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CEFR and Eye Movement Characteristics during EFL Reading: The Case of Intermediate Readers

Emrah Dolgunsöz [a] *, Arif Sarıçoban[b]

[a] *Bayburt University, Bayburt, Turkey*
[b] *Hacettepe University, Ankara, Turkey*

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Abstract

This study primarily aims to (1) examine the relationship between foreign language reading proficiency and eye movements during reading, and (2) to describe eye movement differences between two CEFR proficiency groups (B1 and B2) by using eye tracking technique. 57 learners of EFL were tested under two experimental conditions: Natural L2 reading and isolated sentence stimulus. The results revealed that total fixation duration and first pass time were predicted significantly by L2 reading proficiency in both experiments while second pass time and single fixation duration were found to be stimulus sensitive. Furthermore, B2 learners were observed to have less total fixation, first pass and second pass time and rate in both experiments when compared to B1 learners. The findings confirmed that characteristics of eye movements change as L2 reading skill develops. The use of eye tracking technique in future language classrooms to observe L2 learner reading development was also discussed.

Keywords: Foreign language reading, eye movements, eye tracking, L2 reading proficiency

1. Introduction

Human beings were never born to read in their native language, it is a challenging skill which develops in time by educational progresses. This development becomes obviously more laborious for an additional language, especially after a certain age. Surely, reading is a fundamental skill in a foreign language (L2) and also a must to be a proficient language user. L2 Learners, however, meet numerous complexities in their reading progress. Reading in L2 is prone to crosslinguistic effects in which first language (L1) interferes L2 reading learning: This dual-language process refers to "continual interactions between the two languages" (Koda, 2007). Meanwhile, L2 learners need to meet the specific demands of L2 including grammar, syntax, vocabulary, morphology etc. Thus, while foreign language learners are exposed to crosslinguistic effects, they are also required to develop lexical, syntactic and morphological aspects in a totally new language to be a proficient comprehender

* Corresponding author. Tel.: 0 507 084 19 45
E-mail address: edolgunsoz@gmail.com

in reading (Koban-Koç, 2016). Furthermore, L1 and L2 reading are totally different developmental processes. First language and foreign language readers begin to learn to read from very different starting points (Grabe, 2010). According to L1 reading research, L1 children who begins to learn reading typically know 5,000 to 8,000 words already before formal education (Singer, 1981; Anglin, 1993; Cunningham, 2005). In addition, L1 beginners has a considerable amount of morphological, phonological and syntactic knowledge of their native language due to their social context before formal reading instruction. On the other hand, beginner L2 learners in foreign language context start to learn L2 reading after a certain age (approximately after 7 years old) without any previous linguistic knowledge. These learners neither have such a social opportunity and a large mental lexicon nor have basic linguistic knowledge of target language before formal reading instruction. For an L2 learner, it will take several years to develop strong implicit knowledge of vocabulary, morphology, syntax, and phonology which are vital for proper reading comprehension (Grabe, 2010). Thus, foreign language reading is both crosslinguistic and intralinguistic, bearing a more complex developmental nature when compared to first language reading. In this respect, eye movements can give valuable clues about how foreign language learners progress from beginning to skilled readers. This study primarily aims to scrutinize and examine developmental eye movement characteristics of foreign language reading proficiency by using eye tracking in two experimental conditions.

