, the accuracy of group B increased slightly.

Therefore, it can be said that a greater effect can be obtained only when the training is carried out with a time of between 30 and 60 minutes in order to improve orientation.

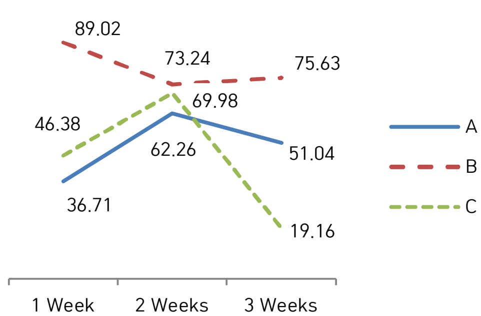

Figure 7. Accuracy of orientation

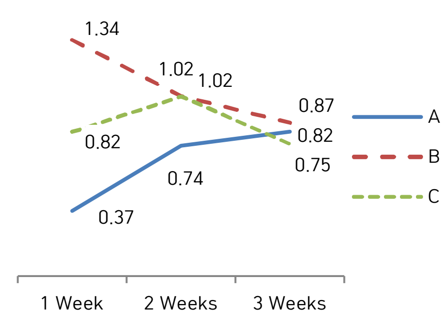

Figure 8. Response time of orientation

4.4 Satisfaction Survey After Using the Program

As a result of a survey on whether the subjects who participated in the experiment were satisfied with the program composition and contents, the overall satisfaction was low with an average of 2.80 points.

1) The results of a survey on whether the composition and contents of the program were interesting during the processing of the program were as follows; Very interesting 2 (9.5%), interesting 4 (19%), moderate 9 (42.9%), not interesting or very uninteresting 6 (28.6%).

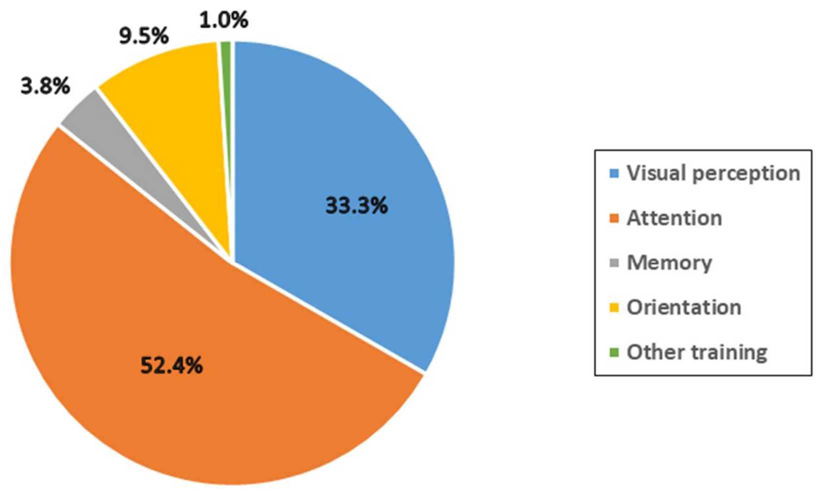

Figure 9. Percentage of composition by areas utilized

2) As shown in the Figure 9, among the contents areas, the areas that participants mainly used were concentration (52.4%), visual perception (33.3%), orientation(9.5%), and memory.

3) Preference of detailed components by content area in computer-based program

We investigated the preferences of students in the details of each contents area composing the computer-based program. The results are shown in Figures 10, Figures 11, Figures 12, and Figures 13.

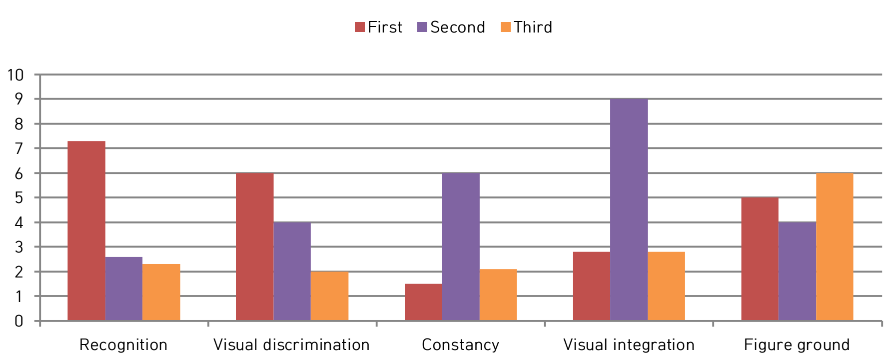

Figure 10. Visual perception

First, as show in Figure 10, in the area of visual perception, in the items as the first priority category, the students preferred the object recognition(7.5%), visual discrimination(6%), and figure-ground (5%) in the order of preference, and in the items as the second priority, students showed preference in the order of visual integration (9%), object identity (6%), visual discrimination, and figure-ground.

