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VISUAL-SPATIAL PERCEPTION AND VISUAL-MOTOR COORDINATION IN STUDENTS WITH HEARING IMPAIRMENTS

VIZUELNO-PROSTORNA PERCEPCIJA I VIZUELNO-MOTORIČKA KOORDINACIJA KOD UČENIKA S OŠTEĆENJEM SLUHA

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ABSTRACT

This paper defines the concepts of visual-spatial perception, visual-motor coordination, and hearing impairment. The aim of the study was to examine the characteristics of visual-spatial perception and visual-motor coordination in students with hearing impairments in comparison to their hearing peers. The research also explored whether these abilities vary depending on the degree of hearing loss and aimed to identify the factors that influence them.
The Diagnostic Kit for Assessing Speech, Language, Reading, and Writing Abilities in Children – Diagnostic Material for Identifying Specific Difficulties in Reading and Writing (Bjelica-Posokhova, 2001) was used, with a focus on variables related to visual-spatial perception and visual-motor coordination. Descriptive statistics, optimal scaling regression, and linear regression analyses were used for data processing.
The findings indicate that hearing students achieved statistically significantly better outcomes in both visual-spatial perception and visual-motor coordination compared to students with hearing impairments. Age, degree of hearing loss, educational conditions, and gender did not influence visual-spatial perception in students with hearing impairments. However, educational conditions and the degree of hearing loss did influence visual-motor coordination, while gender and age did not. Understanding how hearing impairment affects visual-spatial perception and visual-motor coordination is essential for the education and rehabilitation of children with hearing loss. These children may experience different developmental patterns in visual-motor and visual-spatial abilities, which can impact their daily functioning and academic performance. Rehabilitation and educational strategies should aim to integrate all sensory inputs to foster the development of adequate visual-spatial and visual-motor skills.

Key words: visual-spatial perception, visual-motor coordination, hearing impairment

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SAŽETAK

Definisani su pojmovi vizuo-prostorna percepcija, vizuo-motorna koordinacija i oštećenje sluha. Cilj istraživanja je bio ispitati karakteristike vizuo-prostorne percepcije i vizuo-motorne koordinacije kod učenika oštećena sluha u odnosu na čujuće učenike, ispitati da li postoji razlika u ovim vještinama u odnosu na kvalitet sluha, te utvrditi faktore koji utiču na iste.
Za procjenu je korišten Dijagnostički komplet za ispitivanje sposobnosti govora, jezika, čitanja i pisanja u djece – Dijagnostički materijal za otkrivanje specifičnih teškoća u čitanju i pisanju (Bjelica-Posokhova, 2001), varijable koje se odnose na vještine vizuo-prostorne percepcije i vizuo-motorne koordinacije. Za statističku obradu podataka je korištena deskriptivna statistika, regresijska analiza optimalnog skaliranja i linearna regresijska analiza.
Rezultati pokazuju da čujući ispitanici ostvaruju statistički značajno bolje rezultate u vizuo-prostornoj percepciji i vizuo-motornoj koordinaciji u usporedbi s ispitanicima s oštećenjem sluha. Uzrast, stepen oštećenja sluha, uslovi školovanja i spol ne utiču na vizuo-prostornu percepciju osoba oštećena sluha. Uslovi školovanja i stepen oštećenja sluha utiču na vizuo-motornu koordinaciju osoba oštećena sluha, dok spol i uzrast ispitanika nemaju uticaja na istu
Razumijevanje uticaja oštećenja sluha na vizuo-prostornu percepciju i vizuo-motornu koordinaciju ključni su aspekti u obrazovanju i rehabilitaciji djece s oštećenjem sluha. Djeca oštećena sluha mogu imati drugačiji razvoj vizuo-motornih i vizuo-prostornih sposobnosti, što se odražava na njihovo svakodnevno funkcionisanje i, obrazovanje. U radu s djecom oštećena sluha, rehabilitacija i obrazovni pristupi trebaju biti usmjereni na integraciju svih osjetilnih informacija, kako bi se pomoglo djeci u razvoju adekvatnih vizuoprostornih i vizuomotornih vještina.