1.1. Literature review

1.1.1. Developmental Eye Movements in First Language

For several decades, eye tracking has been accepted as a robust technique to examine developmental differences in reading ability. Many studies showed that reading proficiency and eye movements are closely associated: As reading proficiency develops, fixation duration, regressions and fixation count decreases while saccade length increases (Rayner, 1998). According to the previous research, beginning readers mean fixation duration was found to be approximately 355ms, fixation count was 191 per 100 words with a regression rate of nearly 30% (Taylor, 1965; Buswell, 1922; Rayner, 1985; McConkie et al 1991). In these studies, for skilled readers, these values were quite lower and were reported as 233ms, 94 and 14%, respectively. Another study by Rayner (1978) also yielded fairly similar results for 10 skilled readers: Mean fixation duration was 216ms, saccade length was 8.1 letters and regression rate was 11%. In addition, some other eye movement measures also correlated with reading proficiency. McConkie et al. (1991) reported that beginning readers refixate on words more than skilled readers. Skilled adult readers refixated 5 letter words 15% of the time, while first grade beginner children refixated 5 letter words 57% of the time. These findings were also confirmed by some other studies (Blythe, Häikiö, Bertam, Liversedge, & Hyönä, 2011; Joseph, Liversedge, Blythe, White, & Rayner, 2009). Furthermore, by using a moving window technique, the study by Rayner (1986) concluded that the perceptual span of beginning readers was smaller than skilled readers. The results revealed that the perceptual span of beginning readers extends about 11 character spaces to the right of fixation and for skilled readers, the span extends 14–15 spaces to the right of fixation. The relationship between reading proficiency and eye movements were also confirmed by many related eye movement research with similar findings (Elterman, Abel, Daroff, Dell'Osso, & Bornstein, 1980; Martos & Vila, 1990; Eden, Stein, Wood, &Wood, 1995).

1.1.2. Eye Tracking Research in L2

In contrast to L1 eye movement research in the context of reading, using eye tracking as a technique to explore L2 topics has recently started to become trendy. Research by Godfroid et al. (2013) scrutinized the noticing hypothesis and incidental vocabulary acquisition during reading with 28 participants. The results indicated that one second more attention on a pseudo-word increased its recognition probability in post-test by 8%. In a similar research, Smith (2012) focused on the role of

eye tracking in measuring noticing during SCMC with 18 participants. In this research, participants engaged in an online short chat interaction task with a native speaker. Remarkably, this research triangulated eye tracking and stimulated recall data reporting that eye tracking was a promising technique to investigate attention in SLA. In another research, Winke et al. (2013b) analyzed the caption-reading behavior of foreign language learners by using eye tracking methodology in a crosslinguistic prespective. The findings revealed that native language significantly affected the reading times in a foreign language: Arabic learners are found to spend more time on captions than other learners from different languages and Chinese learners are observed to have spent comparatively less time on captions in the unfamiliar content video. Siyanova et al. (2011) used eye tracking to scrutinize the idiom processing of L2 learners. They used metaphoric expressions as stimulus with 36 learners participating in their research. According to their results native speakers were better at idiom processing when compared to non-natives. In addition, non-natives were observed to have processed idioms and novel words at identical speed. Research by Liu (2014) examined the effect of morphological instruction in a second language bu using eye tracking. In this between-subjects research, 68 learners received traditional and morphological instruction on vocabulary learning for 7 weeks. According to the results, learners who received morphological instruction showed higher fixation-duration on morpheme areas, while other learners did not show the same sort of behavior. Recently, the study by Kim et al (2015) examined the binding theory and scrutinized how adult L2 learners make use of grammatical and extragrammatical information to interpret reflexives and pronouns by using eye tracking. They investigated the interpretation of reflexives (himself) and pronouns (him) in contexts where there is a potential co-argument antecedent and in the context of picture noun phrases (a picture of him/himself), where the distribution of reflexives and pronouns can overlap. The results revealed that the L2 learners interpreted reflexives in a native like fashion in both contexts, however they interpreted pronouns differently from native speakers, despite their advanced English proficiency. Using eye-tracking, Godfroid et al (2015) studied the grammatical judgment ability of L2 learners with 20 native and 40 nonnative English speakers without time pressure. The results indicated that time pressure suppressed regressions in nonnative speakers only and both groups regressed more on untimed, grammatical items. The findings revealed that timed and untimed grammatical judgment tests measure implicit and explicit knowledge, respectively.

In sum, eye tracking research in L2 mainly focused on attention-learning relationship, implicit and explicit knowledge in L2 and crosslinguistic differences in language processing. Among these studies, however, none of them focused on characteristics of developmental eye movements in L2 reading and gave a detailed description of eye movement measures between L2 reading proficiency levels.

