Uluslararası Sosyal Araştırmalar Dergisi
The Journal of International Social Research
Cilt: 5 Sayı: 20 Volume: 5 Issue: 20
Kış 2012 Winter 2012
www.sosyalarastirmalar.com Issn: 1307-9581

VISUAL PERCEPTION OF GRAPHEMES OF STUDENTS WITH REGARD TO THE DEGREE OF VISUAL IMPAIRMENT

Amela TESKEREDŽIĆ*
Lejla JUNUZOVIĆ-ŽUNIĆ*
Vesna BRATOVČIĆ*

Abstract

Aim of this work was to establish perception of graphemes of different types and sizes of subjects with impaired vision, with the regard of the degree of visual impairment. Sample and Methods Used: This research involved fifty children from the elementary school, from the Center for the blind and visually impaired children and youth in Sarajevo, ages from 6 to 15, with different degrees of visual impairment. We used 10 texts which were appropriate for the different ages of the questioned children. All the texts had 50 words or 476 graphemes. In this research we used graphemes of the Arial type with no spacing, Times New Roman and Arial Black with spacing. We also questioned letter sizes, which were of the following sizes; cicero (12,5 tt - 4,513mm); milt (14,5 tt – 5,265 mm); cicero and a half (18 tt - 6,769 mm); two cicero (24 tt - 7,521mm). Results have shown that the subjects with different visual impairment prefer to read different types and sizes of the graphemes. We also concluded the existence of a significant difference between the subjects with different degree of visual impairment when it comes to choosing the size of graphemes and the type of the letters. This work shows the importance of choosing the type and the size of graphemes in the education of students with the different levels of visual impairment.

Key Words: Visual Impairment, Graphemes, Visual Perception.

Introduction

Future and higher development of each individual and also the entire society highly depends on the level of conduct of so called cultural techniques, reading and writing skills (Best, 1997). Reading is a skill which includes more things then one. First, it is important to recognize graphical symbols, then to connect them with the proper meaning and in the end to have some use for what is being read. The ongoing process of learning and reading is also based on hereditary and environmental factors (Daneman, Carpenter 1980, Dikić,1991a). Reading is a linguistic process, based on language and it highly depends on the readers understanding and the syntactic and

* University of Tuzla, Faculty of Education and Rehabilitation, Bosnia and Herzegovina.

semantics of the language equally as on the alphabetic knowledge and awareness of certain aspects of the linguistic language structure that is used for reading.

Three of the most important achievements that characterize good readers are the understanding of the alphabetic language system to be able to identify printed words, to have and to be able to use previous knowledge and strategies, and to be able to understand the meaning from the written text and to read fluently. In the Bosnian language one grapheme responds to one letter (Best, 1997).