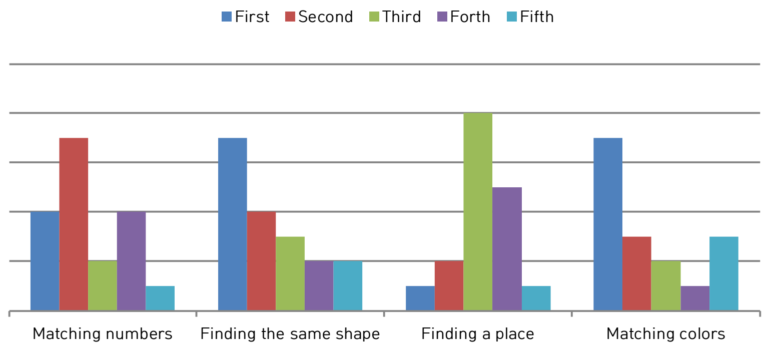

Figure 11. Attention

Second, as shown in the Figure 11, in the area of attention, in the items as the first priority category, the students preferred finding the same shape and matching colors (7%), matching numbers (4%), and focusing (3%), in the order of preference; and in the items as the second priority, students showed preference in the order of matching numbers (7%), finding the same shape (4%), finding a place(8%) in the order of preference.

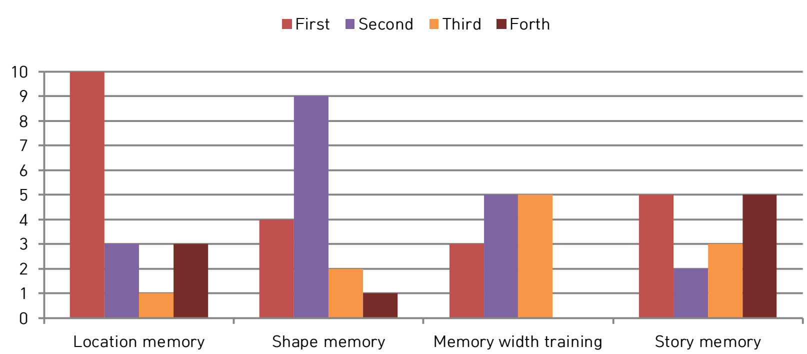

Figure 12. Memory

Third, as shown in the Figure 12, in the area of memory, for the items as the first priority category, the students preferred location memory (10%), story memory (5%), shape memory (4%) in the order of preference; and in the items as the second priority, students showed preference shape memory (9%), memory width training (5%), planning memory (4%) in the order of preference.

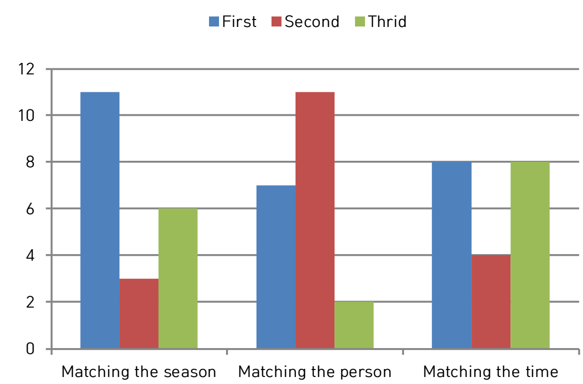

Figure 13. Orientation

Fourth, as shown in the Figure 13, in the area of orientation, for the items as the first priority category, the students preferred matching the season (11%), matching the time (8%), matching the person (7%) in the order of preference; and for the items as the second priority, students showed preference matching the person(11%), matching the time (4%), in the order of preference. Finally, in the area of metacognition of other training, for the items as the first priority category, the students preferred number and quantity (9%); and for the items as the second priority, students showed preference for the categorization (12%).

