Long-Term Effect of IQ Up Cognitive Development Method on the Development of Cognitive Process in Children

Hatice Kafadar
Assistant Professor
Department of Psychology
Faculty of Arts and Science
Abant İzzet Baysal University
Bolu, Turkey.

Zafer Akıncı
Clinical Psychologist
Human Psychological Research and Development Institute
İstanbul, Turkey.

Belgin Çakır
Clinical Psychologist
Human Psychological Research and Development Institute
İstanbul, Turkey.

Abstract

Present study explores whether IQ Up Cognitive Development Method has any long-term effect on the cognitive development process of healthy children. IQ Up Cognitive Development Method is a cognitive training program. Current research stands as the continuity of a previous empirical study. The research includes 74 healthy participants between 10-12 age group. In present study participants have received 8 neuropsychological tests 3rd times measuring cognitive processes such as attention, problem solving, and general competency. Participants' pretest neuropsychological test scores before receiving IQ Up Cognitive Development Method training and 3rd posttest neuropsychological test scores received 11months later by the participants after the training have been compared. Statistical analysis reports revealed that there is a significant differentiation between pretest and 3rd posttest score averages. As a cognitive training program, IQ Up Cognitive Development Method has affected cognitive process developments of the participants in a positive and long-term manner.

Keywords: IQ Up Cognitive Development Method; Cognitive development; Cognitive training; Intelligence; Reasoning; Fluid intelligence

Introduction

Cognitive training can be identified as a structured systematic training program formed to enable effective use of various cognitive processes and integrating in itself several cognitive tasks (working memory, attention, reasoning, problem solving etc.). Cognitive training programs are available to use on healthy as well as impaired individuals in addition to minor and adult populations. In a wide range of literature studies it has been reported that there are increasing numbers of scientific evidences proving the positive effects of cognitive training programs on cognitive processes (Alloway, Bibile, Lau, 2013; Barkl, Porter, Ginns, 2012; Holmes, Gathercole, Dunning, 2010; Beck et all., 2010; Brehmer, Westerberg, Backman, 2012; Jaeggi, Buschkuehl, Jonides, Shah, 2011; Klauer, Willmes, Phye, 2002; Klinberg, 2010; Mahncke et all., 2006;Olesen, Westerberg, Klinberg, 2004;Owen, et al., 2010;Willis et all. 2006). These reports also underline that long-term effects, or in other terms, transfer effects of such training programs need to be probed in depth (Jaeggi et al., 2011)

In Klauer, Willmes and Phye (2002) study covering 279 healthy children with age average 7, the participants have attended 10 cognitive training courses lasting approximately 45 minutes. Number of participants in cognitive training classes varied between 3 to 5.

Context of cognitive training has been created in a quality to develop inductive reasoning/reasoning skill elaborated by researchers.

Participants have received Raven's Coloured Matrices (RCM), Cattell's Culture Fair Test (CFT) and Vocabulary Test (VT). At the end of research significant increases have been observed in inductive reasoning skill-related Cattell's CFT subtests and RCM's score averages while in the average of VT scores less significant increases have been detected. Results obtained from delayed posttest conducted 6 months after cognitive training have also demonstrated that the effect of training was still persistent. LISREL model analysis results also supported research hypotheses. Accordingly inductive reasoning training offered to children much developed fluid intelligence while it left no such positive effect on crystallized intelligence. In the words of Klauer and Phye (2008) trainings that involved inductive reasoning strategies have positive effect on cognitive functions development, fluid intelligence performance as well as setting a better academic learning environment in course subjects.

Jaeggi et al. (2011) in their study have examined short and long term benefits of cognitive training. The research has included healthy students. A video game that sets a working memory task has been utilized as cognitive training tool. At the end of research it has been observed that some performance has been witnessed in not only working memories of participants but also their fluid intelligence performance. Researchers have also noted that this effect lasted for a period of 3 more months. A different study by Nouchi et al. (2013) has revealed that cognitive training can be utilized to develop certain cognitive processes white cognitive training can also be beneficial in clinical and training fields. A different study by Takeuchi and Kawashima (2012) has pointed that a cognitive training program geared towards developing process rate can at the same time be effective in developing different sorts of cognitive functions and an effective cognitive training program may trigger a change in neural mechanisms. Researchers claim that cognitive training program context needs to be identified according to individual performances; that its difficulty level should rise progressively and dissimilar cognitive tasks should be integrated in its context.

