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DEVELOPMENT OF THE MOTOR FUNCTIONS OF CHILDREN WITHOUT VISUAL IMPAIRMENT AND VISUALLY IMPAIRED CHILDREN

Original scientific paper

Dz. Radzo Alibegovic[1]

[1] *Faculty of Education and Rehabilitation, University of Tuzla, Bosnia and Herzegovina*

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ABSTRACT

The aim of this research was to examine the development of motor functions in children with visual impairment compared to children without visual impairment. The research included a sample of 70 respondents; 35 with impaired vision and 35 with no visual impairment. The research was conducted in Sarajevo at the Center for Blind and Visually Impaired Children and Youth "Nedzarici", and in Tuzla at the Elementary School "Centar". The results of the research have shown that respondents with visual impairment have less developed motor functions compared to respondents without visual impairment. The variables on which the respondents with visual impairment achieved the worst results, which refer to the quality of drawing and the speed of drawing, were especially singled out.

Keywords*: motor functions, visually impaired children, children without visual impairment*

INTRODUCTION

The organization of motor skills is the way in which the child's abilities and its behavior as a whole are manifested. Through motor skills, we perceive those qualities of a child that indicate its personality (Povse-Ivkic and Govedarica, 2000). Data from the literature indicate that interaction with family members (especially with the mother) and with other children has a great influence on the mental and motor development of children. (Poresky and Henderson, 1990). An insufficiently stimulating environment, in terms of inadequacy of space, means of work and work methods, and an unstimulating family environment affect the motor development of healthy preschool children (de Barros et al., 2003). Among numerous postnatal factors, the biggest influence on children's motor development is nutrition, socio-economic factors, stimulation from the environment, the relationship between parents and their participation in children's daily activities, and the cultural status of the family (Bacharach and Baumeister, 1998).Sensor-motor integration plays a very important role in motor learning. A minimum level of stimulation is needed to indicate to the child its overall potential for exploring the environment and thus stimulating its motor, structural, cognitive and emotional abilities (Bly, 1996). Children born with impaired vision bear the consequences, which are manifested in various forms of their development. Due to the impossibility of imitation and the lack of environmental incentives for movement, these children in most cases remain motor passive (Cvetkovic, 1989). Due to the impossibility of learning movements by imitation, as well as due to the inadequate influence of the environment, the blind child becomes disinterested in the objects around it (Eskirovic et al., 2005). Motor visual imitation plays a role in learning to walk, expressive speech movements, various games

Correspodence to: Dzenana Radzo Alibegovic, Faculty of Education and rehabilitation, University of Tuzla
Email: dzenana.radzo@gmail.com

and various activities of everyday life. In a blind child, there is no visible imitation, so in this respect its motor skills are significantly poorer. In the motor development of a blind child, the role of visual imitation is taken over by tactile-kinesthetic imitation, with which the child learns to perform certain actions correctly through passive movements (Radzo Alibegovic, 2013). The main goal of this work was to determine the differences in motor functions between respondents with visual impairment and respondents without visual impairment.

METHODOLOGY

In this research, a sample size of 70 respondents aged between 7 and 15 years was included. 35 respondents were selected from the population of students without visual impairment and 35 visually impaired students from the Center for Blind and Visually Impaired Children and Youth in "Nedzarici" were selected.

Variables for testing motor functions

1. motor speed and dexterity
2. movements based on kinesthesia
3. copying the position of an object in space according to the given model
4. knowledge of the final level of experience of bodily wholeness at the level of execution of crossed motor commands
5. alternating alternative activities within the melokineticapraxia based on the evaluation of dynamic organization
6. presence/absence of motor perseverations
7. oral motor skills
8. quality and speed of drawing
9. coordination of movements according to the verbal command

METHODS

The research was conducted in Sarajevo at the Center for Blind and Visually Impaired Children and Youth "Nedzarici" and in Tuzla at the Elementary School "Centar": All respondents were examined individually in a separate room and in a pleasant environment.

Measuring instruments

One of the more complex scales ("C1") within the LNNB-C battery was used to assess motor functions (Golden, 1987). According to the instructions for use of the LNNB-C Battery, it is intended that each of the answers to individual tasks be scored in the following way: grade 0 indicates a normally developed function; grade 1 indicates marginally developed function; grade 2 indicates a pathologically developed function.

Data processing methods

After the research, the obtained data was processed with the computer program for statistics SPSS 16.0 for the Microsoft Windows operating system. Univariate and multivariate statistical methods were used in the statistical data processing, in accordance with the defined research objectives. Basic statistical parameters were calculated: minimum and maximum results, arithmetic mean and standard deviation. The distribution of respondents according to the test results is presented in frequencies. To determine the significance of the differences, a t-test, univariate analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA) were used. Discrimination analysis was used to determine the factor of differences between the examined groups.

