EYE MOVEMENTS DURING THE PERFORMANCE OF READING COMPREHENSION TASKS

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Abstract
The submitted paper introduces the general overview of mental processes in reader´s mind during the performance of reading comprehension tasks. The effectiveness of reading comprehension strongly depends on the quality and the appropriate choice of reading style. Saccades, regressions (basic types of eye movements) and areas of interests were analysed during the analysis of data. The conclusions were made on the basis of acquired experiment data, which were recorded during an online reading experiment.

Key words: *reading, experiment, literary text, eye tracking, reading comprehension, reading tasks, functional literacy*

1. INTRODUCTION

Reading is a complex communicative skill and its main use in school context is to retrieve relevant information out of the text that can be used in real life or school related communicative situations (Scribner, Cole 1981). In order to perform the reading comprehension tasks successfully, the readers must develop successful reading strategies which will help them to accomplish this goal. Mental processes behind reading comprehension and the way the reader´s brain works is unknown and to these days psycholinguistics tries to investigate the model of this process.

One of the useful research methods of discovering these processes is eye-tracking, the research method based on recording eye movements of readers in order to understand what parts of the text are crucial in reading in order to understand the text. The basic two types of eye movements are glances forwards and backwards. The eye tracking method established that reading is not a gliding movement, skimming all letters and spaces in the text (Hyona and Niemi, 1990); while reading, the eye makes jumping movements fixating on specific places, usually on between 7 and 10 letters (Mistrík, 1996).

The first type of jumping movement of eyes is so called saccades, which are used when the reader reads the text without any need to clarify the meaning. The other type of eye movements, looks backwards, are so-called regressions, which occur when the reader looks back to the text which has already been read, mostly in order to clarify the meaning of the text. Both types of these eye movements are subconscious; they usually are not controlled by the readers. That is why they are relevant tool for the psycholinguists in identifying the parts of the text which are not clear to the reader and need second glance by the reader in order to understand the text.

For the teachers, understanding this mental process behind reading comprehension is crucial in order to help the learners to achieve their reading comprehension successfully, as their task is to be facilitators in the process of learning. This knowledge can help teachers either to design learning materials that are comprehensible to the reader or point out the parts of the text that can be helpful but are otherwise neglected by the readers while performing reading comprehension tasks. Actually, eye tracking method is used in different fields of study, such as advertisements, commercials or medicine.

In their study, Hyona and Nurminen (2006) defined four basic types of readers:

1. Fast linear readers
2. Slow linear readers
3. Topic structure processors
4. Non-selective reviewers

Hyona and Nurminen (2006) described these types as follows: linear readers have almost no looks-back, but the difference between fast and slow linear readers is that slow linear readers make more rereading fixations before moving to the next sentence. Topic structure processors and non-selective reviewers look back often, but whereas the former concentrate on topic headings and topic sentences, the latter look back at different types of sentences.

Reading of each type of the text has its specifics but some of the rules can be applied to texts across all genres. Previous research shows that the readers tend to create chronology even when reading the non-chronological, non-narrative text (Wolfe and Woodwyk, 2010).

Readers apply different reading strategies when reading from screen and reading from the paper (Dyson&Haselgrove, 2000). Reading from the paper is related to studying, which is the reason why readers tend to read in details and to analyse the text. On the other hand, reading from the screen is related to search for relevant information, which is why the readers tend to skim the texts and evaluate their relevance for future use.

In order to learn the level of reading competence of a student, one of the most useful tools is a didactic test. When creating reading comprehension test, several criteria must be taken into consideration. One of them is the Bloom´s taxonomy of learning domains (revised by Singh, 2009, p. 64-65) dividing the mental processes and tasks resulting from them into six categories and providing the basic operative verbs for each category:

Knowledge – define, list, libel, measure, name, recall, recognize, reproduce, select, state, write underline;

Comprehension – change, classify, distinguish, explain, formulate, identify, illustrate, indicate, interpret, justify, judge, name, represent, select, summarize, transform, translate;

Application – assess, change, choose, conduct, construct, compute, demonstrate, discover, explain, establish, find, generate, illustrate, modify, predict, perform, select, solve, use;

Analysis – analyse, associate, compare, conclude, contrast, criticize, differentiate, identify, justify, point out, resolve, select, separate;

Synthesis – argue, conclude, combine, derive, discuss, generalize, integrate, organize, precise, prove, relate, restate, select, summarize, synthetize;

Evaluation – associate, choose, compare, criticize, conclude, defend, determine, evaluate, judge, identify, recognize, relate, select, summarize, support, verify.