In an empirical study prepared by Kafadar, Akıncı, Çakır (2013; 2014) it has been examined whether IQ Up Cognitive Development Method prepared to eliminate some daily problems that might emerge as a consequence of cognitive processes has any effect on healthy children. IQ Up Cognitive Development Method is a brain training program allowing the participants to use their cognitive processes in an active manner. To that end the research included 201 healthy participants between 10-12 age group. In the research, test and control group pretest –posttest research pattern has been employed. As pretest, participants from test and control groups have received neuropsychological tests measuring their memory, attention, problem solving, general skill, planning, working memory and similar cognitive processes. Next, 131 participants in test group received IQ Up Cognitive Development Method 45 minutes long in a day, 5 days a week totaling 30 days. Subjects in control group however received no such training. In the next stage test group and control group participants having completed IQ Up Cognitive Development Method have been given neuropsychological tests for the second time. Posttest neuropsychological test score averages of test group participants have been higher than posttest neuropsychological test score averages of control group participants. Results obtained from this statistical analysis have proved that IQ Up Cognitive Development Method has positive effect on children's cognitive development. Current research stands as the continuity of referred study.

The objective in present research is to conduct an empirical test on IQ Up Cognitive Development Method of which positive effect on cognitive functions and cognitive development in participant individuals towards the aim of determining whether it has any long-term effects on children. Parallel to this objective it has been analyzed whether, of the test group participants in previous research, pre-scores in IQ Up Cognitive Development Method training program and scores received 11 months after, via pretest and 3rd posttest, there has been a continuity in cognitive functions development. Within the scope of research, in order to determine if IQ Up Cognitive Development Method training program had any long-term effect or not, participants who were in test group in previous research have received once more the neuropsychological tests as 3rd posttest. In this study, pretest and 3rd posttest neuropsychological test scores of test group participants having received Cognitive Development Method training program have been compared.

These neuropsychological tests are: Wechsler Intelligence Scale For Children-Revised; WISC-R arithmetic subtest to measure verbal and arithmetic skills, Wechsler Adult Intelligence Scale-Revised; WAIS-R symbol subtest to measure focused and continuous attention as well as perceptual motor cognition skills; Serial Digit Learning Test; SDÖT to measure verbal memory and learning processes, Öktem Verbal Memory Process Test (Öktem-SBST) to measure short and long term verbal memory skills, Rey Complex Figure Test And Recognition Trial; RCFT-R to measure short and long term visual memory and recognition skills; Raven Progressive Matrix Test (RSPM) to measure problem solving, reasoning, abstract thinking, working memory and general skill skills and Tower Of London^{DX} (TOL)^{DX} to measure planning and strategy formation skills.

Method

Participants

74 healthy children in sum participated in research. 44 are boys and 33 are girls. Age average of participants has been calculated as 10.87 (±0.37). Participants had taken place in the test group of previous research. Participants in test group received IQ Up Cognitive Development Method training 45 minutes long in a day, 5 days a week totaling 30 days. Prior to conducting the research, approval of Abant İzzet Baysal University Social Sciences ethics committee has been taken. In addition, parents have been informed regarding the context of research. Following the approval of parents children have been included in research. Participants who had taken place in the test group of previous research and now received cognitive training took part in the research on the basis of volunteering basis.

Materials

Information Collection Form: Data on participants' demographic characteristics and health conditions (such as whether the participant had any illnesses or required medicine or had a visual defect or color differentiation problem) were collected using the Standard Information Collection Form.

Raven Standard Progressive Matrices Test: The RSPM, which was developed by Raven, consists of 60 test items in 5 sets, each of which contains 12 items (Raven, 2000; Raven, Raven, Court, 2000).

Tower of London^{DX} :The TOL^{DX} test consists of two pieces of wood that are equal lengths. One of these strips belongs to the participant, while the other belongs to the examiner. There are three wooden pegs on each of the strips of wood. The longest of these pegs can hold three balls, while the one with middle length holds 2 balls, and the shortest one holds one ball. On each strip of wood, there are three balls of different colors: blue, red and green (Atalay, Cinan, 2007; Culbertson, Zillmer, 2005).

Serial Digit Learning Test: This test was developed by Zangwill in 1943. In the Serial Digit Learning Test, the required number of attempts to correctly repeat a sequence of numbers consisting of 9 digits is measured. In this test, it is possible to use a different number sequences for repeated measurements.

Öktem Verbal Memory Processes Test: The test, which consists of 15 perceptible words, was developed by Öktem (2011) to measure short- and long-term verbal memory abilities. There are different word lists in three different forms of the test; therefore, in repeated measurements, different word lists are used.

Rey Complex Figure Test and Recognition Trial: In the current study, the revised version of this test by Meyers and Meyers (1995) was used. The RCFT-R consists of 4 stages and measures momentary memory, short- and long-term visual memory, and recognition abilities (Varan, Tanör, Gürvit, 2007).