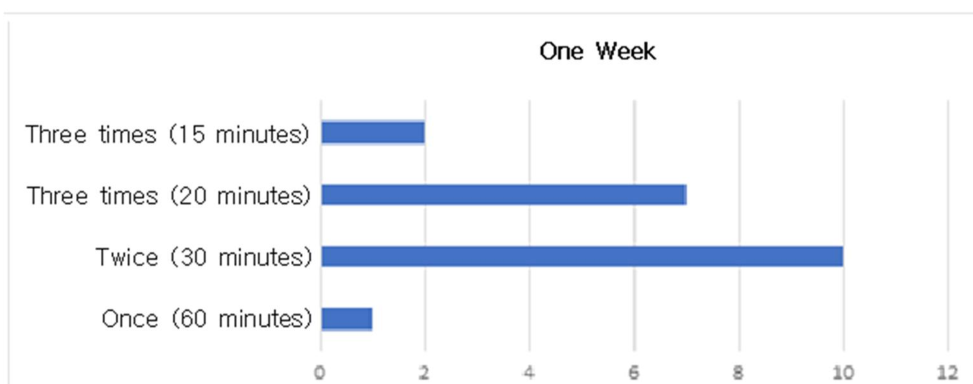

Figure 14. Preferred time

As shown in the Figure 14, students were asked about the most appropriate time and number of times per week if they used the program. They answered that twice a week for 30 minutes (50%), three times for 20 minutes (35%) each, three times for 15 minutes (10%) each, and once a week for 60 minutes (5%) were suitable. In other words, more than 50% of students answered that 30 minutes twice a week is suitable .

The advantages of this program are that you can adjust the level of difficulty, that it gives fun for you, and that it improves your cognitive function. The disadvantages of this program are that if you continue for a long time, your attention will decrease, and more than 50% of the respondents answered that they felt bored while proceeding. Students presented various opinions.

5. CONCLUSION

As the number of patients with dementia such as stroke and cognitive impairment increases due to the aging of the population, methods for cognitive rehabilitation treatment are being diversified. Recently, in hospital sites, new technologies have been introduced and used in various ways for cognitive rehabilitation treatment. In the field of rehabilitation treatment, computer-based programs for computer are being actively used for cognitive rehabilitation treatment for patients. However, since the effectiveness of the program was limited to some patients with brain damage, we conducted in this study an experiment on normal people and verified in which areas the cognitive rehabilitation program is effective; we analyzed the contents of the program so that the program could be used more efficiently in the future, and suggested a utilization plan by considering the satisfaction of the program. The result is as follows.

First, as a result of analyzing the groups using the Computer-based Cognitive Rehabilitation Program (CoTras), in terms of the difference in accuracy for the case of visual perception group B was statistically significantly improved than group C ($p<0.05$). In the case of attention, memory, and orientation, there was no significant difference between groups ($p>0.05$). In the case of reaction time difference, there was no significant difference between groups in visual perception, attention, memory, and orientation ($p>0.05$). Therefore, it can be said that the result is similar to the previous research [14, 15] that the program is effective for visual perception.

Second, in the degree of change by areas, the C group gradually improved in the case of concentration and visual perception, but in the case of geomancy and memory, it gradually decreased. Therefore, in order to improve attention and visual perception, it is recommended to conduct the program three times with a duration of 20 minutes, and in order to improve orientation and memory, it can be said that it is helpful to conduct one experiment for at least 30 minutes rather than conducting short and frequent experiments.

Third, in the survey of satisfaction conducted after the program, the overall satisfaction with the program composition and content was low at 2.80. In the case of the frequency used by area, attention (52.4%), visual perception (33.3%), cognitive power (9.5%), and memory were found in the order.

Fourth, in the case of the visual perception area in the preference survey of program composition and contents, the first priority was the object recognition (7.5%), object recognition (7.5%), visual discrimination (6%), and figure-ground (5%). In the area attention, the first priority was finding the same shape and matching color (7%), matching the number (4%), and focusing (3%).

In the case of memory area, the first priority was location memory (10%), story memory (5%), and shape memory (4%). In the area of orientation, as the first priority, it was found that matching with the season (11%), matching with the time (8%), and matching with people (7%) were preferred. Also, for the most appropriate time and number of times per week, 30 minutes (50%) twice a week were answered as appropriate

Through this study, we can see that it is effective to apply time and frequency differently, according to each area, in order to improve human cognitive function. In other words, according to the purpose of which cognitive function is to be improved, the running time of the program should be applied differently. For example, in order to improve attention, it is good to set the running time of the program not to exceed 20 minutes, and to improve memory the running time of the program should be for more than 30 minutes.

Finally, due to the limitations of the small sample size of the study and the short research period of the stu dy, it is not sufficient to say that the contents analysis of the program has been completely performed. Theref ore, continuous research is needed to ensure that these results can be used for various groups in the future.

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