

The Effectiveness of Dawson-Guare Program on the Executive Functions of Pre-School Students with Neurological Learning Disability

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Abstract

The present study aimed to examine the effectiveness of the Dawson-Guare Program on executive functions in children with Neuropsychological/Developmental Learning Disability (NDLD). The Wechsler Preschool and Primary Scale Intelligence (WPPSI) and Behavior Rating Inventory for Executive Function-Preschool (BREIEF-P) were chosen for the purposes of this study and 40 children of the total number of 700, exhibited executive functions difficulties indicating a probable NDLD. The 40 students diagnosed with NDLD were equally separated into two groups. The intervention group attend a 15-week Dawson-Guare program while students of the control group followed the regular preschool schedule. All participants were tested prior to the start and after the end of the 15-week period. The results indicated that after a 15-week Dawson-Guare program, the intervention group improved all of dimensions of executive functions that examined. In conclusion, Dawson-Guare program training can be an effective intervention for improving executive functions for children with NDLD.

Keywords: the Dawson-Guare Program, executive functions, neuropsychological/developmental learning disability

1. Introduction

Pre-school period provides a valuable opportunity for learning, development, and use of intervention programs and is a very important opportunity for development and prevention of developmental disorders (Anderson & Reidy, 2012). One of the developmental problems which is developing in pre-school students and in recent decade, has attracted a lot of attention to itself in research, can be neuropsychological/developmental learning disabilities (Stefanie, Rene, & Cristoph, 2013).

Neuropsychological/developmental skills include that group of Prerequisite Skills that children need for acquiring and learning course subjects (Gartland & Storsnider, 2007; Semrud-Clikman, 2005; Steele, 2004). These disabilities are the prelude of academic learning disabilities which will occur later (Lisa, Sofia, Sissela, Gunilla, & Torkel, 2009). Children with normal developmental skills easily can acquire academic prerequisite skills, but developmental and neuropsychological deviations may become preludes for learning disabilities and children need early intervention to acquire prerequisite skills for being successful in future academic learning. Therefore, it is necessary that these problems in pre-school students should be diagnoses and to increase these skills, early intervention programs should be provided (Seidman, 2006).

One of the problems of pre-school children with learning disabilities which attracted the attention of researchers and scholars to itself is Executive Functions (EF) (Semrud-Clikman, 2005; Seidman, 2006; Kirk, Gallagher, Anastasiow, & Coleman, 2006). Executive functions are high-level cognitive actions which are considered very important for directing behaviors and self-regulation. They are activated by prefrontal regions of the frontal lobe (Lisa et al., 2009). Research conducted on this domain indicates that these functions have the most functions in academic preparedness, and the delay and deficits in the development of executive functions at the age of 4 years old has correlation with the degree of social, emotional, and cognitive competence in adolescence (Howard, Okely, & Ellis, 2015) and can predict learning problems at entering school and drug abuse in adulthood (Diamond, Barnett, Thomas, & Munro, 2007).

A lot of findings indicate that executive functions in pre-school ages experience expansive transformations (Munnakata, Michaelson, & Chevalier, 2013) which highlight the necessity of executing programs in pre-school periods with the aim of enhancing executive functions in children suffering from neuropsychological/developmental learning problems more and more (Ebrahimi, Abedi, Yarmohammadian, & Faramarzi, 2014). Accordingly, how to reinforce executive functions in early ages are among important aims of research plans regarding the health of societies (Stefanie et al., 2013). In recent years, effective efforts for designing and evaluating educational plans with the aim of enhancing executive functions in pre-school children has been exerted.

The team at the Karolinska Institute extended their work on memory training to typically developing or normal preschool children (Thorell, Lindqvist, Bergman, Bohlin, & Klingberg, 2009). Children in the working memory training group improved significantly on all trained tasks, while those in the inhibition training group improved only on the trained go/no-go and interference control tasks. The Dawson-Guare Program is a program based on play and practice for the pre-school period, which by purposive enhancement of self-regulation and executive functions in children, reinforces bases of success in school (Snow & Vanhemel, 2008). These instruments have significant effects on increasing self-regulation of children and these effects cause the increase in academic achievement scores as well as reading and math levels for children (Hanly, 2005).

Regarding the mentioned issues stating the significance of trainings, skills, and behaviors of children at pre-school ages as a ground for acquiring healthy life, and the significance of early trainings in the development of children's executive skills in early ages, in the present study, the effectiveness of the Dawson-Guare Program on the executive functions of pre-school children with neuropsychological/developmental learning disabilities.