RESEARCH RESULTS

Table 1 shows the results of respondents with visual impairment on motor skills variables. On the motor speed and dexterity variable (items 1-3), the average achievement was 1.34 and the standard deviation was 1.71. For the kinesthesia-based movements (items 4-7) variable, the arithmetic mean was 0.23 with a standard deviation of 0.94. For the copying the position according to the given model in space (items 8-10) variable, the arithmetic mean was 0.57 and the standard deviation was 0.95. For the knowledge of the final level of experiencing bodily wholeness (items 11-14)variable, the average achievement was 1.94 and the standard deviation was 2.86. For the variable of alternating alternative activity within the melokinetic apraxia based on the evaluation of dynamic organization (items 15-17), the arithmetic mean was 2.23 and the standard deviation was 2.22. For the presence/absence of motoric perseverations (item 18) variable, the arithmetic mean was 0.86 and the standard deviation was 1.00. For the oral motor variable (items 19 and 20), the arithmetic mean was 0.17 and the standard deviation was 0.75. For the drawing quality (items 23, 25, 27, 29, 31) variable, the arithmetic mean was 7.46 and the standard deviation was 3.87. For the variable drawing speed (items 22, 24, 26, 28, 30 and 32), the arithmetic mean was 4.40 with a standard deviation of 4.69. 0.51 with a standard deviation of 0.89. The arithmetic mean, which points out the development of motor functions as a whole, is 19.71 with a standard deviation of 13.20.

Table 1. Results of respondents with visual impairment on variables of motor skills

Variable	N	min	max	$\overline{X}$	SD
motor speed and dexterity	35	0	6	1.34	1.71
movements based on kinesthesia	35	0	4	0.23	0.94
copying the position according to the given model in space	35	0	3	0.57	0.95
knowledge of the final level of experiencing bodily wholeness	35	0	8	1.94	2.86
alternating alternative activities	35	0	6	2.23	2.22
presence/absence of motor perseverations	35	0	2	0.86	1.00
oral motor skills	35	0	4	0.17	0.75
drawing quality	35	0	12	7.46	3.87
drawing speed	35	0	12	4.40	4.69
coordinating movements according to a verbal command	35	0	3	0.51	0.89
motor skills in total	35	1	45	19.71	13.20

As can be seen from the above, different areas contain a different number of items and the ranges of the scales are not the same. For this reason, the scores were transposed to a common scale with a range of 0 to 24 points. This way, a ranking list of the development of motor functions was obtained. The obtained results are shown in table 2. Considering the development of respondents with visual impairment, we can conclude that there are 6 groups of motor functions. The first group consists of movements based on kinesthesia and oral motor skills. The second group consists of copying positions and coordinating movements according to a verbal order. The third group consists of motor speed and dexterity and knowledge of the final level of experiencing bodily wholeness. The fourth group consists of drawing speed and alternating alternative activities. The presence/absence of motor perseverations constitutes the fifth group. The quality of drawing is in the sixth group and it is the least developed motor function.

Table 2. Ranking list of the development of motor functions in respondents with visual impairment

Rank	Motor functions	$\overline{X}$
1.	movements based on kinesthesia	0.69
2.	oral motor skills	1.03
3.	copying positions	2.29
4.	coordinating movements according to a verbal command	2.66
5.	motor speed and dexterity	5.37
6.	knowledge of the final level of physical integrity	5.83
7.	drawing speed	8.80
8.	alternating alternative activities	8.91
9.	presence/absence of motor perseverations	10.29
10.	drawing quality	14.91

Table 3 shows the average achievements of respondents with no visual impairment on motor skills variables. For the motor speed and dexterity variable, an arithmetic mean of 0.71 points with a standard deviation of 1.32 was achieved. For the variable movements based on kinesthesia, the average score was 0.11 and the standard deviation was 0.68. For the variable position copying, the average score was 0.66 and the standard deviation was 1.16. For the variable knowledge of the final level of physical integrity, the arithmetic mean was 3.06, with a standard deviation of 1.98. For the alternating alternative activity variable, the arithmetic mean was 1.23 and the standard deviation was 1.31. For the variable presence/absence of motor perseverations, the arithmetic mean was 0.57 and the standard deviation was 0.92. For the oral motor skills variable, the arithmetic mean was 0. For the drawing quality variable, the arithmetic mean was 2.74 with a standard deviation of 2.34. For the drawing speed variable, the arithmetic mean was 1, with a standard deviation of 1.88. For the variable matching movements according to the verbal command, the arithmetic mean was 0.29, with a standard deviation of 0.52. For motor skills as a whole, the arithmetic mean was 10.37 and the standard deviation was 5.5.