1.1.3. Eye Movements Examined in Current Research

Eye tracking refers to the online registration of eye movements via infrared illumination. Simply put, infrared reflected onto the cornea pursues eye movements on a screen or in natural environments with the help of a micro camera. The movements of the eye are registered with the aid of a dedicated eye tracking software. In visual information processing including reading, two main eye movements are examined: fixations (the place and duration of the eye fixation) and saccades (ballistic and rapid movements of the eye from one point to another). This examination fundamentally depends on the "Eye-Mind Hypothesis" (Just & Carpenter, 1980) which assumes that eye movements and cognitive processes are closely linked. In this research, 4 types of fixational eye movements were analyzed: First Pass Time (gaze duration), total fixation duration, second pass time and single fixation duration.

First pass time refers to the successive fixations made on a word to the right of the text until the region is exited. In the hypothetical case given above, fixation#1+2 on the word "American" refers to first pass time for this word. Single fixation duration is calculated when reader makes only one fixation on a word and exits the region. In the example above, fixation#3 refers to single fixation

duration as the reader employed one fixation on the word "farmer" and exited the region. Second pass time is the measure which is calculated when a participant exits the AOI by making a forward saccade or a regressive saccade but then returns to the same AOI and rereads it. As indicated in the scanpath example, reader rereads and reanalyzes the word "produced" by operationalizing fixation#6. As the most common eye movement index, total fixation duration (fixation#4+6) for the word "produced" refers to the sum of all fixations on the related AOI. Total fixation duration is therefore calculated by summing any fixation duration on the related AOI by dismissing its characteristic features such as whether or not it follows a regression or a second pass.

Remarkably, these measures can give informative clues about the reading process. First pass time indicates processes associated with early word recognition skills such as recognition of orthography, phonology and morphology and lexical access (Clifton et al 2007). Inflated values for first pass signal problems with initial word recognition processes and lexical access. As a late measure, total fixation duration is a general panorama giving clues about the overall cognitive load, reading efficiency and word familiarity. Similarly, second pass time is more syntactic and discursive associated with delayed effects such as reanalysis of syntactic structure (Hyöna et al. 2003). Inflated values in this measure indicate an inability to recognize the word in a sentential construct. This measure is also informative about strategy use during reading. Both second pass time and total fixation duration are late stages of processing and may be an indicative of the interruption to the normal reading process (Frenck-Mestre, 2005; Winke et al. 2013a). Single fixation duration, on the other hand, is a special early case which is an indicative of rapid word recognition. This measure was found to be highly sensitive to word frequency and familiarity effects (Juhasz et al. 2003) and may be considered to be fairly associated with automaticity in word recognition during reading. Second pass rate refers to the measure indicating the rate of the words the reader employed second pass time, such as 10 of 15 words as 66%. Single fixation rate is also similar which refers to the rate of the words passed by single fixation, such as 10 of 20 words with single fixation equals to 50% single fixation rate. Different from duration based calculations, single fixation rate and second pass rate draws a general panorama.

1.2. Research questions

This research aims primarily to examine the effect of foreign language reading proficiency on eye movements during L2 reading and to reveal eye movement differences among two (B1-lower intermediate, B2-upper intermediate) EFL reading proficiency groups. The present research is significant because in contrast to previous research which mainly examined eye movements of L2 learners on different language processing conditions, this study aims to reveal developmental characteristics of eye movements across two foreign language reading proficiency groups by scrutinizing 4 measures regarding different L2 reading proficiency groups. These differences are significant as they are precisely informative about the developmental progress of foreign language reader behavior. Additionally, the results of this study may lead to the further use of eye tracking technique for the online observation L2 learner reading development. Two main research questions were addressed:

1-What is the effect of reading proficiency on 4 eye movements in foreign language reading?

2-Is there a statistically significant difference among two proficiency groups regarding first pass time, total fixation duration, single fixation duration and second pass time?

2. Method

2.1. Sample / Participants

57 participants took part in all procedures of the experiments and received course credit for their participation. All participants were learners of English as a foreign language in two different foreign language reading proficiency levels (B1= 24, B2=33). The age of the participants was within the range 19 to 22. All of the participants started to learn English after a certain age in a non-English speaking country with the same L1 background. In total, 57 participants (10 males and 47 females) were included in the data analysis. All participants had normal or corrected to normal eyesight.