Testing these domains help teachers to learn the level of reading competence of their students.

The second criterion applied was that when offering readers the answers in multiple choice tasks, one of them is always correct answer, other three are distractors – two possible and one of them should be a clearly improbable choice (Lapitka, 1996).

2. EXPERIMENT

2.1 Participants

Ten participants (7 Czechs, 3 Slovaks; 7 men, 3 women) of average age 23,57 (men: 24,3 – women 23,4; Czechs 24,28 – Slovaks 22,3). All of the participants of the experiment were university students;

eight of them had studied at the secondary grammar school before and two of them attended other type of school before university studies.

2.2 Material

Eye tracking experiment – self paced reading of four excepts of continuous literary text (1 prosaic text, 1 poem, two dramatic texts in readers´ mother tongues) on screen and eight reading comprehension tasks following Bloom´s taxonomy related to excepts of literary text. The text could be only moved forward – the readers could not return to the previous screen, once they had read it.

2.3 Procedure

Visual aspect of the material presented to readers was also very important. The material was presented on white background and the type of font was Calibri in order to keep the reading material as authentic and similar to the one that would be normally read from the paper. Dyson and Haselgrove (2000) formulated basic differences between reading from the screen and the paper and it was taken into consideration when designing the layout of the presented material.

When preparing the texts, so-called areas of interest were identified in advance according to the expectations where the readers would try to find the correct answers.

The test consisted of two stages – reading the excerpt of literary text followed by answering reading comprehension task. When necessary, excerpt of literary text was presented on the screen again.

The first of the tasks was open question asking the readers to formulate the main idea of the text. Other tasks were mostly multiple choice items – explanation of metaphors, filling the gaps, yes/no questions, organizing part of the plot into the chronological order etc. Each of the multiple choice tasks options contained one correct answer and three distractors in order to observe how readers process this type of reading comprehension task.

Quantitative data of the readers´ performance can be found in comprehensive table of results at the end of this contribution.

2.4 Data

To analyse data, video recordings were used. These recordings offered unique video sequences showing the directions of eye movements.

Another analytic tool used in this research was so called “hot spot” analysis. This analysis is based on the static pictures coloured according to the time devoted to certain area in the text. The “hotter” the colour, the more time spent in that area of the text. The most read parts were red coloured; the least read parts of the text were green.

3. READING COMPREHENSION TASKS AND RESULTS

Results of this experiment point out the processes taking place in the moment of performing reading comprehension tasks and the possibility to learn in the real time how the readers carry out answers during solving various reading tasks. This part contains three illustrative hot spot analysis of three and quantitative chart of readers’ ´performance follows general description of the tasks.

