IDENTIFYING THE READING SPEED OF LOW VISION STUDENT'S

AT ELEMENTARY LEVEL

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ABSTRACT

This study was carried out to identify the relationship between features of the reading material and reading speed of low vision students. Study participants were comprised of 30 low vision students, 18 boys and 14 girls, attending Mitat Enç and Aydınlıkevler Göreneller Elementary School for Visually Impaired in Ankara during the 2011-2012 education years on a voluntary basis. All of the participants were to be between 2nd and 7th grade and able to read the print as a prerequisite. 81 different reading cards (texts) were drawn up considering variables such as type font, font size, line spacing and character spacing. Each reading card comprised of 35 word texts with 5 or 6 lines. Reading performances of the participant low vision students were video recorded. Then, the data were marked on the "Reading Time Record Form" developed by the researchers. The video records were watched by the researchers, and reading speeds were calculated by taking the average of the reading times identified by the three researchers according to the number of words read correctly in 1 minute.

Keywords: Low vision, reading speed, functional vision

1.   INTRODUCTION

As one of the most effective ways of acquiring knowledge through their lives, reading is among basic skills acquired in elementary school. After learning how to read in elementary school, majority of the children acquire most of the learning experience from books. Therefore, reading is influential on children's acquiring knowledge and thus gaining life experience (Özmen Güzel, 1999). Reading skill is important not only for children without disability but also disabled ones because it is crucial for children to get ready for social life and to sustain their life at high quality no matter they are disabled or not.

It can be thought that the visually impaired can face the biggest difficulty in the process of acquiring reading skill, which is based on visual perception. The visually impaired are divided into two; as totally impaired and low vision. While the totally impaired are able to

learn the Braille by touching, most of the low vision children use the print. The low vision can be defined in legal and educational terms. In legal definition, low vision covers individuals whose eye sight is between 20/70 and 20/200 after all corrections. This means that they can see an object from 2 meters or shorter destination while a normal sighted person can see the same from 100 meters. In educational terms, low vision includes visually impaired persons who can read written materials in normal and large font size with the help of glasses (Huebner, 2000; Şafak, 2005).

There are many factors which effect the reading speed of low vision people. These factors could be categorized into two. First one contains factors related with the individual's visual disability, while the other is related with features of the reading material. Visual disabilities affecting reading speed include eye diseases such as retinopaty of prematurity, cortical visual disorder, retinitis pigmentosa, microphthalmos, coloboma, microcornea, rod/cone dystrophia, congenital cataract, congenital glaucoma, opaque cornea, optic atrophy, albinism etc and accidents (Negrel, Minassian & Sayek (1996). On the other hand, the factors affecting reading speed due to the reading material are type font, font size, line spacing, character spacing, contrast between text color and ground color, and the light amount in the environment, etc (Bailey, Lueck, , Greer, Tuan, Biley, & Dornbush 2003, Brown, 1981; Lovie-Kitchin, Bevan & Hein 2001; Whittaker, Lovie-Kitchin, 1994; Legge, Rubin, Pelli & Schleske 1985; Legge, Rubin;1986; Rubin & Legge 1989).

The studies on the relationship between reading speed of low vision students and features of the reading material are mainly about reading speed and font size. There are some studies showing that reading speed increases as font size increases (Legge et al, 1985a; Chung, 1991; Johnston and Chung, 1991; Mansfield et al, 1994; Mansfield, Legge, and Banet, 1996). Also other studies carried out by Lovie-Kitchin and Woo, 1987; Rubin and Turano, 1992; Chung, 1991 show that reading speed decreases due to the narrow visual space as font size increases. Contrast ratio is another factor affecting reading speed of low vision individuals. Some studies show that reading speed increases as contrast ratio between text color and background increases, and thus the speed decreases as the ratio decreases (Rubin, Legge, 1989; Whittaker, Lovie-Kitchin, 1994). Other factors increasing reading speed of the low vision are marked line spaces and increased character spaces (Bailey, Lueck, , Greer, Tuan, Biley, & Dornbush 2003).