2.2. Designing and Defining AOIs

This research includes two eye tracking experiments. All participants were exposed to the same two experimental conditions in which 35 words were used as areas of interest (AOIs). As eye movements were quite sensitive to length and frequency effects (Rayner and McConkie, 1976; Inhoff and Rayner, 1986; Rayner and Duffy, 1986), length and frequency of the words were kept homogenous; both long and short; frequent and infrequent vocabulary items were used. Word frequency was determined by using COCA (Corpus of Contemporary American English). The AOIs used in the experiments are as follows:

Table 1. *Words as AOIs*

EXPERIMENT 1			EXPERIMENT 2		
AOI	LENGTH (characters)	FREQUENCY	AOI	LENGTH (characters)	FREQUENCY
To travel	6	36197	cathedral	9	4402
Survey	6	32827	postponed	9	1744
Traveler	8	2907	formulate	9	1493
Billion	7	66979	ineffective	9	2727
Mainstay	8	772	ambitious	9	6963
Domestic	8	27446	owe	3	5355
Combined	8	19895	flee	4	2899
Agriculture	11	11750	fry	3	2707
Souvenirs	9	1033	ale	3	1386
Accommodation	13	2133	elk	3	4616
To spring up	9	328	established	11	30421
Catering	8	1670	decided	7	57388
To pour into	9	874	influence	9	38307
Retail	6	10624	development	11	96195
Manufacturing	13	12034	conflict	8	30043
			cup	3	57106
			met	3	59928
			pass	4	44611
			fat	3	43607
			nice	4	51477
MEAN	*8.6*	*15164*	*MEAN*	*6.2*	*21168*

2.3. Text Stimuli

In experiment 1, eye movements during natural foreign language reading process were recorded. For this purpose, a passage from a sample IELTS General Reading (International English Language Testing System) was used. The natural reading passage comprised 203 words, 1297 characters and 11 sentences. For experiment 2, 10 identical sentence frames (see Juhasz and Pollatsek, 2011, p.875) including 20 different words with different frequencies and length were presented within the same syntax pairs. This experiment involved 275 words and 1205 characters. To control frequency and length effects, in each pair, two different conditions were used: Short-high frequency words versus long-low frequency words and short-low frequency words versus long-high frequency words. The pairs were presented one by one.

2.4. Vocabulary Test

To assess participant familiarity on 35 AOIs in total, a vocabulary knowledge scale as unannounced vocabulary test (see Scarcella and Zimmerman, 1998; Wesche and Paribakht, 1996) was used. In this test, learners were required to choose the best of 3 options: "I know the word"; "I am familiar but not sure"; and "I have no idea". If one of the first 2 options were chosen, participants were asked to write the Turkish meaning(s) or their predictions about the word. The familiarity option was used to ensure that learners had minimal word recognition on a certain word. The scores were determined by calculating how many words were exactly known by the learners (1st option in the test).

2.5. Apparatus

Eye movements were recorded with the Tobii TX300 with a sampling rate of 300Hz, equivalent to a temporal resolution of 3.3ms. For eye movement data acquisition, visualization and analysis, Tobii Studio Enterprise Software 3.2.3 was used.

2.6. Procedure

All participants were volunteers, naïve to the research questions and tested individually. To define foreign language reading proficiency levels, a sample IELTS General Reading Exam was conducted before the experiments. IELTS General Reading Exam is an international exam which assesses reading proficiency in English language. Learner proficiency level is determined via 11 IELTS bands (from 4, 4.5 to 8.5, 9) which relies on how many questions has been answered correctly by the candidate. These bands equal to 6 different CEFR (Common European Framework of Reference) levels; A1-A2, B1-B2 and C1-C2 (see Verhelst et al 2009; Martyniuk, 2010). For this study, B1 (lower intermediate) and B2 (upper intermediate) learners were chosen as these groups were homogenous and most common. Before starting the eye tracking session, the participants individually took the vocabulary test at least 1 hour before the experiments to minimize any priming effect. Then each participant sat for the eye tracking session one by one within the control of the researcher. In experiment 1, learners were instructed to read the passage silently for comprehension purposes. For the second experiment, learners were instructed to read sentence pairs for comprehension and pass another pair when they were ready. To avoid anxiety and emotional arousal which might cause reactivity, no time limit was given. Calibration was done with a 9 point grid calibration setting. The stimuli were presented in Times New Roman, 18-pt font, on a 23'' monitor with 1920x1080 screen resolution set up at 67 cm from the participants' eyes.