Adopting the reading skill is a very hard, complicated and long-term process. Even though at first it does not seem to be so, reading is a very complex cognitive skill, which demands coordination of oculomotor and perceptive processes, and also processes of understanding (Dikić,1991). While reading, processes that coordinate the eye movement from one location to the other are involved. Also processes on the word level that include the decoding of the visual sample of words and the recalling of the words from the memory, and also processes on the text level that include connecting of the semantics, syntactic and referential relations between the successive words, phrases and sentences in the text (Đorđević,1976). Processing of the impressions entails a clear visual impression on the eye retina. During the reading process we are receiving a whole series of visual impressions, while following the text. Expressive visual impulses are transferred to the brain cortex, where they are recognized and decoded. Recognition of the meaning of written words usually takes other meanings as well, due to experiences and current needs (Lightfoot, 1948). For clear vision we need visual sharpness, but also a number of other visual skills, such as maintaining of fixation point, changes in focus, following of the objects and also some perceptive skills (depth perception, visual memory, figure and shape discrimination). All these are factors that work together, in combination that is, and they are tested through functional evaluations (Pašiček, 1998). Sense of vision includes synergy of accommodation and convergence, which has impact on the sharpness of the eye, and oculomotoric abilities, which is oculomotoric coordination, which is important for the fixation, perception and discrimination. Several deficiencies in vision results in reduced sharpness of the images and reading disabilities. Most of the visual deficiencies can be successfully improved by the use of glasses, contact lenses, exercises, surgical options and so on. It is of highest importance to discover the deficiencies on time and treat them. Otherwise, damage can become permanent (Rončević, 2005). In the recent years, more and more has been argumented about the visual damages as the result of the modern information technology and the lack of prevention, as much in the prenatal as in postnatal period of the development of the visual apparatus. Many research results have shown that there have been noticed differences in the reading speed in accordance to the size and type of grapheme, and also in perception of graphemes in accordance to type and level of the impairment. But, we still do not have a research that would completely explain which graphemes and types and sizes are suitable for children with visual impairment and to which degree of visual impairment. That means that we have a great lack of evidence which would show us the specific visual functioning of visually impaired person (Rončević, 2005). Easier reading also depends on the size of the letters. Cursive is very tiring for the eyes. Reading smaller letters probably leads faster to fatigue then with the big letters. Fat letters have no impact on the reading speed. It has been concluded that fatigue of the eyes while reading is not that big, and that it mostly can be disregarded (Salihović, Junuzović-Žunić, Ibrahimagić, 2006). Some observations that have been given by Stankovic (1895) are interesting, in which he gives criticism not only to the school buildings, but also to the school literature which is "inappropriately printed". He talks about eye accommodation, different strabismus and amblyopia, in school children, about the effort that pupils are making while reading, and then he gives us the number of shortsighted children in schools and ten rules on the subject of school books regarding the printing techniques and the proper lighting of the school rooms: 1) school books should be printed on clear white or yellow paper with black letters; 2) line of letters should not be longer then 7 to 8 cm, so

that the eyes move less and do not tire out,; 3) every book should be rejected if healthy eyes can not read it from the distance of 80 cm when the room is lit with one candle from a distance of 1 m; 4) all the maps that hang on the wall should be rejected if they can not be seen from the distance of 40cm with the lighting of one candle; 5) the letters should be round, regardless of their height, they should be wide, fat and easy to read; 6) spacing between the lines should be 5 mm; 7) shortsighted eyes should be regularly checked and obligatory corrected with glasses; 8) for shortsighted eyes of 6D reading, writing, and work with small things should be forbidden; 9) long sighted eyes above +4D should be corrected by the use of glasses; 10) light is best from the ceiling… the use of letters 0.50 and 1 mm, even in footnotes, should be forbidden by law (Teksheva at all, 2008). Research shows that the reading field consists of total of 13 letters, which depend on the size and the type of grapheme in the word. The needs of pupils with poor vision in writing and reading are so specific, that the problem of children with vision impairment can only be solved on the individual basis (Teskeredžić, 2009). Javal (1798) has by watching the eyes of the reader concluded that those jumpy movements take place in fixation pauses. During that fixation some parts of the texts are being noticed directly and some indirectly. About 95% of the time is being used on the fixations, and the rest on the eye movements, which also depends on the training of the reader, that is, the training of the reader and the time lasting for the one fixation (Teksheva at all, 2008). This means that better the training, the smaller fixation time (Vasić, 1980). Eye moves fixating only on a couple of dots in the line and jumping from one fixating point to the next, fast enough not to allow even the smallest clear view while jumping, which means that not all the letters come into the hot spot, so direct viewing also must be used (Vasić, 1980). Kartel (1923) has found that one group of letters in comparison with only one letter must come closer to the fixation point to be read. He used parametric method, which means gradual movement of one object from the periphery to the center of clear vision, until the subject is able to recognize that object, while maintaining the fixation. Big letters from a greater distance then smaller letters, and some of these on a greater distance then the others. Isolated letters on a greater distance then words, and the longer one word is, the closer fixation point must be (Vudvort, 1964). Eye movement is a jumpy movement as it would be in examining one object or a scene, but it is more regular in holding a course, because it concentrates on the printed lines. Regressive movements in the frame of the line show some difficulties or some interesting points that are found during the reading. For some of them it can be shown that they are the results of mistakes in reading. Sense of vision includes synergy of accommodation and convergence, which has impact on the eye sharpness, and oculomotoric abilities, which is oculomotoric coordination, which is important for the fixation, perception and discrimination (Vasić, 1980). Several deficiencies in vision result in reduced sharpness of the images and reading disabilities. Most of the visual redundancies can be successfully improved by the wear of glasses, contact lenses, exercises, surgical options and so on. It is of highest importance to find the deficiencies on time and treat them. Otherwise, damage can become permanent. Several deficiencies lead to reduced picture sharpness and reading disability.