In this study; the relationship between features of the reading material and reading speed of the low vision children is studied.

2. METHOD

2.1 Participants and Selection

30 low vision students, 18 boys and 14 girls, attending Mitat Enç and Aydınlıkevler Göreneller Elementary School for Visually Impaired in Ankara participated in the study on a

Low vision students	Sex	Grade	Eye Disease
1	M	2	High Astigmatic
2	M	2	ROP
3	F	2	Bilateral Nistagmus
4	F	2	Nistagmus Megalocornea
5	F	3	ROP
6	F	3	Bilateral Microphthalmia
7	M	3	Bilateral Nistagmus
8	M	3	Bilateral Nistagmus
9	M	3	Bilateral Nistagmus + Hypermetropia Astigmatic
10	M	4	High Astigmatic
11	M	4	ROP
12	F	4	Bilateral Congenital Cataract
13	F	4	Nistagmus Megalocornea
14	M	4	Bilateral Nistagmus
15	F	4	High Astigmatic
16	M	4	Bilateral Congenital Cataract
17	F	5	Nistagmus Megalocornea
18	F	5	ROP
19	M	5	Bilateral Nistagmus
20	M	5	Bilateral Microphthalmia
21	M	5	64 % sight only in the right eye
22	F	6	Bilateral Nistagmus
23	M	6	Bilateral Nistagmus
24	F	6	Bilateral Congenital Cataract
25	M	6	Nistagmus
26	M	6	High Astigmatic
27	M	7	Bilateral High Myopy
28	F	7	Bilateral Congenital Cataract
29	F	7	Bilateral Optic Atrophy
30	F	7	Bilateral Nistagmus+ Hypermetropia Astigmatic

voluntary basis during the 2011-2012 education years. All of the participants were to be between 2nd and 7th grade and able to read the print as a prerequisite.

TABLE 1

Details of the participant low vision students in the Study

2.2 Setting and materials

Low vision students from both two schools joined activities in classrooms determined by the school administration. The setting was illuminated with natural light sources and desks were selected suitable for the students' height. Similarly, the desk to be used by the low vision student was relocated to prevent glowing on the reading material when daylight was shining. The participants could not use any instruments such as lenses during reading activities because they cause differentiation in other variables *(type font, font size, line spacing and character spacing)*.

In this study; 81 distinct reading cards (texts) were prepared by taking into consideration variables such as type font, font size, line spacing and character spacing. The texts were selected from story books appointed for elementary schools under Ministry of National Education. Each reading card contains 35-word texts in 5 or 6 lines. Type fonts were selected as Times New Roman, Century Gothic and Comic Sans MS on the 81 cards. These fonts were preferred on this study because they are obviously distinct. Font size is another variable taken into consideration while preparing the reading cards. 18, 24 and 28 font sizes were used on the cards, respectively. Font sizes above 28 were not preferred because they could cause impaired visual perception difficulty as students had limited visual space and visual acuity. Also line spacing was considered while preparing the cards. One, one and half and double line spaces were used, respectively. Lastly, character spacing was also selected as narrow, normal and wide. Reading cards and respective variables are listed as a table in 2.

2.3 Method – Using of Reading Cards

Because participant students have limited reading spaces, a certain limit was not identified for reading distance so that the low vision students can adjust the distance ideally for themselves. Each participant took 15 reading cards in every 40 minutes everyday, but 21 reading cards were given on the last day. Every student participated for 5 days. Misarticulating, reading the word after a waiting period of more than 3 seconds and skipping a word are identified as reading mistakes. Reading performances of the participant low vision students were video recorded and then marked on the "Reading Time Record Form" developed by the researchers. The records were watched by the researchers, and reading speeds were calculated by taking the average of the reading times identified by the three researchers according to the number of words read correctly in 1 minute.