3. Results

The variables in the data set were observed to have distributed normally. All statistical assumptions were tested and met including normal distribution, linearity, sample size and outliers.

3.1. Experiment 1: Natural L2 Reading Processes

In this experiment, participants read a passage and eye movements in natural L2 reading was analyzed. Linear regression with IELTS scores as the predictor variable and total fixation duration as the dependent variable revealed a significant effect of proficiency on total fixation duration; β_1= -13.501, t(55) = 5.028, p =.000. IELTS scores also explained a significant proportion of variance in total fixation duration; R^2 = .315, F (1, 55) = 25.281, p = .000. A similar effect was also observed for first pass time; β_1= -10.205, t(55)= 9.827, p =.000 with a significant explanation rate; R^2 = .212, F (1, 55) = 14.837, p = .000. For single fixation duration, proficiency effect also persisted with lower predictive power; β_1= 3.916, t(55) = .909, p =.034 and weak but significant explanatory power; R^2 = .079, F (1, 55) = 4.710, p = .034. No significant effect of proficiency was observed on second pass time.

According to between subjects analysis, B2 learners (M=9, SD=2.1) significantly recognized more words and scored better in vocabulary test than B1 learners did (M=7, SD=2.1.); t(55)= 2.618, p = .011, d=1.00. Regarding eye movements, B1 learners were observed to have spent significantly more total time on words (M=538, SD=77.18) than B2 learners did (M=426, SD=89); t(55)= 4.893, p = .000, d=1.33. Similarly, first pass time for B1 learners (M=475, SD=91.24) were higher than of B2 learners (M=389, SD=75.14); t(55)= 3.890, p = .000, d=1.01. Significantly, B2 learners (M=27, SD= 31.23) revisited words less and spent less time for second pass than B1 learners did (M=56, SD=38.68); t(55)= 3.128, p = .003, d=0.81. Also, B2 learners have employed more single fixation time (M=163, SD=51.07) than B1 learners did (M=125, SD=60.69); t(55)= 2.535, p = .014, d= 0.61. Beside these, while refixation rate was 15% for B1 learners, this rate is only 9% for B2 learners. B2 learners also had a higher single fixation rate (52%) than B1 learners (35%). A detailed table is given below:

Table 2. Eye Movement differences between B1 and B2 learners for Experiment 1

	B1 Learners	B2 Learners
Total Fixation Duration	538ms	426ms
Gaze Duration	475ms	389ms
Second Pass Time	56ms	27ms
Single Fixation Duration	125ms	163ms
Refixation Rate	15%	9%
Single Fixation Rate	35%	52%

Zero values were included in the analysis

3.2. Experiment 2: Identical Sentence pairs process in L2

In this experiment, participants read 10 pairs of sentences which bear same syntax but different words that vary in length and frequency. Linear regression results with IELTS scores as the predictor variable and total fixation duration as the dependent variable indicated a significant effect of proficiency on total fixation duration; β_1= -12.848, t(55) = 3.835, p =.000. IELTS scores also explained a significant proportion of variance in total fixation duration; R^2 = .211, F (1, 55) = 15.708, p = .000. Likewise, proficiency also significantly predicted first pass time; β_1= -7.571, t(55)= 7.884, p

=.008. Proficiency scores explained a significant proportion of variance in first pass time; R^2 = .120, F (1, 55) = 7.522, p = .008. These two measures were observed to be fairly consistent with the results in experiment 1. However, findings on second pass time and single fixation duration was not confirmatory. On the contrary to experiment 1, proficiency had a significant effect on second pass time; β_1= -3.706, t(55) = 3.948, p =.009. Proficiency also explained a significant proportion of variance in second pass time; R^2 = .119, F (1, 55) = 7.428, p = .009. No significant effect of proficiency was observed on single fixation duration.