WISC-R Arithmetic Sub-Test: In this sub-test of the WISC-R, participants are asked to respond to 18 arithmetic problems by performing mental calculations in the shortest time possible. There is a time limit for each problem. If a participant answers incorrectly four times in succession, the test is terminated. The participant receives 1 point for each correct answer (Savaşır, Şahin, 1995; Wechsler, 1974).

WAIS-R Symbol Sub-Test: In the registration form of this sub-test, each number from 1 to 9 is marked with a different sign (for example, a short perpendicular line or two short lines, one over the other). While there is a number on each of the boxes on the registration form, the underside is left blank, to be filled in by the respondent. The task of the respondent is to draw the sign corresponding to each number in the box below the number in 90 seconds. At the end of the time, 1 point is awarded for each correct sign (Baştuğ, 2000; Yargıcı, 2000; Yılmaz, 2000, Wechsler,1981).

IQ Up Cognitive Development Method: The materials for the IQ Up Cognitive Development Method were prepared specifically to develop cognitive processing in individuals, and each of the items requires cognitive processing to complete. No harm material was used in the testing design. Each item is targeted to the functions of a local area of the brain and, correspondingly, to different cognitive functions. The difficulty level of the cognitive tasks in the materials gradually increases. IQ Up Cognitive Development Method was developed to improve participants' verbal, numeric and visual memory; verbal, numeric and visual attention; and verbal, numeric and visual reasoning. A verbal text is given to the participants to improve their verbal memory processes. In the cognitive task, the participant must improve the skills of first reading the text and then recalling what is read. The participant must answer the questions related to the text in a certain period of time. In the numeric memory task, the participant is given number sequences in different combinations. The participant is required to give answers to the questions related to those numbers during a specified time period.

In the visual memory task, on the other hand, the participant is expected to answer the questions related to the visual stimuli presented in different combinations in a specified time period. Memory tasks aim to improve participants' working memory capacity and the speed of mental processes.

In the numeric attention test, the participant must find the numbers and number sequences indicated in the instructions among mixed numbers in a certain period of time. In the verbal attention task, the participant is required to find the letters in a given text and the differences between two texts in a certain time period. In the visual attention task, on the other hand, the participant is expected to find some certain figures among mixed figures and the differences between two pictures during a specified time period. Through these tasks, such basic features of objects as color, size, direction, and movement must be determined. Attention tasks aim at improving participants' visual-spatial perception, selective attention, reaction speed and rashness.

In the verbal reasoning task, the participant is asked to form meaningful associations between the data in the text in a certain period of time. The participant must reach new data by making some logical inferences from the present data. In the numeric reasoning task, the participant is asked to form meaningful associations between numbers and try to reach the expected results within a specified time period. In this cognitive task, the participant must use the skills of scrutinizing, changing categories, and general ability. In visual reasoning task, the participant is expected to make logical inferences by forming meaningful associations between pictures and shapes in a certain time period. The aim of the reasoning tasks is to improve participants' skills of orderly thinking, mental activity speed, working memory, visualization, and general ability.

The materials used in the IQ Up Cognitive Development Method and the tasks to be performed by the participants using these materials are as follows:

IQ Up-1. There are different colors in the background, in the letter used in imprinting and in the inscription itself. The participant is expected to match the three specified combinations. The aim is to improve participants' visual attention and memory.

IQ Up-2. On a different background color, there are pictures that are similar to each other, identical to each other, or different from each other. The participant is expected to match or remember the pictures with respect to the specified features. The aim is to improve participants' visual attention, memory and reasoning.

IQ Up-3. On a different background color, there are phonologically and semantically similar words. The respondent is expected to match or remember the inscriptions based on the specified features. The aim is to improve participants' verbal attention, memory and reasoning.

IQ Up-4. On a white background, there are specific number combinations. The respondent is expected to match or remember the numbers based on the specified features. The aim is to improve participants' numeric attention, memory and reasoning.

IQ Up-5. There are stimuli made up of 4 numbers and 8 colors. The respondent is expected to answer the question by matching the numbers with the specified colors. The aim is to improve participants' visual memory and reasoning.

*IQ Up-6***.** This item consist of rectangles and squares that are proportional to each other, but in different sizes. The respondent is expected to carry one of the materials from one point to another point among the other materials based on a given rule. The aim is to improve participants' visual reasoning.

IQ Up-7. This item consists of materials with different shapes, colors and sizes. The respondent is expected to choose the material with the specified shape, color, or dimensions to form another meaningful shape from these or to arrange the shapes in accordance with their specified characteristics. The aim is to improve participants' visual attention, memory and reasoning.

IQ Up-8. This item consists of materials with different geometrical shapes and colors. The respondent is expected to form a shape within the specified boundaries with the given materials. While doing this, the participant is also expected to use the materials correctly. The aim is to improve participants' verbal and visual reasoning.