2.4. Data Analysis

In order to find out reading speed of low vision students, each participant's read time for each of the 81 cards was identified and descriptive statistics were calculated from measurement results obtained in this way. In order to discover the typical reading time of students for each text, measures of central tendency (arithmetic average and median) were calculated. To identify distribution of the other data around such a typical value, measures of distribution (standard deviation and quartile deviation) were calculated. Besides, coefficient of skewness and kurtosis (normal, right sight skewed, left side skewed, etc) were calculated to find out the shape of the distribution.

3.   FINDINGS and COMMENTS

Descriptive statistics were calculated to identify reading speed of low vision children. Initially, the distribution of the measuring results was examined, deviating values (in extreme ends) were analyzed and extreme values in the distribution were determined. As a result of the analysis, measuring results of participant 23 were found significantly deviant from the other measuring results. Considering that arithmetic average is affected by marginal values, median and quartile deviations were calculated first. Then, arithmetic averages were found by subtracting the deviating values as the number of deviating values was small. After subtracting the deviating values, resulting averages were found quite close to the median values. Descriptive statistics obtained from the participants' reading time of the 81 texts in the study are given in Table 2.

Table 2 **Participant Students' Reading Time of the Reading Card**

Student No	Min.	Max.	$\bar{x}$	SS	Ave.	Ç.S 25	75	SH$\bar{x}$	Confidence Interval		Çarp	Bas.
1	12,90	45,30	24,58	8,86	22,32	18,40	33,04	1,67	21,14	28,01	,84	-,10
2	17,30	48,00	27,41	7,84	25,74	22,41	36,73	1,53	24,25	30,58	,93	,22
3	10,65	34,70	20,70	7,00	19,32	14,83	27,77	1,30	18,04	23,37	,56	-,86
4	12,32	39,64	22,06	6,59	20,05	16,88	29,67	1,29	19,41	24,71	,83	-,04
5	15,13	49,30	26,49	8,61	24,84	20,84	33,84	1,60	23,21	29,76	,91	,55
6	12,30	38,60	21,72	6,48	20,70	15,93	27,18	1,20	19,26	24,18	,73	,10
7	12,57	34,56	21,36	6,16	20,20	16,47	27,50	1,18	18,92	23,80	,55	-,63