Similar to experiment 1, between subjects analysis of experiment 2 showed that B2 learners (M=16, SD=1.7) significantly recognized more words and scored better in vocabulary test than B1 learners did (M=14, 2.4.); t(55)= 2.695, p = .009, d= .96. In terms of eye movements, it was observed that B1 learners spent significantly more total time on words (M=495, SD=104) than B2 learners did (M=396, SD=106); t(55)= 3.492, p = .001, d= .94. Likewise, first pass time for B1 learners (M=419, SD=79) were higher than of B2 learners (M=356, SD=89); t(55)= 2.738, p = .008, d= .74. In addition, B1 learners (M=61, SD= 54) revisited words more and spent more time for second pass than B2 learners did (M=35, SD=31); t(55)= 2.228, p =.030, d=0.60. For single fixation duration, no significant difference was observed between groups. Furthermore, refixation rates were highly consistent with the Experiment 1. While refixation rate was 15% for B1 learners, this rate is about 10% for B2 learners. Contrary to Experiment 1, single fixation rates were observed to be identical between groups; 56% for B2 learners and 52% for B1 learners. A detailed table is given below:

Table 3. Eye Movement differences between B1 and B2 learners for Experiment 2

	B1 Learners	B2 Learners
Total Fixation Duration	495ms	396ms
Gaze Duration	419ms	356ms
Second Pass Time	61ms	35ms
*Single Fixation Duration	200ms	186ms
Refixation Rate	15%	10%
Single Fixation Rate	52%	56%

Zero values were included in the analysis
*not significant

4. Discussion

The aim of this study was to examine any predictive effect of foreign language reading proficiency level on eye movements during L2 reading and to reveal developmental characteristics of four eye movement measures between two proficiency groups. Results from both experiments were given below:

Table 4. Results of the two experiments regarding two proficiency levels

	B1 Learners		B2 Learners	
	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Total Fixation Duration	538ms	495ms	426ms	396ms
First Pass Time	475ms	419ms	389ms	356ms
Second Pass Time	56ms	61ms	27ms	35ms
Single Fixation Duration	125ms	200ms*	163ms	186ms*
Refixation Rate	15%	15%	9%	10%
Single Fixation Rate	35%	52%	52%	56%

*not significant

According to the results obtained from both experiments, total fixation duration was found to be highly associated with proficiency. The findings from experiment 1 and 2 was quite consistent regarding total fixation duration reporting that total time spent on words increase as proficiency level decreases. Related eye movement research showed that more familiar words were processed more quickly than less familiar words; readers spend less time on familiar words and more time on unfamiliar words (Gernsbaher, 1984; Balota, Pilotti& Cortese, 2001; Ferraro and Sturgill, 1998; Whalen and Zsiga, 1994). Indeed, better proficiency means better vocabulary knowledge; skilled L2 readers possess a larger mental lexicon in L2 (Carver, 1994; Grabe, 2010). Thus, good learners with better vocabulary storage are less likely to meet unfamiliar words and spent less time on words during reading when compared to weak learners. In another aspect, when compared to first language values, L2 reading total fixation values were highly inflated. In related L1 research, mean fixation was reported about 355ms for beginning readers (Taylor, 1965; Buswell, 1922; Rayner, 1985; McConkie et al 1991). According to the findings of the present research, even upper intermediate (B2) learners' average total fixation duration from two experiments (411ms) is higher than a beginner L1 reader. This difference indicates the significance of language exposure before starting to learn reading and how starting points for L1 reading and L2 reading as stated by Grabe (2010) are different from each other. Another robust finding of this research is that first pass time is highly correlated with proficiency level. As mentioned above, first pass time is an early measure closely associated with initial word recognition processes and lexical access. According to the results, larger mental lexicon that better learners have led less first pass time. Weak learners, however, spent more first pass time on words due to their lesser vocabulary knowledge. In addition, better learners have better morphological knowledge and awareness (Liu, 2014) which enable them to spend less time on first pass.