Ključne riječi: vizuo-prostorna percepcija, vizuo-motorna koordinacija, oštećenje sluha

INTRODUCTION

Visual-spatial perception is a component of cognitive functioning that refers to the ability to process and interpret visual information about the location and spatial relationships of objects in the environment. It is primarily based on visual perception - how the brain interprets, analyzes, and assigns meaning to what we see. Visual perception can be examined through several components: visual-spatial relationships, visual discrimination, shape constancy, visual closure, figure-ground differentiation, visual memory, and visual sequential memory (Jaiswal, 2016). Categories that contribute to the development of visual perception include: Sensory processing – accurate registration, interpretation, and response to sensory input from both the child's environment and their own body; Visual attention – the ability to focus on relevant visual stimuli while filtering out irrelevant background information; Visual discrimination – the ability to detect differences or similarities in objects based on characteristics such as size, color, and shape; Visual memory – the ability to recall visual features of objects or shapes; Visual-spatial relationships – understanding the position and orientation of objects in space; Visual sequential memory – the ability to remember a sequence of visual stimuli in the correct order; Figure-ground differentiation – the ability to distinguish an object from its background; Form constancy – the recognition that shapes

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remain the same even when resized or rotated; Visual closure – the ability to identify an object or shape when parts of it are missing (Butterfield, 1986). In children, visual perception involves skills such as: eye-hand coordination, shape recognition and differentiation, accurate tracking of patterns and lines, identifying the position and orientation of objects in space, distinguishing figures from the background, comparing object characteristics (similarities and differences), recognizing objectss regardless of position, and identifying objects in incomplete images. This supports the conclusion that perception and motor development are closely connected (Teodorović et al., 1997). Visual-motor coordination refers to the ability to synchronize visual information with body movements (APA, 2018). It encompasses motor control, precision, coordination, and psychomotor speed. In essence, it is the integration of visual "input" with motor "output" (Sanghavi & Kelkar, 2005). This coordination involves multiple systems: Motor processes - involving the eyes, head, and hands; Sensory systems - including visual, vestibular, and somatosensory components; Internal representation - of sensory perception and motor actions; Higher-order processes - that support adaptive motor behavior. Visual-motor coordination improves as a result of a child's neuromotor and sensorimotor development, as well as through learning and practice (Bavčević et al., 2019). The link between perceptual-motor abilities and graphomotor skills is particularly evident in a child's readiness for writing (Beery, 1989; cited in Kaiser, Albaret & Doudin, 2009). From a developmental standpoint, visual-motor integration and eye-hand coordination are prerequisites for writing. To acquire writing skills, a child must coordinate visual input with fine motor control. This can be observed in activities such as tracing lines (a sign of visual-motor coordination), and in writing or copying words and shapes (a reflection of visual-motor integration) (Davis & Matthews, 2010). Therefore, assessing visual-motor coordination offers valuable insight into a child's overall psychomotor development (Škrbina & Šimunović, 2004). Hearing impairment is defined as the partial or complete inability to receive, conduct, or register auditory stimuli, caused by congenital or acquired damage, underdevelopment, or reduced function of the auditory organ, auditory nerve, or auditory centers in the brain (Dulčić & Kondić, 2002). According to the World Health Organization (WHO, 2008), hearing impairment is considered present in adults when hearing loss of 40 dB or more is detected in the better-hearing ear, and in children when hearing loss reaches 30 dB in the better ear. The WHO classification defines the degrees of hearing loss as follows: mild hearing loss, corresponding to an audiometric ISO value of 26 to 40 dB in the better hearing ear; moderate hearing loss, corresponding to an audiometric ISO value of 41 to 60 dB in the better hearing ear; severe hearing loss, corresponding to an audiometric ISO value of 61 to 80 dB in the better hearing ear; profound hearing loss, including practical deafness, corresponding to an audiometric ISO value of 81 dB or more in the better hearing ear. Hearing impairments are generally classified into deafness and hearing loss. Children with hearing loss of 80 dB or more who are unable to perceive speech even with hearing aids are considered deaf. Children with hearing loss between 25 and 80 dB, whose speech is partially or fully developed, are considered hard of hearing (Huremović et al., 2025). Hearing impairment affects not only speech and language development but also broader cognitive processes and overall functioning. It significantly impacts listening and verbal communication abilities and may also indirectly affect other cognitive functions, such as visual-spatial perception and visual-

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motor coordination. Although most research has focused on the communicative and linguistic consequences of hearing loss, the impact on motor and perceptual abilities is gaining increasing attention. Horn, Davis, Pisoni, and Miyamoto (2004) explored the predictive role of visuomotor integration abilities before cochlear implantation and their relationship to later speech development in prelingually deaf children. They found that individual differences in visuomotor skills were predictive of specific audiological outcomes in children with cochlear implants Later, Horn, Fagan, Dillon, Pisoni, and Miyamoto (2007) concluded that early auditory and language experiences influence the development of visual-motor integration. In other words, visuomotor abilities before implantation can serve as predictors of post-implantation speech and language outcomes in deaf children. In this context, the main aim of this research is to examine the characteristics of visual-spatial perception and visual-motor coordination in children with hearing impairments - to determine whether these abilities vary based on the degree of hearing loss, and to identify the factors that influence them.