IQ Up-9. This item consists of 28 cards that are different from each other. The respondent is expected to see and maintain the movement of the given cards. The aim is to improve participants' visual attention.

IQ Up-10. This item consists of 32 letters. The letters are upper or lower case, and with respect to size, they are large followed by small or the reverse. The respondent is expected to match the same letters according to a specified order, to remember the letters in detail, or to form some words given in a text with these materials. There are also some other applications, such as forming a combination with other materials or matching the materials with other materials. The aim is to improve participants' verbal attention, memory and reasoning.

IQ Up-11. This item consists of 10 numbers, and with respect to the content and size, the materials are large or small, black or white, and the reverse. The respondent is expected to match the same numbers according to a specified order, to remember the numbers in detail, or to form a combination with other materials or to match the materials with other materials. The aim is to improve participants' numeric attention, memory and reasoning.

IQ Up-12. This item consists of different shapes with different sizes and colors. The respondent is expected to choose the material with the specified shape, color or size, to form another meaningful shape, or to arrange the order of the shapes according to specified features. There are some other applications, such as forming a combination with other materials or matching the materials with other materials. The aim is to improve participants' visual attention, memory and reasoning.

IQ Up-13. This item consists of materials with different colors. The respondent is expected to remember or choose the color according to the meaning given to the color. There are some other applications, such as forming a combination with other materials or matching the materials with other materials. The aim is to improve participants' visual memory, reasoning, and attention.

IQ Up-14. The participant is expected to match the squares containing pictures similar to each other, the same as each other, or different from each other. The respondent is also expected to remember or match the pictures according to the specified content. The aim is to improve participants' visual attention, memory and reasoning.

IQ Up-15. Cards consist of specified letters or numbers. The respondent is expected to find the requested information among all the cards. The aim is to improve participants' verbal and numeric attention.

IQ Up-16. This item consists of sticks with different dimensions. The respondent is expected to use the materials to solve the problems given. The aim is to improve participants' visual and verbal reasoning.

IQ Up-17. Cards consist of information related to daily life, such as a name, a profession, an age, a town, a food, or an entertainment area. The respondent is expected to remember or find the information on the card in an excerpt of text. The aim is to improve participants' verbal memory and reasoning.

IQ Up-18. This item consists of different place names and aerial view maps. The respondent is expected to find the places on the map based on data provided in the text and to remember the names of the places in the correct order. The aim is to improve participants' verbal memory and reasoning.

IQ Up-19. This item is a set consisting of a plastic panel, rubber bands, and cards with numeric and verbal content. The application starts by placing the cards on the panel. The respondent is expected to form a shape by using the rubber bands in accordance with the directions. The respondent is also expected to find specific letters or shapes in the picture. The aim is to improve participants' visual attention and memory, and verbal and numeric reasoning.

Procedure

In the research participants received neuropsychological tests as 3rd posttest after 11 months break. Parents of participants who had taken part in the test group of previous research and now received IQ up Cognitive Development Method training 45 minutes long in a day, 5 days a week totaling 30 days have been contacted on May 2013. Participants who willed to continue the research have been scheduled an appointment to conduct neuropsychological tests. Participants have been provided with appropriate setting in İstanbul Üsküdar Municipality Public Houses to perform the tests. Each participant received tests in separate rooms. Neuropsychological test performance has been conducted as 2 sessions for each participant. Neuropsychological tests have been conducted individually to participants by psychologists having received appropriate test –giving training. In the research IQ Up Cognitive Development Method trainers and neuropsychological test conductors are not the same.

Results

In order to test whether the data obtained from research are significant, ANOVA has been conducted. Arithmetic mean and standard deviation values have been computed. To enable a comparison in Table-1, participants in test group have received pretest, and as 2nd and 3rd posttest, neuropsychological test scores' arithmetic mean, standard deviation values and participant numbers have been provided. The table reveals that participants' 2nd and 3rd posttest neuropsychological test scores' arithmetic mean values are, compared to pretest neuropsychological score averages, higher . In addition, although there is no significant differentiation between 2nd and 3rd posttest scores' arithmetic mean values, 3rd posttest neuropsychological test scores are partially higher.