In terms of second pass time, data obtained from experiments were contradictory. While natural reading experiment showed no predictive power of proficiency on second pass time, identical pairs experiment revealed a significant effect of proficiency. Although regression results of second pass were not identical in two experiments, second pass time, however, was found to be significant in between group analysis. It was observed that better learners refixate less on words while weaker ones reread them more. In addition, refixation rates in both experiments were highly consistent; B2 learners refixate less than 10% while this rate is about 15% for B1 learners. This results also confirm McConkie et al. (1991) who reported that beginning readers refixate on words more than skilled readers. It can be inferred that with superior syntactic and lexical skills, better learners make better sense of words and their functions in the syntactic structure which enables less refixations and less second pass time. In another perspective, second pass time can be evaluated as an indicative of strategy use during L2 reading. According to Zabrucky and Commander (1998), poor learners generally reread more than skilled readers and good readers were better able to selectively direct their rereading to text coherence problems and had better text memory relative to poor readers. In this respect, better learners employ rereading strategy more efficiently than poor learners do with less second pass time and rate.

Automaticity in word recognition is a vital component of reading proficiency. It refers to rapid and efficient word recognition ability which enables automatized and fluent reading (Grabe, 2010). Surely, automaticity is the core of parallel processing and a requirement of proficient reading ability (Samuels, 1988; Segalowitz, 2003; Moors & De Houwer, 2006; Segalowitz & Hulstijn, 2005). Developing automaticity requires time and continual practice; with the extended learning experience, the cognitive components underlying word recognition are automatized in L2 reading (Segalowitz et al. 1998). This research approached single fixation duration as an indicative of automaticity as this measure refers to making only one fixation on the related linguistic item and exiting the region. The results of the experiment 1 showed that L2 reading proficiency and single fixation duration were closely associated:

Better learners had higher single fixation duration and higher single fixation rate (52%) than of weaker learners. Natural reading experiment indicated that better learners were better in recognizing words with a single fixation and so more rapid in word recognition. In fact, this is mainly due to higher vocabulary skills that B2 learners possess as rapid word recognition requires well developed lexical entries (Perfetti, 2007). However, same effect was not observed for Experiment 2. The main reason for that contradiction was linked to the nature of the stimuli. Natural reading stimuli triggered single fixation duration more while isolated sentence pairs led to less single fixation duration and more examination of the sentence area.

5. Conclusions

This study examined the effect of L2 reading proficiency on eye movements and scrutinized eye movement differences among two L2 proficiency groups during L2 reading. The primary finding of this research is that total fixation duration and first pass time are precisely affected by proficiency regardless of stimuli type. During both natural reading and isolated reading conditions, L2 reading proficiency predicts total time and the initial time spent on words. Although regression results did not present significant results, the findings also showed that better learners revisit words less and their refixation rate was lower in both experimental conditions. Besides, single fixation duration was found to be sensitive towards the type of stimuli; only the natural reading experiment reported expected results. Despite a number of contradictory findings, the present research showed that eye movements in L2 reading is affected by reading proficiency in general terms and L2 learners in different L2 reading proficiency levels exhibited different eye movements during reading. Better L2 learners with better lexical and syntactic skills were observed to have less inflated values and less refixation time and rate. On the contrary, weak L2 readers spent more time on words and revisit words more. Natural reading experiment also indicated that better L2 readers are more automatized in word recognition regarding single fixation efficiency. Indeed these differences indicated that eye movements in L2 are somehow proficiency driven and their characteristics change as the reading ability develops. This developmental change can enable eye tracking technique as a medium for the online observation of L2 reading development. The results of the present research also confirmed that eye tracking technique may also be used as a part of L2 reading instruction and classroom in which learners' reading development is continuously observed to determine L2 reading challenges and solutions.

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Appendix A. Natural L2 reading Stimulus for Experiment 1

AUSTRALIA

Have you ever travelled to another part of your country and stayed for a few days? Travel within one's own country is popular throughout the world. And, according to a survey carried out in Australia in 2002, travellers are spending more and more money on their holidays.

The Domestic Tourism Expenditure Survey showed that domestic travellers – those travelling within the country – injected $23 billion into the Australian economy in 2002. As a result, domestic tourism became the mainstay of the industry, accounting for 75% of total tourism expenditure in Australia. International tourism, on the other hand, added $7 billion to the economy.

So, tourism has become one of Australia's largest industries. The combined tourist industry now accounts for about 5% of the Australian economy, compared with agriculture at 4.3% and manufacturing at 8%. Tourism is therefore an important earner for both companies and individuals in a wide range of industries.