The aim of the research has been to establish if there are differences in perception of graphemes of different types and sizes in the examined subjects with impaired vision in regard to the level of their visual impairment.

Subjects and Methods

The sample included 50 subjects (pupils) with visual impairment that attend „Center for blind and visually impaired children and youth“ in Sarajevo. The sample was received from a total of 60 subjects, from which 50 subjects were set apart. Criteria for the selection of subject were following:

- That the subjects are with different types and degrees of visual impairment with correction

- That beside the visual impairment they do not have any other development delays (preserved IQ).

Using this criteria and review of the medical documentation we received the sample of 50 subjects (22 male subjects and 28 female subjects), ages from 6 till 15 years, with different levels of visual impairment.

Bearing in mind that all the subjects had different levels of visual impairment (amblyopia), they were then divided according to:

- severe amblyopia up till 0,1;.

- moderate amblyopia from 0,1-0,3 and

- mild amblyopia over 0,3.

The examination was done individually with given explanation of the purpose of the research. During the examination we used daily light and time before noon, when all the subjects were well rested, that is in period from 8 till 11 a.m. All the instruments were applied in the same conditions, with compulsory avoidance of sunlight glow on the working area, and while reading from a distance of 30cm.

For the examination of grapheme perception we used 10 texts which were chosen according to the age of the subjects. All the texts have 50 words each or 476 graphemes. For a better and more realistic evaluation of perception of objects and sizes of graphemes, each text was presented in logically sensible and illogically sensible form. By applying mentioned texts the goal was to establish what kind of values for visual perception the size and the shape of different letters has.

For this research we used grapheme type Arial with no spacing, Times New Roman and Arial black with spacing. These forms are widely used in everyday practice.

In accordance to the letter sizes we examined following sizes; cicero (12,5 tt - 4,513 mm); milt (14,5 tt – 5,265 mm); cicero and a half (18 tt - 6,769 mm); two cicero (24 tt - 7,521 mm). Subjects themselves chose the type and the size of the grapheme that suit them best for reading.

Information received was then processed by the use of softver program for statistics SPSS 16.00. For the examination of frequency of the preferred type and size of graphemes we calculated the absolute frequencies. For establishing significant differences between groups of subjects in the analyzed variables we did the analysis of variance.