MATERIAL AND METHODS

Sample of participants

The study sample consisted of 62 students aged 6 to 11 years, divided into two groups. The experimental group included 31 students with hearing impairments, of whom 21 (67.7%) were female and 10 (32.3%) were male. The control group also included 31 students without hearing impairments, with 19 (61.3%) female and 12 (38.7%)male participants.

Table 1. Structure of participants by gender

Gender		n	%
Experimental group	Female	21	67.7
	Male	10	32.3
	Total	31	100.0
Control group	Female	19	61.3
	Male	12	38.7
	Total	31	100.0
Total		62	100.0

In the experimental group, 7 participants (22.6%) were 6 years old, 7 participants (22.6%) were 7 years old, 2 participants (6.5%) were 8 years old, 4 participants (12.9%) were 9 years old, 4 participants (12.9%) were 10 years old, and 7 participants (22.6%) were 11 years old.
In the control group, 6 participants (19.4%) were 6 years old, 10 participants (32.3%) were 7 years old, 11 participants (35.5%) were 8 years old, 2 participants (6.5%) were 9 years old, and 2 participants (6.5%) were 10 years old.

Table 2. Structure of participants by age

Group	Age	n	%
Experimental	6	7	22.6
	7	7	22.6
	8	2	6.5
	9	4	12.9
	10	4	12.9
	11	7	22.6
	Total	31	100.0
Control	6	6	19.4
	7	10	32.3
	8	11	35.5
	9	2	6.5
	10	2	6.5
	Total	31	100.0
Total		62	100.0

From Table 3, it can be seen that among the 31 participants with hearing impairment, 21 (67.7%) had severe hearing loss, while 10 (32.3%) were totally deaf. All participants experienced prelingual hearing impairment, occurring before the acquisition of speech and language. Furthermore, 28 participants (90.3%) were educated in homogeneous settings, whereas 3 participants (9.7%) attended heterogeneous educational settings.

Table 3. Demographic characteristics of participants with hearing impairment

Variable	f	%
Group		
Experimental	31	50
Control	31	50
Degree of hearing impairment		
Severe hearing loss	21	67.7
Total deafness	10	32.3
Time of onset of hearing impairment		
Prelingual	31	100
Gender of participants		
Female	21	67.7
Male	10	32.3
Educational conditions		
Homogeneous	28	90.3
Heterogeneous	3	9.7

Method of conducting research

The research was carried out at the Public Institution Centre for Hearing and Speech Rehabilitation in Sarajevo and at the Audiology Department of the University Clinical Centre Tuzla. Prior to data collection, necessary preparations were made. The procedures required by

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the Ethics Committee of the University Clinical Centre Tuzla were strictly followed, and informed consent was obtained from the parents, in which the examination methods and data collection procedures concerning the participants were clearly explained. Additionally, approval for conducting the scientific research project at the Public Institution Centre for Hearing and Speech Rehabilitation in Sarajevo was granted by the Ministry of Education of the Sarajevo Canton. Parental consent was also obtained for the examination of children attending regular schools. Data were collected through direct contact with the participants.

Measuring instruments

For assessment, the Diagnostic Kit for Examining Speech, Language, Reading, and Writing Abilities in Children – Diagnostic Material for Identifying Specific Difficulties in Reading and Writing (Bjelica-Posokhova, 2001) was used, with a focus on variables related to visual-spatial perception and visual-motor coordination skills.

Data processing methods

In the statistical analysis, descriptive statistics, the Mann-Whitney U test, measures of central tendency, and measures of dispersion were employed. To assess the normality of the data distribution, the Kolmogorov-Smirnov and Shapiro-Wilk tests were applied. Nonparametric methods were used for hypothesis testing. To examine the influence of predictor variables on criterion variables, as well as the effects of independent variables on dependent variables, optimal scaling regression analysis and linear regression analysis were performed. Data preparation and storage for statistical analysis were conducted using MS Excel 2019, while data processing was carried out with IBM SPSS Statistics version 25.0. The results are presented in tables and graphs.