2. Methods

2.1 Participants

The children who participated in this study were all 4 to 5 year old children with neuropsychological learning disabilities in the City of Isfahan, who were registered in the academic year 2014-2015 in pre-school centers. In the present study, to select subjects, the stratified random sampling method was used in such a way that firstly from among 218 pre-schools in the 14 areas of education of Isfahan, 4 areas were selected and from these four regions, 20 pre-schools were randomly selected. Then, the questionnaire of Behavior Rating Executive Functions for pre-school children were distributed among the parents of 700 children. Then, the scores of these questionnaire were changed into standard t-scores and children whose scores in this questionnaire were as one SD higher than the mean scores (i.e., 60) were identified; and this diagnosis was confirmed by experts interviewed, then from among this group, 40 children were randomly selected and were divided into experimental and control groups. In the present study, most children divided into two experimental (Dawson) group (52.9%) and control group (73.3%) were five years old. In addition, most children in the two experimental group (52.9%) and control group (60.0%) were males. Most mothers in the two groups were housekeepers, and most fathers of the experimental group (64.7%) worked in state professions and control group (53.3%) were self-employed. In the next stage, a briefing was held for parents about the research design and intervention programs. Then, all parents provided written informed consent prior to participation that allowing childrens involvement in the program and access to relevant information. For differential diagnosis of neuropsychological learning disability from the shortcomings of intelligence, children were tested by The Wechsler's Subtest Intelligence for Children fourth edition (WISC-IV) and their IQ were extracted. It should be noted that the inclusion criteria were as follows:

- 1) Have neuropsychological/developmental learning disability based on scores of the questionnaire of BRIEF-P for pre-school children-parents' form (one SD higher than the mean scores);
- 2) Achieve a moderate to high score (i.e., 85) in WPPSI;
- 3) Being 4 years to 5 years and 11 months old;
- 4) Physical health (regarding the health ID of children in pre-schools, their physical-movement, visual and auditory disabilities were investigated).

Then, fifteen 60 to 90 minute training sessions were held for children in intervention group. The presented exercises and trainings were summarized in Table 1. At the end of session, regarding the fact that some subjects were absent for more than three sessions, tended to leave the experiment, or some questionnaires had not been answered appropriately, some of the subjects were excluded from the groups and at last, the scores of 17 subjects of the experimental group and 15 subjects of the control group were analyzed. The collected data were analyzed using descriptive statistics including frequency, percentage, mean scores, and SD as well as inferential statistics

such as ANCOVA and MANCOVA by SPSS-19.

Table 1. Content of training sessions

Sessions	Content of Dawson-Guare Program
1	The familiarity of therapists and children with each other and stating regulations and duties of each member, then paying attention to activities desired by children for creating a friendly relationship and sense of security for children.
2	Doing reverse theatrical activities and building towers.
3	Implementing the activity of rolling a ball with song and doing activities without using thumbs.
4	Doing the activity of waves of joy and implementing the play of taking chairs.
5	Reviewing previous sessions and doing the activity of red and black cards.
6	Implementing the play of following a polar bear and the activity of "Rostam Said".
7	Implementing the activity of mirror image and the acidity of Freeze with Music.
8	Reviewing previous session and implementing the activity of "neighbors".
9	Implementing the play of hide and seek with balls and implementing animal games.
10	Implementing the activity of sandwich and the activity of freeze with colors.
11	Doing the activity of good gesture, and implementing the activity of balls and words.
12	Implementing Li Li game and the activity bulbs, scissors, knives, forks.
13	Implementing the activity of "not follow the tutor".
14	Implementing the play of "guessing the name of animals" and the activity of socks and identifying objects.
15	Reviewing previous sessions, implementing a play suggested by children and distributing posttest questionnaires.

2.2 Testing Procedures and Instrumentation

2.2.1 The Wechsler Preschool and Primary Intelligence Scale for Children (WPPSI)

The Wechsler Preschool and primary Intelligence Scale for Children (WPPSI) developed by Wechsler (1967) for children aged at 4 to 6/5 years old. The WPPSI provides the measurement of general intelligence and fullscales including verbal comprehension, Visual Spatial, Fluid Reasoning, working memory, and processing speed. This test was adapted and normalized on an Iranian sample of children by Abedi (2005). The validity of sub-tests in the test-retest was reported in the range of 0.65 to 0.95 and the split-half validity coefficient in the range of 0.71 to 0.86. in investigating the concurrent validity of this scale with the WPPSI, the correlation coefficient of verbal, practical, and total IQs of the two scales are 0.84, 0.74, and 0.85 respectively (Shahim, 2008). In the present study, the WPPSI was used for measuring children's IQs.