Table-1: Neuropsychological Test Scores of the Participants in the Experimental Group Pretest, 2nd and 3rd Posttest Means, Standard Deviations

Neuropsychological tests	Experimental Group Pretest (April-May, 2012)			Experimental Group Posttest (2nd) (June-july, 2012)			Experimental Group Posttest (3rd) (May, 2013)		
	N	$\overline{X}$	S.D.	N	$\overline{X}$	S.D.	N	$\overline{X}$	S.D.
WAIS-R Symbol	115	39.51	8,25	115	44,26	8,83	73	49.19	10.89
WISC-R Arithmetic	109	13.11	2.47	109	14.11	2.14	67	14.61	2.39
Serial Digit Learning Test	115	14.01	6.54	115	17.90	4.49	68	17.57	4.63
Öktem-Verbal Memory Processes Total Learning	117	114.25	16.75	117	126.96	11.59	73	128.34	12.39
Öktem-Verbal Memory Processes Long Term Memory	102	12.73	2.12	102	13.00	1.74	65	13.01	1.99
Rey Complex Figure Copy Test	120	31.92	4.75	120	32.94	3.97	74	34.35	2.17
Rey Complex Figure Test and Immediate Recall	117	18.73	7.64	117	24.33	6.31	72	26.40	6.47
Rey Complex Figure Test and Delayed Recall	118	19.03	7.87	118	23.86	6.54	73	25.62	6.84
Rey Complex Figure Test and Recognition Trial	114	20.30	2.10	114	21.11	1.86	68	20.94	1.89
Stroop-1 Time	117	10.57	3.29	117	8.89	1.85	72	10.67	3.73
Stroop-2 Time	117	11.13	4.25	117	10.71	3.23	72	9.74	2.30
Stroop-3 Time	117	15.36	3.32	117	13.68	2.99	72	12.61	2.81
Stroop-4 Time	117	23.57	6.30	117	18.64	4.04	72	17.31	4.67
Stroop-5 Time	117	33.54	11.52	117	26.45	7.48	72	23.79	6.42
Tower of London Total Correct Score	113	2.53	1.91	113	2.95	2.13	70	3.20	2.24
Tower of London Total Move Score	113	47.60	18.25	113	43.20	18.48	70	37.40	17.30
Tower of London Total Initiation Time	113	30.05	40.24	113	32.77	34.50	70	37.11	38.11
Tower of London Total Time	113	339.11	140.1	113	263.00	87.72	70	244.00	86.49
Raven Standard Progressive Matrices Total Score	103	37.66	8.49	103	41.18	7.98	61	44.27	7.05
Raven Standard Progressive Matrices Time	103	30.56	8.27	103	28.31	8.51	61	29.50	7.50

In Table-2 arithmetic mean, standard deviation, F values and significance levels of the same number of participants having taken all pretest and 3rd posttest neuropsychological tests have been presented. This table has been prepared in such way to enable a comparison between pretest and 3rd posttest arithmetic mean scores. Table-2 shows that except long-term memory score of Öktem-Verbal Memory Processes, F values of all the other neuropsychological test results are statistically significant. Obtained findings prove that IQ Up Cognitive Development Method has long-term effect.

Table-2: Neuropsychological Test Scores of the Participants in the Experimental Pretest and 3rd Posttest Means, Standard Deviations, F Values, and Significance Levels

	Pretest			Posttest (3rd) (11 months later)				
Neuropsychological Tests	N	$\overline{X}$	S.D.	N	$\overline{X}$	S.D.	F	P
WAIS-R Symbol	73	40.05	8.10	73	49.19	10.89	76.30	**.000**
WISC-R Arithmetic	67	13.42	2.36	67	14.61	2.39	18.19	**.000**
Serial Digit Learning Test	68	14.50	6.46	68	17.57	4.63	14.93	**.000**
Öktem-Verbal Memory Processes Total Learning	73	114.85	17.09	73	128.34	12.39	54.21	**.000**
Öktem-Verbal Memory Processes Long Term Memory	65	13.00	2.06	65	13.01	1.99	003	.954
Rey Complex Figure Copy Test	74	31.77	5.21	74	34.35	2.17	18.80	**.000**
Rey Complex Figure Test and Immediate Recall	72	19.84	7.48	72	26.40	6.47	71.99	**.000**
Rey Complex Figure Test and Delayed Recall	73	19.49	8.24	73	25.62	6.84	58.81	**.000**
Rey Complex Figure Test and Recognition Trial	68	20.19	2.16	68	20.94	1.89	7.94	**.006**
Stroop-1 Time	72	8.46	1.76	72	10.67	3.73	24.78	**.000**
Stroop-2 Time	72	10.79	3.63	72	9.74	2.30	5.55	**.021**
Stroop-3 Time	72	15.33	3.66	72	12.61	2.81	54.39	**.000**
Stroop-4 Time	72	23.64	7.01	72	17.31	4.67	92.44	**.000**
Stroop-5 Time	72	32.65	11.34	72	23.79	6.42	65.32	**.000**
Tower of London Total Correct Score	70	2.51	1.87	70	3.20	2.24	5.26	**.025**
Tower of London Total Move Score	70	47.43	16.86	70	37.40	17.30	15.89	**.000**
Tower of London Initiation Time	70	23.84	21.66	70	37.11	38.04	6.01	**.012**
Tower of London Total Time	70	326.13	129.36	70	244.00	86.49	22.46	**.000**
Raven Standard Progressive Matrices Total Score	61	38.75	8.43	61	44.27	7.05	83.91	**.000**
Raven Standard Progressive Matrices Time	61	32.33	8.72	61	29.50	7.50	6.96	**.011**