8	15,70	42,79	27,28	7,36	26,45	23,65	34,45	1,41	24,38	30,19	,39	-,55
9	10,54	42,80	20,96	8,24	19,40	13,96	26,77	1,53	17,83	24,10	,88	,39
10	9,00	27,43	14,83	5,18	13,20	10,49	13,20	1,01	12,74	16,92	,93	-,19
11	11,00	38,70	22,01	6,73	23,28	16,53	27,03	1,25	19,45	24,57	,53	,12
12	7,94	32,40	16,12	6,48	15,23	10,92	19,69	1,20	13,66	18,59	,99	,51
13	9,48	34,00	17,00	6,25	15,53	12,18	21,35	1,16	14,62	19,38	1,03	,60
14	10,01	35,00	17,86	6,24	17,19	12,52	22,43	1,16	15,48	20,23	,83	,37
15	9,70	21,70	14,05	3,47	14,64	10,87	17,34	0,67	12,67	15,42	,53	-,39
16	9,88	23,80	15,39	4,48	14,89	11,25	20,50	0,86	13,62	17,16	,51	-,97
17	10,60	37,70	19,59	6,58	18,99	14,93	25,26	1,24	17,04	22,14	,96	,61
18	8,36	30,40	16,97	6,22	16,92	12,32	21,39	1,16	14,60	19,33	,62	-,52
19	7,12	26,80	13,77	4,92	15,35	10,15	16,69	0,93	11,86	15,67	,78	,47
20	9,40	28,26	14,66	4,84	13,90	10,98	19,78	0,93	12,75	16,57	1,10	,72
21	7,64	26,40	14,58	4,73	13,76	11,01	17,50	0,88	12,78	16,38	,97	,72
22	8,14	28,20	14,98	5,25	14,22	10,01	17,85	0,97	12,98	16,97	,89	,53
23	8,82	23,70	15,14	4,08	16,40	12,10	19,87	0,80	13,49	16,79	,42	-,44
24	6,77	18,40	11,56	3,34	10,99	9,63	17,64	0,67	10,18	12,94	,84	-,04
25	7,67	23,99	15,00	4,10	15,46	13,22	18,62	0,79	13,37	16,67	,27	-,15
26	6,10	30,05	17,05	5,31	17,77	13,51	21,47	1,02	14,95	19,15	,63	1,02
27	7,90	27,53	14,48	5,52	13,83	10,28	19,55	1,06	12,30	16,66	1,06	,39
28	10,78	35,80	18,37	6,64	16,34	14,34	25,02	1,27	15,74	20,99	1,26	,89
29	9,92	31,70	19,58	6,35	19,48	13,53	25,84	1,20	17,12	22,04	,44	-,86
30	9,46	34,90	19,46	7,44	17,03	13,85	27,10	1,38	16,63	22,29	,74	-,80
31	10,56	40,21	20,75	8,42	18,51	13,29	27,37	1,56	17,55	23,96	,87	-,26
32	10,46	36,72	20,04	5,80	21,97	15,99	26,73	1,16	17,65	22,43	,84	1,22
33	9,30	31,80	17,50	6,61	16,34	11,66	24,60	1,23	14,98	20,01	,55	-,82
34	12,39	40,62	22,68	8,54	21,45	16,17	28,28	1,59	19,43	25,93	,92	-,19
35	11,06	42,30	23,70	8,68	21,63	17,98	31,58	1,61	20,40	27,00	,86	-,21
36	10,81	32,23	17,72	5,99	17,23	12,08	21,21	1,11	15,44	19,99	,76	-,19
37	9,27	20,90	14,20	3,28	14,41	11,90	17,06	0,62	12,83	15,37	,33	-,77
38	6,80	30,25	15,44	5,90	14,39	10,68	20,83	1,09	13,20	17,69	,99	,39
39	8,88	26,45	14,72	5,09	13,75	10,52	19,22	0,94	12,79	16,65	,79	-,30