Results and discussion

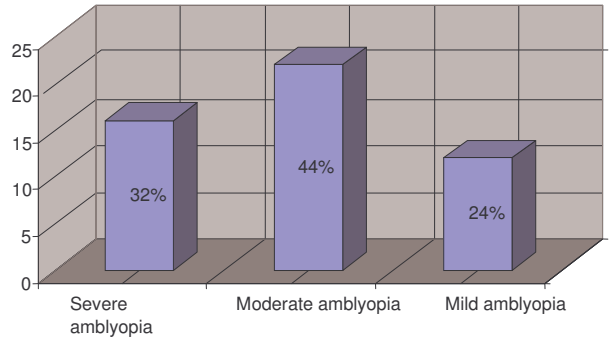


Figure 1: Sample of participants according to the level of amblyopia

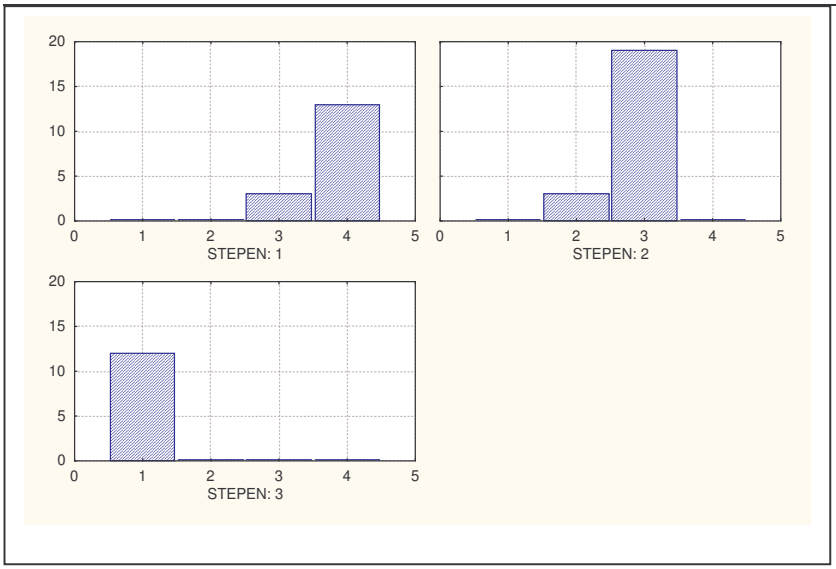
The structure of the subjects is presented on the figure 1. from which we see that 16 (32% subjects) belonged in the group of severe amblyopia, 22 (44% subjects) belonged in the group of moderate amblyopia, a 12 (24% subjects) were with mild amblyopia.

In the table 1. we have shown the frequency of using certain size of graphemes in relation to the level of visual impairment. The minimum size of grapheme that was chosen by the subjects with severe visual impairment was Cicero and half (19% subjects), and 81% subjects preferred the maximal letter size, 2 Cicero, which means that the subjects most often chose grapheme size 18 and 24 points. Subjects with moderate amblyopia opted for the grapheme sizes Milt which was 3 subjects (14%), and the biggest number of subjects from this group, 86% of them, preferred to read the size of grapheme Cicero and half. Unlike the subjects with severe and moderate amblyopia, the group of subjects with mild amblyopia (100% subjects of this group) read only one size of graphemes which was Cicero, and that would respond the size of 12 points.

Visual acceptance and understanding of words and signs is an unusually complicated process that entails coordination of several exterior factors with the visual and physiological reading characteristics. Legibility depends on the size and the shape of the letters, the lightning of the contours, the general condition of the eye, and some physiological factors: fatigue, effort, strain. The size of the letters influences the legibility of the text, with established number of reading errors, which we can see from the results of an experimental study done by Zovko (1998) on the 58 children with visual impairment and 10 pupils with normal vision, all of the same mental status. His results show this: for the letters size 12 points legibility is 48% (one point in England represents 1,74 inch); for 18 points legibility is 60%; for the size of 24 points legibility is 70%; for the size of 36 points legibility was 74%. To get a better understanding of the size of the points, we should mention that the size of the letters in the school books is 12 or 14 points. Author emphasizes the importance of the angle under which the text is being read (Zečić, Mujkanović, Devolli, 2010).

Table 1: Frequency of using certain size of graphemes in relation to the level of amblyopia

Size of grapheme	**Severe amblyopia**		**Moderate amblyopia**		**Mild amblyopia**	
	N	**%**	**N**	**%**	**N**	**%**
Cicero	0	0	0	0	12	100%
Milt	0	0	3	14%	0	0
Cicero and half	3	19	19	86%	0	0
2 Cicero	13	81	0	0	0	0
Total	**16**	**100%**	**22**	**100%**	**12**	**100%**



Legend:
stepen 1- severe visual impairment;
stepen 2- moderate visual impairment;
stepen 3- mild visual impairment;
TT- size of graphemes:
1- Cicero; 2- milt; 3- Cicero i pol; 4- 2 Cicera

Figure 2: Subject with different degree of visual impairment in relation to the size of graphemes

On the figure 2. the difference is very obvious between the subjects when it comes to choosing of the size of the grapheme. Namely, in the group of subjects with severe amblyopia, subjects have mostly chosen graphemes size in 2 Cicera or 24 points, and in the group with moderate amblyopia they preferred graphemes size Cicero and a half or 18 points, while the subjects in the group of mild ambylopia mostly read graphemes size 12 points, that is Cicero.