Discussion

Present research has been conducted to detect whether IQ Up Cognitive Development Method's effect on the development of cognitive processes in 10-12 age group healthy children has been long term or not. To that end, participants who have been in the test group in previous research and received IQ Up Cognitive Development Method training received neuropsychological tests 11 months later as 3rd posttest. In the research to detect whether cognitive training's effect is continuous, pretest conducted before IQ Up Cognitive Development Method training and neuropsychological test results conducted as 3rd posttest 11 months after the training have been statistically compared. Research findings manifest that IQ Up Cognitive Development Method has lasting effects. Statistical findings of current research reveal that training has lasting effects on neuropsychological test score averages of the group. Obtained findings are statistically significant. This finding is consistent with the results obtained in relevant literature studies (Alloway, Bibile, Lau, 2013; Dahlin, 2011; Holmes et all. 2010; Jaeggi et al., 2011;Rueda, Checa, Cómbita,2012;Roughan, Hadwin, 2009).

Conducted IQ Up Cognitive Development Method had positive effects on participants' working memory, visual and verbal long-term memory, response rate, focused and continuous attention, problem solving, reasoning, planning and strategy setting and similar cognitive processes. It has also been proved that this development has been permanent. This result has been supported via findings obtained from researches.

Findings of current research and previous research have been consistent (Kafadar, Akıncı, Çakır, 2013;2014). In addition transfer effect of cognitive training has also been observed. Although IQ Up Cognitive Development Method has no cognitive task to elevate participants' direct problem solving skills, there has been a visible increase in arithmetic mean scores of RSPM Test measuring fluid intelligence performance of participants in particular while there has been a decrease in the arithmetic mean scores of the same test's period score average. This finding is attributed to cognitive training received by participants and is consistent with researches in relevant literature (Klauer, Willmes, Phye, 2002; Klauer, Phye, 2008). In the studies conducted by Kafadar (2010; 2012a;2012b) it has been pointed that problem solving is associated with several cognitive processes.

Another finding is that systematic and appropriate reasoning as well as mental flexibility have accelerating effect on problem solving and fluid intelligence success in turn. It is thus considered that IQ Up Cognitive Development Method has similar effect on children having received this training. In other terms it is assumed to have a positive effect on participants' systematic and appropriate reasoning, mental flexibility, attention span, process speed and working memory capacity.

In several literature studies, it has been noted that people who received inductive reasoning training that enables to identify similarities and differences between surrounding events and objects gain better problem solving skills (Klauer, Phye, 2008) . In the theory termed as Prescriptive theory of inductive reasoning, it is noted that inductive reasoning is a thinking process aiming to detect the similarities and differences amongst their relations with stimulants' verbal, visual, quantitative, geometric features. It is also claimed that during problem solving process, inductive reasoning is associated with identifying the rules, defining the pattern and arriving at generalizations. Accordingly once inductive reasoning is used as a strategy in problem solving there has been an increase in problem solving success. In line with the findings of a metaanalytic research by Klauer and Phye (2008) it has been argued that rendering such cognitive training to children enables an increase in their fluid intelligence performance that is associated with inductive reasoning. The same positive effect is also associated to IQ Up Cognitive Development Method. In addition Klinberg's (2010) study also revealed that cognitive training fuels an activity increase in frontal, parietal and basal ganglia of brain which in turn is connected to the change in dopamine receptor density. Increase in the activation rate in brain is most probably the neural basis of the development that emerges as a consequence of cognitive training-stimulated problem solving or fluid intelligence.

Cognitive training programs are significantly useful in minimizing or even eliminating a variety of problems that might accrue due to the failure of both children and adults to effectively implement cognitive processes. In addition such training programs also bear importance in the behavioral treatment of neurological and psychiatric diseases. Nonetheless it should be noted that such cognitive training programs need to bear extensive context in terms of quality. It is required that the context of cognitive tasks demanded from participant must decidedly correspond to certain cognitive processes. In another saying it is likely that the validity of cognitive training program or independent application of the program to individuals may be effective in accelerating its usefulness. It is also believed that application of cognitive training manually to small groups under the supervision of a trainer might be the other factor in elevating the ratio of success. Some cognitive training programs include cognitive tasks that are merely geared towards increasing working memory capacity while other cognitive training programs integrate cognitive tasks aiming to enhance reasoning, problem solving, attention, memory, response rate capacities. In addition rendering cognitive training to independent individuals or in case of group performance the number of participants in the group, motivation of participants are the variables that need to be controlled in such researches. One other factor that might be effective in increasing the success of cognitive trainings is keeping their application period long and keeping the application interval of cognitive tasks short at the time of training process.