RESULTS AND DISCUSSION

Results of descriptive statistics and the Mann-Whitney U test on Variables of Visual-spatial perception

Table 4 presents the distribution of participants' scores on the "figure construction" subtest. The results of cross-tabulations, showing the relationships between the observed variables, are also included. According to Table 5, within the experimental group of 31 participants, 11 (35.5%) scored 3 points, 9 (29%) scored 2 points, and 11 (35.5%) scored 0 points. All participants in the control group (hearing students) scored 3 points on this subtest.

Table 4. Distribution of participants' results on the "figure construction" subtest

Figure construction		Score			Total
		0	2	3	
Experimental group	N	11	9	11	31
	%	35.5	29.0	35.5	100
Control group	N	0	0	31	31
	%	0	0	100	100
Total	N	11	9	42	62
	%	17.7	14.5	67.7	100

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Table 5 shows the distribution of participants' scores on the "verbalization of spatial relations" subtest. The results indicate that in the experimental group, 6 participants (19.4%) scored 3 points, 1 participant (3.2%) scored 2 points, 4 participants (12.9%) scored 1 point, and 20 participants (64.5%) scored 0 points. All participants in the control group scored 3 points on this subtest.

Table 5. Distribution of participants' results on the "verbalization of spatial relations" subtest

Verbalization of spatial relations		Score				Total
		0	1	2	3	
Experimental group	N	20	4	1	6	31
	%	64.5	12.9	3.2	19.4	100
Control group	N	0	0	0	31	31
	%	0	0	0	100	100
Total	N	20	4	1	37	62
	%	32.3	6.5	1.6	59.7	100

Table 6 presents the results of descriptive statistics for the variables related to visual-spatial perception. The arithmetic mean for participants with hearing impairment on the "figure construction" subtest is 1.65, with a standard deviation of 1.31, a median of 2, and a mode of 0; the scores range from a minimum of 0 to a maximum of 3. On the "verbalization of spatial relations" subtest, participants with hearing impairment achieved an average score of 0.77, with a standard deviation of 1.20, a median and mode of 0, and scores ranging from 0 to 3. The overall average score for participants with hearing impairment on the visual-spatial perception variable is 2.42, with a standard deviation of 2.11. For the control group, the arithmetic mean on both subtests reached the maximum score of 3, resulting in an overall mean of 6 for the visual-spatial perception variable.

Table 6. Results of descriptive statistics on variables of visual-spatial perception

Variable	Group	AS	SD	SG	MED	MOD	MIN	MAX
Figure construction	Experimental	1.65	1.31	0.23	2.00	0.00	0	3
	Control	3.00	0.00	0.00	3.00	3.00	3	3
Verbalization of spatial relations	Experimental	0.77	1.20	0.22	0.00	0.00	0	3
	Control	3.00	0.00	0.00	3.00	3.00	3	3
Total	Experimental	2.42	2.11	0.38	3.00	0.00	0	6
	Control	6.00	0.00	0.00	6.00	6.00	6	6

In addition to measures of central tendency and dispersion, the normality of the data distribution was examined. Based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests (Table 7), it was concluded that the data do not follow a normal distribution. Therefore, the Mann-Whitney U test was used to test the stated hypothesis.

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Table 7. Examination of the normality of the distribution of participants' results on variables of visual-spatial perception

Variable	Kolmogorov-Smirnov			Shapiro-Wilks		
	KS	Df	P	SW	Df	P
Visual-spatial perception	.34	62	.000	.72	62	.000

Based on the results presented in Table 8, it can be concluded that hearing participants achieved significantly better scores in visual-spatial perception compared to participants with hearing impairments, with a statistical significance level of 0.01 (Z = -6.53; p < 0.001).

Table 8. Results of Mann-Whitney U test on variables of visual-spatial perception

Variable	Group	N	Average range	Total range	Z	P
Visual-spatial perception	Experimental	31	18.00	558.00	-6,53	.000
	Control	31	45.00	1395.00		
	Total	62				

Assessment of Visual-Motor Coordination

Table 9 shows the distribution of participants' scores on the "spatial orientation" subtest. The results of cross-tabulations, illustrating the relationships between the observed variables, are presented. According to Table 10, out of 31 participants with hearing impairment, 12 (38.7%) scored 3 points, 6 (19.4%) scored 2 points, 1 (3.2%) scored 1 point, and 12 (38.7%) scored 0 points. All participants in the control group (hearing students) scored 3 points on this subtest.