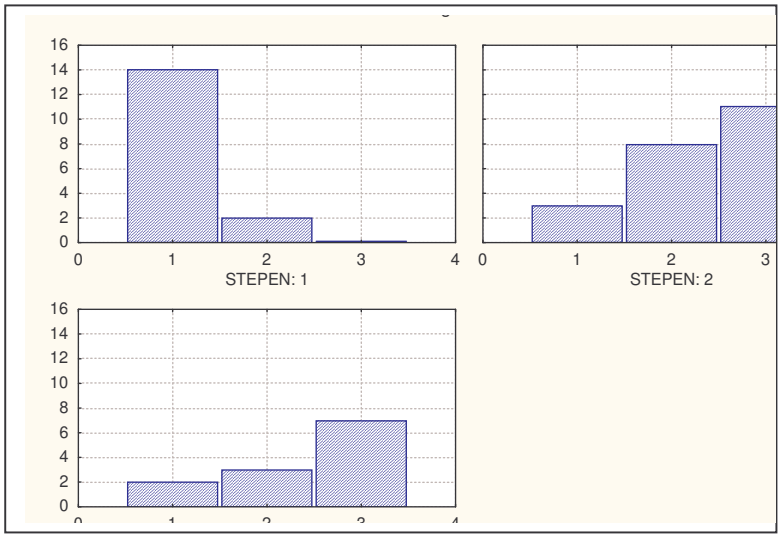
In relation to the type of grapheme most subjects with severe ambylopia (87% subjects) read Ariel with no spacing, while only 13% subjects read graphemes types Times New with no spacing. In the group of subjects with moderate amblyopia, 50% subjects read Arial Black with spacing, 37% subjects chose graphemes type Times New with no spacing, and 13% subjects read Arial with no spacing. The largest number of subjects in the group with mild amblyopia (58% subjects) used Ariel black with spacing, 25% of them used Times New Roman with no spacing, while 17% read Arial with no spacing.

Based on the results received it is obvious that the subjects that have better vision, prefer to read graphemes type Arial black with spacing, and the subjects with more damaged vision prefer type Arial with no spacing. In contribution to these results we can also say that the subjects with a larger portion of their vision left, are adjusting and maximally trying to use the remaining visual perception with no the effort, unlike the subjects with more severe damage who usually have to make a bigger effort to use their remaining visual perception, and because of that Arial is better for them, because it has thinner lines and the text is more consistent.

Lightfoot (1948) states that the most clear shape of the letters used is under the angle of 90 degrees on the optical axle, that the letter size that the eye sees responds to the one which is being printed. The same author points out that the length of the printed line is very important and that it has to be regarded in relation to the size of the letters, since there is a certain optimal relation between these two sizes (Zovko, 1991). Fatigue of reading is the least when the length of the line is 15-20 times bigger then the letter. Reading of the text, with big graphemes, prevents the development of visual fatigue and ensures higher efficiency and visual quality (Zovko, 1998).

Table 2: Frequency of using certain type of graphemes in relation to the level of amblyopia

Type of graphemes	Severe amblyopia N	%	Moderate amblyopia N	%	Mild amblyopia N	%
Ariel with no spacing	14	87%	3	13%	2	17%
Tajms New with no spacing	2	13%	8	37%	3	25%
Ariel black with no spacing	0	0	11	50%	7	58%
Total	**16**	**100%**	**22**	**100%**	**12**	**100%**



Legend: stepen 1- severe visual impairment; stepen 2-moderate visual impairment; stepen 3- mild visual impairment; VS-type of graphem 1- Ariel without spacing; 2- Times New Roman without spacing; 3- Ariel+black with spacing

Figure 3. Subject with different degree of visual impairment in relation to the stype of graphemes

From the figure 3. we can see that the subjects with the severe visual impairment mostly used graphemes type Arial with no spacing, subjects with moderate and mild impairment preferred Ariel+black with spacing.