Table 3. The results of respondents without impaired vision on motor skills variables

Variable	N	min	max	$\overline{X}$	SD
motor speed and dexterity	35	0	5	0.71	1.32
movements based on kinesthesia	35	0	4	0.11	0.68
position copying	35	0	4	0.66	1.16
knowledge of the final level of physical integrity	35	0	7	3.06	1.98
alternating alternative activities	35	0	5	1.23	1.31
Presence/absence of mot. pres.	35	0	2	0.57	0.92
oral motor skills	35	0	0	0.00	0.00
drawing quality	35	0	8	2.74	2.34
drawing speed	35	0	8	1.00	1.88
coordinating movements according to a verbal command	35	0	2	0.29	0.52
motor skills in total	35	3	27	10.37	5.50

Table 4 shows the differences in the motor functions of children with no visual impairment and visually impaired children. On the oral motor skills variable, it was not possible to determine the significance of differences in arithmetic means because there is no variance. On the variables of alternating alternative activity, quality of drawing, speed of drawing and motor skills, a statistically significant statistical difference between the arithmetic means was achieved (p<0.05). Respondents with no visual impairment on these variables have better developed motor functions than respondents with visual impairment. There are no statistically significant differences in the variables motor speed and dexterity, movements based on kinesthesia, copying of positions, knowledge of the final level of integrity, presence/absence of motor perseverations, coordination of movements according to verbal orders. A significant correlation at the 0.01 level was achieved for the variables drawing quality and drawing speed. There is a statistically significant mean correlation between the development of motor functions as a whole (r=-0.39). There were no statistically significant correlations on the other variables.

Table 4. Differences in the motor functions between respondents without visual impairment and respondents with visual impairment

Variable	Without visual impairment (N=35)		With visual impairment (N=35)		t	p_{sig}	r_s	p_{sig}
	$\overline{X}$	SD	$\overline{X}$	SD				
motor speed and dexterity	0.71	1.32	1.34	1.71	-1.72	0.09	-0.23	0.06
movements based on kinesthesia	0.11	0.68	0.23	0.94	-0.58	0.56	-0.07	0.56
position copying	0.66	1.16	0.57	0.95	0.34	0.74	-0.01	0.97
knowledge of the final level of physical integrity	3.06	1.98	1.94	2.86	1.89	0.06	0.23	0.06
alternating alternative activities	1.23	1.31	2.23	2.22	-2.29	**0.03**	-0.18	0.13
presence/absence of mot. pres.	0.57	0.92	0.86	1.00	-1.24	0.22	-0.15	0.22
oral motor skills	0.00	0.00	0.17	0.75	no variance		-0.17	0.16
drawing quality	2.74	2.34	7.46	3.87	-6.17	**0.00**	-0.60	**0.00****
drawing speed	1.00	1.88	4.40	4.69	-3.99	**0.00**	-0.34	**0.00****
coordinating movements according to a verbal command	0.29	0.52	0.51	0.89	-1.32	0.19	-0.10	0.44
motor skills in total	10.37	5.50	19.71	13.20	-3.87	**0.00**	-0.39	**0.00****

*correlation significant at the significance level 0,05
** correlation significant at the significance level 0,01
It is not possible to determine the significance of the differences of the arithmetic means because there is no variance for the variables:

- Oral motor skills (λ^2=2,06; p=0,36), It can be seen that respondents without visual impairment achieved better average results on motor functions than respondents with visual impairment. Respondents without visual impairment have more harmoniously developed motor functions than respondents with visual impairment. In order to examine the differences between respondents with and without visual impairment in the space of 10 variables that determine motor abilities, a discriminant analysis was applied (table 5). Multivariate analysis of variance revealed that Wilks' lambda is statistically significant for the first discrimination function ($p<0.05$). A univariate analysis of variance (ANOVA) was performed for individual variables of motor abilities, and the results indicate that there are statistically significant differences between respondents with and without visual impairment on the following variables: "drawing quality", "drawing speed" and "alternating alternative activities" where respondents without visual impairment achieved statistically significantly better results. The variable "drawing quality" (c=1.067; r=0.630) contributes the most to the discrimination of groups of respond ents. The square of the canonical correlation indicates that the variables of motor skills can, with approximately 59% certainty, classify the respondents into two categories of the criterion variable related to the presence/absence of visual impairment. Therefore, in addition to visual impairment, there are 41% of other factors that could affect the motor skills of the respondents, but which were beyond the scope of the variables of this research.