	Min.	Max.	$\bar{x}$	SS	Ave.	Ç.S 25	75	SH$\bar{x}$	Confidence Interval		Çarp	Bas.
40	7,74	22,50	14,80	3,90	15,05	12,61	19,53	0,75	13,26	16,34	,31	-,65
41	8,26	27,60	16,21	5,13	15,72	12,57	21,20	0,99	14,19	18,24	,48	-,22
42	8,21	23,10	13,78	4,43	12,83	10,16	19,31	0,84	12,06	15,49	,57	-,76
43	8,71	24,80	14,81	4,19	15,04	11,34	18,94	0,81	13,15	16,47	,63	-,23
44	8,74	27,80	15,35	5,56	13,50	10,86	20,09	1,03	13,24	17,47	,84	-,34
45	6,35	21,00	12,57	3,92	13,53	9,45	16,55	0,74	11,05	14,08	,26	-,83
46	7,04	21,70	12,92	4,31	12,80	9,64	17,50	0,81	11,24	14,58	,59	-,78
47	7,44	25,10	12,88	5,05	11,21	8,69	16,89	0,94	10,96	14,79	,97	-,17
48	6,56	21,50	12,25	4,13	12,59	8,73	15,28	0,78	10,65	13,85	,40	-,49
49	5,81	24,00	14,10	4,84	14,18	10,06	19,08	0,91	12,23	15,98	,21	-,91
50	6,90	26,20	14,49	5,02	14,04	10,21	18,96	0,95	12,54	16,43	,68	-,27
51	6,50	15,69	10,85	2,58	11,66	9,15	14,40	0,51	9,78	11,91	-,04	-,95
52	5,80	16,91	10,11	2,51	10,43	9,47	12,36	0,50	9,08	11,14	,28	1,10
53	6,13	21,20	11,80	3,77	11,60	9,34	15,79	0,71	10,34	13,27	,81	,23
54	5,70	25,30	12,30	5,53	11,49	7,10	18,54	1,04	10,15	14,43	,88	-,11
56	5,21	35,67	22,56	7,42	23,70	17,51	29,72	1,40	19,68	25,43	,01	-,22
57	9,32	34,68	19,99	6,98	19,23	14,10	25,96	1,30	17,33	22,64	,67	-,23
58	10,16	25,97	18,53	4,00	19,90	15,90	24,69	0,80	16,88	20,18	-,17	-,32
59	13,39	34,96	20,74	6,28	20,32	14,74	24,50	1,18	18,30	23,17	,85	,08
60	10,30	33,50	19,11	5,36	19,10	15,81	25,51	1,03	16,99	21,22	,98	,79
61	12,07	37,70	21,43	7,31	20,51	14,78	25,98	1,36	18,64	24,20	,68	-,53
62	10,14	40,50	21,78	6,96	20,19	16,82	26,83	1,21	19,13	24,42	,79	,51
63	10,44	30,60	17,56	5,34	17,72	13,68	23,64	1,05	15,40	19,71	1,06	,82
	Min.	Max.	$\bar{x}$	SS	Ave.	Ç.S 25	75	SH$\bar{x}$	Confidence Interval		Çarp	Bas.
64	8,95	30,25	16,05	5,68	15,57	11,08	19,02	1,05	13,89	18,14	,83	,18
65	10,16	32,80	17,36	6,26	15,65	12,58	23,72	1,16	14,98	19,74	,72	-,43
66	7,30	23,49	14,54	4,05	15,62	12,15	17,89	0,78	12,94	16,14	,026	-,26
67	9,23	19,10	13,03	2,54	13,38	11,59	16,82	0,51	11,99	14,08	,60	,24
68	7,39	30,50	15,13	5,66	15,01	10,71	19,00	1,07	12,93	17,32	,86	,68
69	6,74	23,20	12,12	3,85	11,97	8,85	15,19	0,73	10,63	13,61	,95	,90
70	7,39	19,72	12,22	3,23	12,43	10,38	17,55	0,65	10,88	13,54	,60	-,04
71	7,34	25,20	14,03	4,73	13,36	10,61	17,76	0,89	12,20	15,87	,92	,56
72	9,00	27,09	15,41	5,54	14,48	10,79	21,03	1,04	13,27	17,57	,88	-,23
73	7,94	17,50	11,73	3,03	10,96	9,90	16,90	0,61	10,49	12,98	,55	-,87
74	6,60	16,20	10,57	2,97	10,23	8,40	14,75	0,57	9,40	11,75	,41	-1,05
75	6,70	16,20	10,64	2,51	11,12	8,61	15,08	0,51	9,58	11,69	,53	-,02
76	6,86	23,60	12,05	4,30	12,43	8,15	14,81	0,81	10,39	13,72	,95	,56
77	5,70	20,00	12,28	4,09	12,70	8,28	17,09	0,79	10,67	13,90	,27	-,77
78	6,78	20,86	12,87	3,84	13,77	10,47	16,12	0,74	11,35	14,39	,49	-,33
79	6,16	19,90	11,67	3,80	10,60	9,39	15,13	0,72	10,20	13,15	,82	,00