Table 9. Distribution of participants' results on the "spatial orientation" subtest

Spatial orientation		Score				Total
		0	1	2	3	
Experimental group	n	12	1	6	12	31
	%	38.7	3.2	19.4	38.7	100
Control group	n	0	0	0	31	31
	%	0	0	0	100	100
Total	n	12	1	6	43	62
	%	19.4	1.6	9.7	69.4	100

Table 10 shows the distribution of participants' scores on the "copying figures" subtest. The results indicate that among participants with hearing impairment, 6 (19.4%) scored 3 points, 8 (25.8%) scored 2 points, 9 (29.0%) scored 1 point, and 8 (25.8%) scored 0 points. All participants in the control group scored 3 points on this subtest.

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Table 10. Distribution of participants' results on the "copying figures" subtest

Copying figures		Score				Total
		0	1	2	3	
Experimental group	n.	8	9	8	6	31
	%	25.8	29.9	25.8	19.4	100
Control group	n	0	0	0	31	31
	%	0	0	0	100	100
Total	n.	8	9	8	37	62
	%	12.9	14.5	12.9	59.7	100

Table 11 presents the results of descriptive statistics for the visual-motor coordination variables. The average score of participants with hearing impairment on the "spatial orientation" subtest was 1.58 (SD = 1.36), with a median of 1 and a mode of 0. On the "copying figures" subtest, the average score was 1.39 (SD = 1.09), with both the median and mode equal to 1. The total average score for visual-motor coordination among participants with hearing impairment was 2.97 (SD = 2.45), with a median of 3 and a mode of 1. In contrast, hearing participants scored the maximum of 3 on each subtest, resulting in an overall average of 6 for visual-motor coordination.

Table 11. Results of descriptive statistics on the variables of visual-motor coordination

Variables	Group	AS	SD	SG	MED	MOD	MIN	MAX
Spatial orientation	Experimental	1.58	1.36	0.24	2.00	0.00	0.00	3.00
	Control	3.00	0.00	0.00	3.00	3.00	3.00	3.00
Copying figures	Experimental	1.39	1.09	0.19	1.00	1.00	0.00	3.00
	Control	3.00	0.00	0.00	3.00	3.00	3.00	3.00
Visual-motor coordination	Experimental	2.97	2.45	0.43	3,00	1.00	0.00	6.00
	Control	6.00	0.00	0.00	6.00	6.00	6.00	6.00

In addition to measures of central tendency and dispersion, the normality of the data distribution was examined. Based on the results presented in Table 12, it was concluded that the data do not follow a normal distribution. Therefore, the Mann-Whitney U test was applied to test the stated hypothesis.

Table 12. Examination of the normality of the distribution of participants' results on the variables of visual-motor coordination

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	KS	Df	P	SW	Df	P
Visual-motor coordination	.32	62	.000	.74	62	.000

Table 13 presents the results of the Mann-Whitney U test for the variable of visual-motor coordination. Based on the obtained results, it can be concluded that hearing participants achieved significantly better scores in visual-motor coordination compared to participants with hearing impairments, with a statistical significance level of 0.01 ($Z = -6.70$; $p < 0.001$).

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Table 13. Results of the Mann-Whitney U test on the variable of visual-motor coordination

Variable	Group	n	Average range	Sum of ranges	Z	P
Visual-motor coordination	Experimental	31	17.50	542.50	-6.70	.000
	Control	31	45.50	1410.50		
	Total	62				

The impact of the Degree of Hearing Impairment, Time of Onset, Age, Gender, and Educational Conditions on the visual-spatial perception and visual-motor coordination of students with hearing impairment

To examine the influence of the degree of hearing impairment, time of onset of hearing impairment, age, gender, and educational conditions on visual-spatial perception and visual-motor coordination in students with hearing impairments, optimal scaling regression analysis was applied. The predictor (independent) variables included the degree of hearing impairment, gender, and educational conditions, while the dependent variables were the overall scores in visual-spatial perception and visual-motor coordination.