For the study of differences between the analyzed groups of subjects on the choice of size of the graphemes and the type of the letters we have done an analysis of variance. Results have shown the existence of significant statistic differences on level $p<0,05$ between the examined groups in analyzed variables.

Table 3: The result of analysis of variance in relation to the selection of size and type of graphemes

Variable	Source of variation	Sum of squares (SS)	Degree of freedom (df)	Mean squares (MS)	Empical proportion (F)	p-value
TT	Between groups	55,05	2	27,53	257,28	0,00
	Within groups	5,03	47	0,11		
	Total	60,08	49			
VS	Between groups	17,22	2	8,61	20,48	0,00
	Within groups	19,76	47	0,42		
	Total	36,98	49			

Legend: TT-size of graphemes; VS-type of graphemes

Conclusion

It is very important in the conclusion to remind ourselves of the progresses that will be made in the future, which are trying to reach maximal development opportunities for all the students. Bearing in mind the visual impairment in relation to the level of visual impairment it has been concluded that the more severe the impairment is, the bigger graphemes it demands, mostly "Cicero" and Cicero and a half" (18 and 24 points), which means that the visual sharpness has a big impact on the quality of visual perception. There should be provided, with the regular school books, texts adjusted to the children with visual impairment. Since the level of impairment plays as important role in visual perception of children with impaired vision, there should be more education offered to the teachers and to the public in general.

REFERENCES

BEST, AB. (1997). *Teaching Children with Visual Impairments*, Philadelphia: Open University Press.

DANEMAN, M. and Carpenter, PA. (1980). „Individual differences in working memory and reading", *Journal of Verbal Learning and Verbal Behavior*, Issue 19, pp. 450-466.

DIKIĆ, S. (1991a). *Specifičnosti vizuelnog opažanja slabovidih učenika*, Beograd: Naučna knjiga.

DIKIĆ, S. (1991). *Metodika vaspitno- obrazovnog rada sa slabovidim učenicima*, Beograd: Naučna knjiga.

ĐORĐEVIĆ, D. (1976). *Pedagoška psihologija*, Beograd: Zavod za udžbenike i nastavna sredstva.

LIGHTFOOT, W. (1948). „ The partially sighted School", London.

PAŠIČEK, LJ. (1998). *Psiholingvističke sposobnosti znajčajne za čitanje i pisanje*, Zagreb: Fakultet za defektologiju.

RONČEVIĆ, B. (2005). „Individualne razlike u razumijevanju pri čitanju", *Psihologijske teme*, Issue 14 (2), pp. 55-77.

SALIHOVIĆ, N., Junuzović-Žunić, L., and Ibrahimagić, A . (2006). *Poremećaji glasa, govora i jezika*, Tuzla: Harfo-graf.

TEKSHEVA, LM., El'ksnina, EV., Perminov, MA. and Zinchenko, EG. (2008). „Visual reactions in children and adolescents on reading editions of various formats", *Gig.Sanit*, Issue 2, pp. 91-3.

TESKEREDŽIĆ, A. (2009). Assessment of visual perception of graphemes in children with visual impairment. (Procjena vizuelne percepcije grafema djece oštećena vida.), (Doctoral theses). Faculty of Education and Rehabilitation, Tuzla: University of Tuzla.

VASIĆ, Š. (1980). *Veština govorenja*, Beograd: Beogradski izdavačko-grafički zavod.

VUDVORT, SR. (1964). *Eksperimentalna psihologija,* Beograd: Naučna knjiga, pp. 630-635.

ZEČIĆ, S., Mujkanović, E. and Devolli, A. (2010). *Sarajevo: Logopedija,* Connectum.

ZOVKO, G. (1991). *Čitanje i pisanje slabovidnih*, Zagreb: Fakultet za defektologiju.

ZOVKO, G. (1998). "Čitanje slabovidnih učenika", *Defektologija*, Issue 25(1), pp. 1-15.