| 80 | 7,78 | 20,28 | 12,60 | 3,50 | 12,82 | 10,33 | 15,98 | 0,66 | 11,25 | 13,96 | ,48 | -,35 |
| 81 | 6,27 | 18,50 | 11,12 | 3,55 | 10,33 | 8,67 | 15,49 | 0,67 | 9,75 | 12,50 | ,64 | -,70 |

Table 2 shows that 30 low vision participants could read text numbers 52, 74, 75, 51 and 81 among the 81 different reading cards at highest speed, respectively. Text 52 is typed as Century Gothic with font size of 28, double line space and normal character space. Text 74 is typed as Coming Sans MS with font size of 28, single line space and narrow character space. Text 75 is typed as Coming Sans MS with font size of 28, single line space and wide character space. Text 51 is typed as Century Gothic with font size of 28; 1,5 line space and wide character space. Lastly, Text 81 is typed as Coming Sans MS with font size of 28, double line space and wide character space. Of the 81 text types based on different variables, low vision participants could read text 52 in 10.11 seconds on average. It reveals that text 52 was read at highest speed among all.

According to Table 2, low vision students could read text 2, 8 and 5 with the smallest number of correctly spelled words in 1 minute. Text 2 is created in Times New Roman with font size of 18, single line space and narrow character space. Text 8 is in Times New Roman with font size of 18, double line space and narrow character space. Text 5 is written in Times New Roman with font size of 18; 1,5 line space and narrow character space. Of the 81 text with different variables, text 2 could be read by participants in 27.41 seconds on average. This shows that text 2 took the longest time to read among all.

It is seen in Table 2 that low vision study participants could read at higher speed written texts in Coming Sans MS and Century Gothic with font size of 28 and wide character space. It is also seen that the participants could read texts written in Times New Roman with font size of 18 and narrow character space in longer duration.

4. DISCUSSION

Study participants, who are low vision student's, read texts typed in Century Gothic with font size of 28, double line space and normal character space in 10.11 seconds on average, while they could read those typed in Times New Roman with font size of 18, single line space and narrow character space in 27.41 seconds.

Our study suggests that low vision children read Comic Sans MS and Century Gothic in a shorter time than Times New Roman. In addition, they read texts in font size of 28 at a higher speed than 18 and 24, but they read the texts with font size of 24 at a higher

speed than 18. Though present findings support other studies showing that reading speed increases in parallel with font size of texts for low vision students (Legge et al, 1985a; Chung, 1991; Johnston and Chung, 1991; Mansfield et al, 1994; Mansfield, Legge, and Banet, 1996) the researchers set the biggest font size as 28. Since low vision children have a limited visual space, they might face difficulty in perceiving and vocalizing the big size characters as a whole due to the weakness of their visual space as a consequence of too large font size. Study data show that "line space (single,1,5 and double)" variable has a slighter influence on reading speed of low vision children than the other variables (font type, font size and character space).

In literature, factors affecting reading speed of low vision children are divided into two; incompetence and reading material related factors. Findings of present study support the studies proving that features of the reading material affects reading speed (Bailey, Lueck, , Greer, Tuan, Biley, & Dornbush 2003, Brown, 1981; Lovie-Kitchin, Bevan & Hein 2001; Whittaker, Lovie-Kitchin, 1994; Legge, Rubin, Pelli & Schleske 1985; Legge, Rubin;1986; Rubin & Legge 1989)

In the light of this study, teachers and parents of low vision children and others around them, if any, should prepare texts with font size of 28 in Comic Sans MS and Century Gothic with wide character space when they do reading exercises and other activities so that the children can better perceive the reading material visually and thus read more speedily. Adjustments to be made on the reading material for low vision children are expected to affect their academic achievement positively as well. Also it can be said that increased reading speed of low vision children will improve their reading comprehension performance.

5. CONCLUSION

It is suggested that amendments on the reading material to be provided for low vision children can be influential on increasing their reading speed. Likewise, it takes shorter time for low vision children to read texts written with wide character space and font size of 28 in Comic Sans MS and Century Gothic than those typed with narrow or normal character space and font size below 28 in Times New Roman.

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