The time of onset of hearing impairment was excluded from the analysis as a predictor variable due to its uniformity across participants—all participants had prelingual hearing loss. Furthermore, age was not used as a predictor variable in the optimal scaling regression, as it is a continuous variable. Optimal scaling requires nominal or ordinal predictors; thus, age was instead included as a predictor in the linear regression analysis, where continuous variables are appropriate. Table 14 presents the results of the regression analysis, indicating the effect of the predictor system on the criterion variables. As shown in the table, gender, degree of hearing impairment, and educational conditions, as a combined predictor system, do not have a statistically significant effect on visual-spatial perception (F = 0.25; p = 0.948) or visual-motor coordination (F = 1.81; p = 0.157).

Table 14. Results of the regression analysis: the impact of the system of predictors on the criterion variables

Model	Sum of squares	Df	Mean sum of squares	F	P
Regression	2.08	6	.34	.25	.948
Residual	18.91	14	1.35		
Total	21.00	20			
R= 0,31; R^2= 0,09; adjusted R^2= -0,27 (Dependent variable “Visual-spatial perception”.)					
Regression	9.35	6	1.55	1.81	.157
Residual	14.64	17	.86		
Total	24.00	23			
R= 0,62; R^2= 0,39; adjusted R^2= 0,17 (Dependent variable “Visual-motor coordination”)					

Table 15 presents the results showing the effect of individual independent variables—degree of hearing impairment, gender, and educational conditions—on the dependent variable *visual-spatial perception*. The results indicate that none of the independent variables have a statistically significant effect on visual-spatial perception scores.

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Table 15. The effect of independent variables on the dependent variable visual-spatial perception

Variables	Beta	Df	F	P
Degree of hearing impairment	.30	2	1.39	.28
Gender	.05	2	.09	.90
Educational conditions	.14	2	1.50	.25

Table 16 presents the effect of independent variables on the dependent variable *visual-motor coordination*. It can be observed from the table that the degree of hearing impairment and educational conditions have a statistically significant effect on visual-motor coordination at the 0.05 significance level.

Table 16. The effect of independent variables on the dependent variable visual-motor coordination

Variables	Beta	Df	F	P
Degree of hearing impairment	.53	2	10.91	.001
Gender	.16	2	1.21	.322
Educational conditions	.38	2	5.12	.018

Table 17 presents the effect of age as a predictor on the criterion variables *visual-spatial perception* and *visual-motor coordination*. The results indicate that age does not have a statistically significant effect on visual-spatial perception (F = 0.18; p = 0.895) or visual-motor coordination (F = 0.39; p = 0.537). Furthermore, based on the coefficient of determination (R^2), only 1% of the variance in the criterion variables is explained by age, suggesting a very weak causal relations.

Table 17. The effect of age on visual-spatial perception and visual-motor coordination

Model	Sum of squares	Df	Mean sum of squares	F	P
Regression	.081	1	.081	.018	.895
Residual	133.467	29	4.602		
Total	133.548	30			
R= 0,02; R^2= 0,01; adjusted R^2= -0,03 (Dependent variable "Visual-spatial perception")					
Regression	1.558	1	1.558	.390	.537
Residual	115.861	29	3.995		
Total	117.419	30			

R= 0,11; R^2= 0,01; adjusted R^2= -0,02 (Dependent variable "Visual-motor coordination")

CONCLUSION

The results of the study showed a significant difference in visual-spatial perception and visual-motor coordination between participants with hearing impairment and hearing participants, in favor of the hearing participants. According to our findings on the "figure construction" and "verbalization of spatial relations" subtests, which assess visual-spatial perception, participants with hearing impairment scored lower compared to hearing participants. The degree of hearing impairment, educational conditions, and gender did not significantly affect the visual-spatial perception of individuals with hearing impairment. On the "spatial orientation" and "copying figures" subtests, which assess visual-motor coordination, participants with hearing impairment also scored lower than hearing participants. Educational conditions and the degree of hearing impairment affected the visual-motor coordination of individuals with hearing impairment, while gender had no significant effect. Age had a very minor influence on both abilities.

Understanding the impact of hearing impairment on visual-spatial perception and visual-motor coordination is a key aspect of the education and rehabilitation of children with hearing impairments. Most research indicates that children with hearing impairments may experience different development of visual-motor and visual-spatial abilities, which affects their daily functioning, education, and language development. Due to reduced reliance on auditory information, children with hearing impairment often depend more on visual information for spatial orientation, which can lead to different developmental patterns compared to hearing children. Skills such as hand-eye coordination, precision, and the ability to interpret spatial relationships form the foundation for many other cognitive functions. Therefore, rehabilitation and educational approaches working with children with hearing impairments should focus on integrating all sensory information to support the development of adequate visual-spatial and visual-motor skills.

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