For example, the transport industry benefits from the extra money poured into it. Hotels spring up in resort areas to provide accommodation, and the catering industry gains as tourists spend money in

restaurants. The retail sector benefits as well, as many tourists use their holidays to shop for clothes, accessories and souvenirs.

Appendix B: Identical Sentence Frames for Experiment 2

Long-infrequent words vs frequent-short words

This gothic cathedral was built in 1519 by a group of Christian priests.

This gothic cup is thought to have been used to drink vine in medieval Europe.

The train was postponed due to bad weather conditions in the region.

The train was met by the president in the Washington train station.

I am sure George will formulate new theories of mathematics.

I am sure George will pass his final exam at the college easily.

My poor cat was so ineffective that I did not think she could ever catch a single rat.

My poor cat was so fat that she could not even climb the little pine tree.

Peter was such an ambitious businessman who owned many companies.

Peter was such a nice person who always thought about homeless people.

Short-infrequent words vs long-frequent words

Our military forces owe so much to their allies in the previous World War.

Our military forces established a new base in Afghanistan two months ago.

All the soldiers in the front flee as they see the war planes coming and firing at them.

All the soldiers in the front decided to attack the tank with their grenades and rifles.

My beloved sisters will fry some chicken for the dinner tonight.

My beloved sisters will influence your naughty children in a few days.

We will make use of this ale for the honor of our new guest coming tonight.

We will make use of this development in our daily lives in the future.

In this part of the country, an elk can be seen at any time of the day.

In this part of the country, the conflict between these radical groups never ended.

Yabancı Dil olarak İngilizce Okuma Sürecinde ADOÇ ve Göz Hareketleri Özellikleri: Orta Seviye Okuyucular

Öz

Bu çalışma öncelikle yabancı dilde okuma seviyesi ve göz hareketleri arasındaki ilişkiyi incelemeyi ve göz takip tekniğini kullanarak ADOÇ seviyeleri (B1-B2) arasındaki okuma becerisi açısından göz hareketlerini tanımlamayı amaçlamaktadır. 57 yabancı dil olarak İngilizce öğrenen katılımcı 2 deneysel ortamda test edilmiştir: Doğal okuma ve izole cümle uyarıcıları. Her iki deneyin sonuçları ortaya çıkarmıştır ki total fixation süresi ve first pass süresi dil seviyesi tarafından önemli derecede belirlenirken, second pass ve single fixation süreleri uyarıcı endekslidir.

Dahası, her iki deneyde de B2 seviyesindeki öğrenciler B1 öğrencilerine nazaran daha az total fixation, first pass ve second pass oranları harcamışlardır. Bulgular göstermiştir ki göz hareketi özellikleri okuma becerisinin gelişmesiyle birlikte farklılık göstermektedir. Bunun yanı sıra gelecekte öğrencilerin okuma davranışlarının çevrimiçi gözlemlenebilmesi için göz takip tekniğinin eğitim amaçlı kullanımının üzerinde durulmuştur.

Anahtar sözcükler: Yabancı dilde okuma, göz hareketleri, göz takibi, yabancı dil okuma seviyesi

AUTHOR BIODATA

Dr. Emrah Dolgunsöz graduated from Karadeniz Technical University from the Department of English Language and literature. He completed his Ph.D in the department of English Language Teaching at Hacettepe University. He is currently working as an assistant professor in the department of English Language Teaching at Bayburt University. His main interests are psycholinguistics, cognitive linguistics and eye movement research.

Dr.Arif SARIÇOBAN has been working as an associate professor of ELT at Hacettepe University since 1997 and acting as an editor-in-chief, an editor, and a reviewer for various national and international journals in the field of Language and Linguistic Studies. He has numerous national and international articles and also presented numerous papers at both national and international conferences. His main focus of interest is EFL, ESL, TEFL, ELT and recently the Teaching of Turkish as a Native Language (TNL) and the teaching of Turkish as a Foreign and/or Second Language (TFL/TSL). He has so far authored various ELT course books. He has recently acted as an editor on Instructional Technologies and Materials Design in which he also has two joint book chapters on the development and use of technology and another book on linguistics in ELT studies. He has many other book chapters in both national and international ELT course books.