Cognitive training provides benefits not merely for healthy individuals. IQ Up Cognitive Development Method has proved to be useful and effective in the long term particularly as supported by present research as well. Further research should be conducted to analyze its potential effect as a behavioral treatment in a variety of diseases. The effectiveness of cognitive training programs in the field of training has been proved via literature studies (Jaeggi et al., 2011; Thorell et all. 2009); however the quality of cognitive tasks integrated in cognitive training programs is also a crucial factor impinging on the success of cognitive training. It is believed that by standardizing and systematizing such training programs they can be integrated into course schedule, hence school children's academic success can be elevated to the highest level. Such trainings or courses may assist the students in achieving greater academic and daily success by spending minimum amount of time.

It should also be noted that cognitive training programs' potential effects on the neural and molecular mechanism changes in brain should also be examined further within the scope of neuroscience researches.

Acknowledgements

We, the authors of present research, would like to express our sincere thanks to Betül Akıncı, Merve Kılıç, Janin Marazyan, Havva Yıldırım, Kısmet Güler, Havva Çelik, Selena Güdücü, and Pınar Erçelik for their valuable contributions in the application of neuropsychological tests.

References

Alloway, T. P., Bibile, V. Lau, G. (2013). Computerized working memory training: Can it lead to gains in cognitive skills in students? Computers in Human Behaviour, 632-638.

Atalay, D., Cinan, S. (2007). Planning ability of adults: Standardization and reliability of TOL^{DX} Turkish Psychology Journal 22, 25-38.

Barkl, S., Porter, A., Ginns, P. (2012). Cognitive training for children: effects on inductive reasoning, deductive reasoning,and mathematics achievement in an Australian school setting. Psychology in the Schools, 49(9), 828-842.

Baştuğ, B. (2000). Pilot study on the performance subtest of Wechsler Adult Intelligence Scale-Revised (WAIS-R) . (Unpublished master thesis), Ankara University .

Beck, S. J., Hanson, C. A., Puffenberger, S. S., Benninger, K. L., & Benniger, W. B. (2010). A controlled trial of working memory training for children and adolescents with ADHD. Journal of Clinical Child and Adolescent Psychology,39, 825–836. doi:10.1080/15374416.2010.517162

Bracy, O. L. (1994). Cognitive functioning and rehabilitation: Journal of Cognitive Rehabilitation, 12, 12-16.

Brehmer, Y., Westerberg, H., Backman, L. (2012). Working-memory training in younger and older adults: training gains, transfer, and maintenance. Frontiers in Human Neuroscience, 6,63.

Culbertson, W.C., Zillmer E.A. (2005). Tower of London Drexel University (2nd Ed.) Toronto: Multi-Health Systems.

Dahlin, K. I. E. (2011). Effects of working memory training on reading in children with special needs. Reading and Writing, 24, 479–491.

Holmes, J., Gathercole, S. E., Place, M., Dunning, D. L., Hilton, K. A., & Elliott, J. G. (2010). Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD. Applied Cognitive Psychology, 24, 827–836.

Holmes, J., Gathercole, S.E., Dunning, D.L. (2010). Poor working memory: impact and interventions. Adv Child Dev Behav *39:1-43*

Kafadar, H., Akıncı, Z.,Çakır, B. (2013). IQ Up Cognitive Training Program's effect on the cognitive improve. Journal of the International Neuropsychological Society, Volume 19, Supplement S2, http://dx.doi.org/10.1017/S1355617713001033.

Kafadar, H., Akıncı, Z.,Çakır, B. (2014). Effects of the Cognitive Training Program on the development of 10-to 12-year old children. Procedia - Social and Behavioral Sciences (in press) .

Kafadar, H (2010). Wisconsin Card Sorting Test and Raven Standart Progressive Matrices: A Latent Variable Analysis. Journal of International Neuropsychological Society, Volume 16, Supplement, 2, 70-71.

Kafadar, H. (2012a). Cognitive Model of Problem Solving. New Symposium 50,(4)195-206.

Kafadar, H (2012b). Mental Flexibility, Reasoning, Focused Attention, Planning and Fluid Intelligence: A Latent Variable Approach. The International Neuropsychological Society, -Mid-Year Meeting 27-30 June 2012, Oslo Norway.

Klauer, K.J., Wilmess, K., Phye, G.D. (2002).Inducing inductive reasoning:Does it transfer to fluid intelligence. Contemporary Educational Psychology, 27, 1,25 . Doi:10.1006/ceps. 2001.1079.