2.2.2 Behavior Rating Inventory of Executive Function—Preschool (BRIEF-P)

This questionnaire was developed by Gioia et al. (2003) in two teacher's and parent's forms. It is one of the most valid scales for measuring and screening executive functions in pre-school students. It has 63 items for children aged at 2 to 5 years and 11 months old, and measures five domains of executive functions: inhibition (11 items), shift (10 items), emotional control (10 items), working memory (17 items), planning and organization (10 items). The time required to complete this questionnaire is 10 to 15 minutes, and the minimum literacy level of is to hold a degree in elementary schools. Parents and teachers, in answering the items related to children should tick the items ranged from mostly (3), sometimes (2), and never (1). These indicators were calculated and indicated in the form of t-scores, percentage, and confidence interval of 90% for indicators. Gioia et al. (2003) reported Cronbach's alpha coefficients for scales in the parents' study as follows: inhibition (0.90), shift (0.85), emotional

control (0.86), working memory (0.88), planning and organization (0.80), total indicator (0.95). These coefficients for teachers are as follows: inhibition (0.94), shift (0.90), emotional control (0.91), working memory (0.94), planning and organization (0.97), total indicator (0.97). In the present study, validity and reliability of the inventory for parents were calculated.

3. Results

Table 2. Descriptive indicators of the variable of executive functions and its dimensions in the pretest and posttest in different groups

Variable	State	Experimental		Control	
		Mean	SD	Mean	SD
Inhibition	Pretest	28.40	4.55	27.35	4.44
	Posttest	21.18	4.54	26.47	4.50
Shift of attention	Pretest	16.23	3.45	14.41	2.86
	Posttest	11.47	2.60	15.07	2.57
emotional control	Pretest	19.94	3.26	18.53	2.29
	Posttest	13.71	3.21	16.87	2.47
Working memory	Pretest	30.65	6.80	31.31	6.55
	Posttest	21.18	5.45	30.00	5.12
Total score	Pretest	115.04	14.93	108.73	12.62
	Posttest	80.29	15.34	105.13	10.79

Regarding the significance of the IQ in the performance of the participants in the administered tests and to be sure of the fact that there is no significant difference between groups in terms of IQ, the significance of the difference of IQ in these groups were investigated. Regarding that the calculated F-score has significance level less than 0.05 ($F_{(1, 31)} = 1.37$ and $p > 0.05$), it can be said that there is no significant difference between the two groups in terms of IQ.

Table 3. The results of ANCOVA for comparing the total scores of executive functions in the two experimental and control groups

Sources of Variation	Total squares	df	Mean Square	F	Sig.	Partial Eta	Statistical power
Pretest	1382.34	1	1382.34	9.98	0.004	0.25	0.86
Group	5889.05	1	5889.05	42.53	0.001	0.59	1.00
Error	4014.91	29	138.44	--	--	--	--
Total modified score	10313.87	31	--	--	--	--	--

$p < 0.05$

As observed in Table 3, after deleting the effect of the pretest of F-score in the ANCOVA, the comparison of the experimental (Dawson) and control groups in the total scores of executive functions is significant at the significance level 0.05 ($F_{(1, 29)} = 42.53$ and $p < 0.05$). Therefore, according to the results, there is a significant difference between the executive functions in preschool students in the intervention and control groups, and it can be concluded that the Dawson Training Program is effective in improvement of the executive functions in pre-school children with neuropsychological learning disabilities. In addition, the eta-squared coefficient indicates that 59% of the variations of executive functions can be explained by group membership. In addition, the statistical power of the test is equal 1 which indicates the sufficiency of sample size and the power of the test in measuring group differences.

Below, the results of the MANCOVA for comparing the total scores of executive functions in the two experimental and control groups in each of the dimensions of executive functions are reported.

Table 4. The results of MANCOVA for comparing the total scores of executive functions in the two experimental and control groups.

Effect	Multivariate tests	Value	F	Sig	Partial Eta	Statistical power
Executive Functions						
	Pillai's trace	0.59	6.08	0.001	0.59	0.97
	Wilks' Lambda	0.40	6.08	0.001	0.59	0.97
	Hotelling's trace	1.44	6.08	0.001	0.59	0.97
	Roy's greatest root	1.44	6.08	0.001	0.59	0.97

p < 0.05

The results of table indicate that after excluding the pretest effect in MANOVA, there is a significant effect for the group factor. This effect indicates that at least in one of the dimensions of the executive functions, there is a significant difference between the two groups (Wilks' Lambda = 0.40, p < 0.05, and F = 6.08). Since the multivariate effect is statistically significant, the separate univariate F-test can be used for each dimension of executive function. The results of this test is reported in Table 5.