Table 5. Analysis of variance and discriminant analysis of motor ability variables between respondents with and without visual impairment

Funktion	**Canonical correlation**	**Wilks' λ**	**χ^2**	**df**	**p**
1	0.765	0.415	55.345	10	**0.000**

	Funktion 1		**ANOVA**	
	c	**r**	**F**	**p**
Drawing quality	1.067	0.630	38.033	**0.000**
Drawing speed	0.447	0.407	15.878	**0.000**
Alternating alternative activities	-0.123	0.234	5.258	**0.025**
Knowledge of the final level of physical integrity	-0.732	-0.194	3.588	0.062
Motor speed and dexterity	-0.069	0.176	2.957	0.090
Oral motor skills	0.133	0.139	1.843	0.179
Coordination of movements according to verbal command	0.478	0.135	1.732	0.193
Presence/absence of motor perseverations	-0.446	0.127	1.545	0.218
Movements based on kinesthesia	-0.048	0.060	0.340	0.562
Position copying	-0.615	-0.035	0.114	0.736

DISCUSSION

Based on the results obtained on the motor skills of visually impaired respondents, it can be observed that the best developed motor functions related to movements based on kinesthesia are oral motor skills, and the least developed motor function is the quality of drawing. Motor functions copying the position of objects according to a given model, coordinating movements according to a verbal command, motor speed and dexterity, and knowledge of the final level of body integrity at the level of execution of crossed motor commands are moderately developed motor functions. The results of the assessment of the development of motor functions in respondents without visual impairment and respondents with visual impairment indicate that motor functions are generally better developed in respondents without visual impairment. Differences in arithmetic means are significant at the 0.01 level, as is the correlation coefficient. Also, for all other variables that examine motor skills, respondents without visual impairment achieved better results, and a statistically significant difference in arithmetic means as well as correlation was achieved for the variables quality and speed of drawing. Respondents without visual impairment achieved better results for most motor skills variables skills compared to respondents with visual impairment. The largest difference in mean values was for the variable “drawing quality” (4.714), and the smallest for the variable “position copying” (0.086). For the variables “position copying” and “knowledge of the final level of physical integrity”, better results were achieved by the visually impaired respondents, but the differences were not statistically significant. Pavlovic (1987) applied the Ozeretzki motor test to a sample of 80 school children, chronologically aged 6-11 years (40 children with impaired vision and 40 children with no visual impairment). The author concluded that visually impaired children showed a significantly lower motor ability compared to children without visual impairment in the overall motor quotient (general motor ability) and on all dimensions of psychomotor space. Levitzon-Korach et al. (2000) examined the characteristics of motor development in a sample of 40 blind children in Israel aged up to 5 years, compared to children without visual impairment. A measuring instrument called “Bayley Developmental Scale” was used for a certain chronological age. The following motor skills were tested: rolling, crawling, standing independently, sitting, walking with the help of others, walking independently, climbing stairs with someone’s help, standing on one leg, hopping with both legs, and walking up stairs without anyone’s help. The examination led to the conclusion that blind children show statistically significant differences in all 10 examined motor skills (abilities). In 2009, Radzo Alibegovic and Jablan conducted research whose goal was to examine the difference in motor skills between children without impaired vision and children with impaired vision. 58 children between the ages of 6 and 15 were tested, of which 29 were visually impaired and 29 with no visual impairment. Psychomotor abilities were assessed using the Ozeretzki test. Using the t-test, it was determined that there are significant differences in motor skills between children with impaired vision and children without impaired vision, that is, that children without visual impairment achieved better results in motor skills than children with impaired vision. Webber et al. (2008) conducted research on the impact of amblyopia on fine motor skills in visually impaired children. 82 children aged 8-16 years were examined with the Bruininks-Oseretsky motor test. They came to the conclusion that fine motor skills were improved in children with visual impairment compared to the control group without visual impairment. The biggest differences were achieved on tasks requiring manual skills related to speed and precision. Troster, Hecker, and Brambing (1993) compared motor development in blind infants and infants without visual impairment. The study included 24 blind babies, but 10 of them were born prematurely so they were not taken into account in the study. The obtained results showed that blind children lag behind in locomotor activities such as crawling, walking while holding on with their hands.

CONCLUSION

Examining the differences in the development of motor functions between respondents without visual impairment and respondents with visual impairment, it was determined that motor functions were generally better developed in respondents with no visual impairment. Differences in arithmetic means are significant at the 0.01 level, as is the correlation coefficient. Also, on all other variables that examine motor skills, respondents without visual impairment achieved better results, but these differences are not statistically significant. Statistically significant difference of arithmetic means as well as correlation was achieved for the quality and speed of drawing variables.

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