Klauer, K.J., Phye G.D. (2008). Inductive reasoning: A training approach . Review of Educational Research, 78:85.

Klingberg, T. (2010). Training and plasticity of working memory. Trends in Cognitive 826 Sciences, 14, 317–324.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Shah, P. (2011). Short and long-term benefits of cognitive training. Proceedings of the NationalAcademy of Sciences of the United States of America, 108, 10081–10086. d

Mahncke, H. W., Connor, B. B. , Appelman, J.,…. (2006) Memory enhancement in healthy older adults using a brain plasticity-based training program: A randomized, controlled study. www.pnas.org_cgi_doi_10.1073_pnas.0605194103

Meyers, J.E., Meyers, K.R. (1995).Rey Complex Figure Test and Recognition Trial. Florida: Psychological Assessment Resources.

Nouchi, R., Taki, Y., Takeuchi, H., Hashizume, H., Nozawa, T., Kambara, T., Sekiguchi, A., Miyauchi, C.M., Kotozaki, Y., Nouchi, H., Kawashima, R. (2013).Brain training game boosts executive functions, working memory and processing speed in the young adults: a randomized controlled trial. PLoS One. 8(2):e55518. doi: 10.1371/journal.pone.0055518.

Raven, J. (2000). The Raven's Progressive Matrices: Change and Stabiliti Over Culture and Time. Cognitive Psychology, 51, 1-48.

Raven, J., Raven, C., Court, J.H. (2000). Raven Manual: Section 3. Standard progressive matrices 2000 Edition. San Antonio, Teksas: Harcourt Assessment.

Roughan, L., Hadwin J A (2009) .The impact of working memory training in young people with social, emotional and behavioural difficulties .Learning and Individual Differences, 21, 759-764.

Rueda, M. R, Checa, P., Cómbita, L. M. (2012). Enhanced efficiency of the executive attention network after training in preschool children: Immediate changes and effects after two months. Developmental Cognitive Neuroscience, 2, 192.

Olesen, P., Westerberg, H., Klinberg, T. (2004). Increased Prefontal and Parietal activity after training of working memory . Nature Neuroscience, 7, 1038-1065.

Owen, A. M., Hampshire, A., Grahn, J. A., Stenton, R., Dajani, S., Burns,A. S., . . . Ballard, C. G. (2010). Putting brain training to the test. Nature,465, 775–778.

Savaşır, I., Şahin, N. (1995). Wechsler For Children Intelligent Scale-Revised (WISC-R) Manuel Book, Ankara: Turkish Psychologist Society Publish.

Smith, G.E., Housen, P., Yaffe, K. ……. (2009) A Cognitive Training Program Based on Principles of Brain Plasticity: Results from the Improvement in Memory with Plasticity-based Adaptive Cognitive Training (IMPACT) Study. JAGS 57,4 594–603.

Takeuchi, H., Kawashima, R. (2012). Effects of processing speed training on cognitive functions and neural systems. Rev. Neurosci., Vol. 23(3): 289–301 . Doi 10.1515/revneuro-2012-0035

Öktem. Ö. (2011). Öktem Verbal Memory Processes Test (ÖKTEM-VMPT) Manuel Book , Ankara: Turkish Psychologist Society Publish.

Thorell, L.B., Lindqvist, S., Bergman Nutley, S., Bohlin, G. , Klingberg, T. (2009), Training and transfer effects of executive functions in preschool children . Developmental Science 12, 106-113.

Varan, E., Tanör, Ö., Gürvit, H. (2007). Rey Complex Figure Test-Recognition Trial: Norm Determination Study on Turkish Adult Sample. Journal of Turkish Neurology , 13, 387-394.

Yargıcı, S. (2000). Pilot study on the performance subtest of Wechsler Adult Intelligence Scale-Revised (WAIS-R) . (Unpublished master thesis), Ankara University .

Yılmaz B. (2000). Pilot study on the vocabulary subtest of Wechsler Adult Intelligence Scale-Revised (WAIS-R) . (Unpublished master thesis), Ankara University .

Wechsler, D. (1974). Manual for the Wechsler Intelligence Scale for Children—Revised. New York: Psychological Corporation.

Wechsler, D. (1981). Wechsler Adult Intelligence Scale —Revised Manual. New York: Psychological Corporation.

Willis, S.L. Tennstedt, S.L., Marsiske, M., Ball, K. et all. (2006). Long-term Effects of Cognitive Training on Everyday Functional Outcomes in Older Adults. JAMA. 296(23): 2805–2814. doi: 10.1001/jama.296.23.2805.

Zangwill, O.L. (1943) Clinical tests of memory impairment. Proceedings of Royal Society of Medicine, 36, 576-580.