Table 5. The results of ANCOVA for comparing the total scores of executive functions in the two experimental and control groups

Sources variation	SS	df	MS	F	Sig.	Partial Eta	Statistical power
Inhibition	140.14	1	140.14	8.17	0.008	0.24	0.78
Shift of attention	71.17	1	71.17	11.47	0.002	0.31	0.90
Emotional control	39.29	1	39.29	5.60	0.02	0.18	0.62
Working memory	399.63	1	399.63	26.24	0.001	0.51	0.99
Planning	116.65	1	116.65	9.73	0.005	0.28	0.85

p < 0.05

As observed in Table 3, after deleting the effect of the pretest of F-score in the ANCOVA, the difference of groups in all dimensions of inhibition, shift, emotional control, working memory, and planning/organization is significant at the significance level 0.05 (p < 0.05). Therefore, according to the results, it can be concluded that Dawson Training Program is effective on the improvement of inhibition, shift, emotional control, working memory, and planning/organization in preschool children with neuropsychological learning disabilities.

4. Discussion

Pre-school period is very sensitive for physical, motor, cognitive, social, and emotional-behavioral development for children because this period is the basis of next stages of development for them. In this period, children are influenced by their surrounding environments; therefore, a lot of state and private institutions have developed programs for reinforcing and enhancing different developmental aspects and academic preparedness for pre-school students (Snow & van Hammel, 2008). The present study aims at investigating the effectiveness of the Dawson-Guare program on executive functions in children with neuropsychological/developmental learning disabilities. The results obtained from the comparison of executive functions of the two experimental (Dawson) and control groups after deleting the pretest effect (Table 3) indicated that there is a significant difference between executive functions of pre-school children of experimental (Dawson) and control group. As a result, the Dawson program is effective on the enhancement of executive functions in children with neuropsychological/developmental learning disability. In addition, the results of the MANCOVA for each of the

dimensions of executive functions (Table 5) indicate that there is a significant difference between the two groups in all dimensions of inhibition, shift, emotional control, working memory, and planning/organization. Therefore, it can be concluded that the Dawson Program is effective on the improvement of skills of inhibition, shift, emotional control, working memory, and planning/organization in children with neuropsychological/developmental learning disabilities.

The results of the present study indicated are consistent with the results of the studies conducted by Ebrahimi et al. (2014), Abedi and Malekpour (2010), Diamond (2012), Coleman et al. (2006), Gartland and Struass (2007), Hanley (2005) and Strayhorn (2002) which reported that early intervention programs are effective on the executive functions of children with learning disabilities (Gartland & Strosnider, 2007; Coleman, Buysse, & Neitzel, 2006; Diamond, 2012; Strayhorn, 2002; Hanly, 2005).

Some children start preschool period with deficits in their executive functions and tutors do not have sufficient training and experience; consequently, these children are dismissed from classes. Deficits in executive functions of children cause teachers' exhaustion, the dismissal of children from schools, drug abuse, and crimes (Diamond et al., 2007). The results of researches indicate that executive functions, called cognitive control, can be taught (Howard et al., 2015). Diamond et al. (2007), using 40 games designed with the aim of training the enhancement of executive functions, could enhance executive functions of children aged at 4 and 5 years old and interestingly, using these functions was generalized to new activities.

In explaining these results, it can be said that the Dawson-Guare Program is an evidence-based program for pre-school period and includes purposive games which are designed for promoting executive functions of children before entering schools. Therefore, regarding the fact that the degree of executive functions in pre-school children with learning disabilities are weaker than those of normal children (Samrud et al., 2005; Kirk et al., 2006; Abedi & Malekpour, 2010) and deficits in executive functions and deficits in attention are the most important antecedent variables of learning disabilities (Steele, 2004); therefore, smart interventions for reinforcing executive functions such as the Dawson-Guare Programs are very effective and suitable for children (Howard et al., 2015). On the other hand, a lot of findings indicate that executive functions in pre-school ages will have rapid upheavals (Munnakata et al., 2013) and the neurological results state that a network of neurons involved in controlling attention and executive functions, and are located at regions of the anterior cingulate cortex and the lateral prefrontal regions, grow in the ages from 3 to 7 years old (Rosario, Rothbart, & Candis, 2005); therefore, efforts such as the Dawson-Guare Program which are exerted for enhancing the development of functions in these ages, are promising and facilitating and contribute to the rapid growth of these functions.

Among the limitations of the present study, one can refer to not using follow-up tests; therefore, for investigating the strengths and weakness as well as evaluating the continuance of improving executive functions in trained children in the Dawson-Guare Program in long term periods, conducting research with follow-up stages is recommended. In addition, the conduction of the present study separately on other age groups is suggested. In conclusion, the results of the present study indicate that Dawson-Guare Program is effective on the improvement of executive functions in children with neuropsychological/developmental learning disabilities; therefore, it is suggested that exercises and drills of this program should be taught to tutors and parents and it should be implemented in kindergartens and preschool centers for enhancing executive functions in children, and particularly in therapeutic centers for increasing cognitive performances in children with neuropsychological learning disabilities. The effect of the Dawson-Guare Program on children with other disorders such as Attention Deficiencies and Hyperactivity Disorder, conduct disorders, etc. are recommended.

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