3.1 Formulate the main idea of the poem.

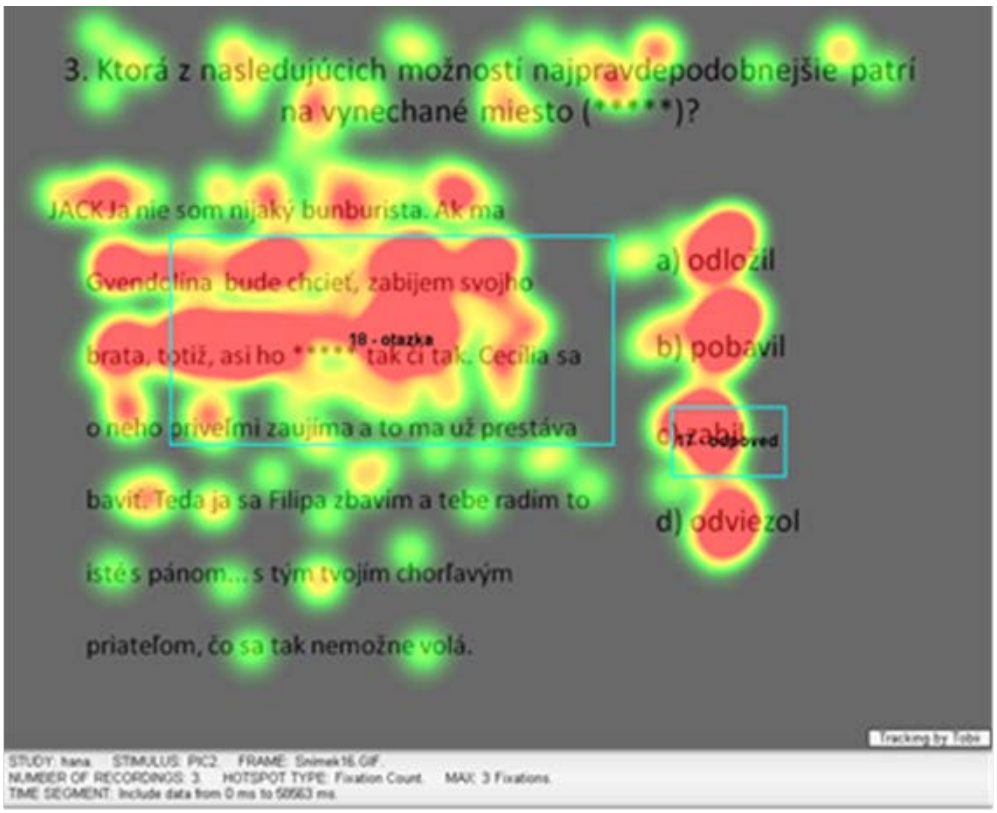
The readers performing this task made the most eye fixations on full meaning words that helped them to construct the meaning and their answers were constructed on the basis of the connection of these

words. It can be argued whether this type of task has its place in contemporary test design; on the other hand, comprehension of the text is the primary goal of any type of text reading and it is worth to observe the eye movements of readers while formulating this idea,

One of answers received by one of the participants of the experiment concentrated on the identification of the genre – a prayer. Although the genre identified by the reader was not correct and the answer was not as expected, it must be taken into consideration that expectations of readers about the text based on the genre of the text (Sparks and Rapp, 2010).

Two readers who had not recognized the layout of the poetic text and read the poem in lines were not able to identify the message of the text.

*3.2 Substitute the "***" in the text with one of the options.*



*Hot spot analysis 1: Reading comprehension task – substitute the "***" with one of the words*

The except comes from the play of Oscar Wilde *The Importance of Being Earnest* and the text presented to readers is available in the hot spot analysis 1 (above). The original text by Wilde is:

*„If Gwendolen accepts me, I am going to kill my brother, indeed I think I'll *** him in any case."*

The participants could choose from options: a) put away; b) entertain; c) kill; d) drive away.

Readers tried to identify the omitted word on the basis of a connector *"tak či tak"* (in any case) what proves the fact that connectors are very useful lexical tools creating coherence of the text and help readers identify the lexical connections between different terms. All options were considered in equally, since the repetition of the same lexical verb is unusual in texts.

Much attention has been paid to research of the use and importance of connecting expressions in text, their contribution in text comprehension and in creating schemata in readers´ mind while different

types of text. As it is indicated in the hot spot analysis 1, the readers tried to compensate the absence of the word in the excerpt by making eye fixations on the words and phrases directly preceding the missing word, and the most important fixation was made on the connecting expression.

3.3 Identify the meaning of the idiom "pour out your anger" /Identify the line can containing an idiom meaning "to take a risk".

These two separate multiple choice tasks are similar in character – they both deal with the meaning of an idiom, but the procedure of the task was different.

In the first case, the readers had the form of the idiom and they were supposed to identify its meaning, whereas in the second case, the participants of the experiment processed from the meaning of the idiom to its form.

The quantitative results show that the performance of readers in this task was relatively comparable (8 and 7 correct answers), indicating, that participants perform slightly better when given knowledge based task (the meaning of the idiom cannot be explained by the meaning of individual words in it; therefore they had known the meaning of the word from previous reading experience).

The readers did not pay much attention to areas of interest identified on the basis of their content of the correct answer. The readers read the whole excerpt again concentrated mostly on the line above the idiom. They tried to guess the meaning of the idiom from the context of the excerpt and then find their match from possible options presented on screen. The improbable answer was ignored.

Readers reading from form to meaning found it easier than those went from meaning to form.

3.4 Explain the idiom "mať filipa".

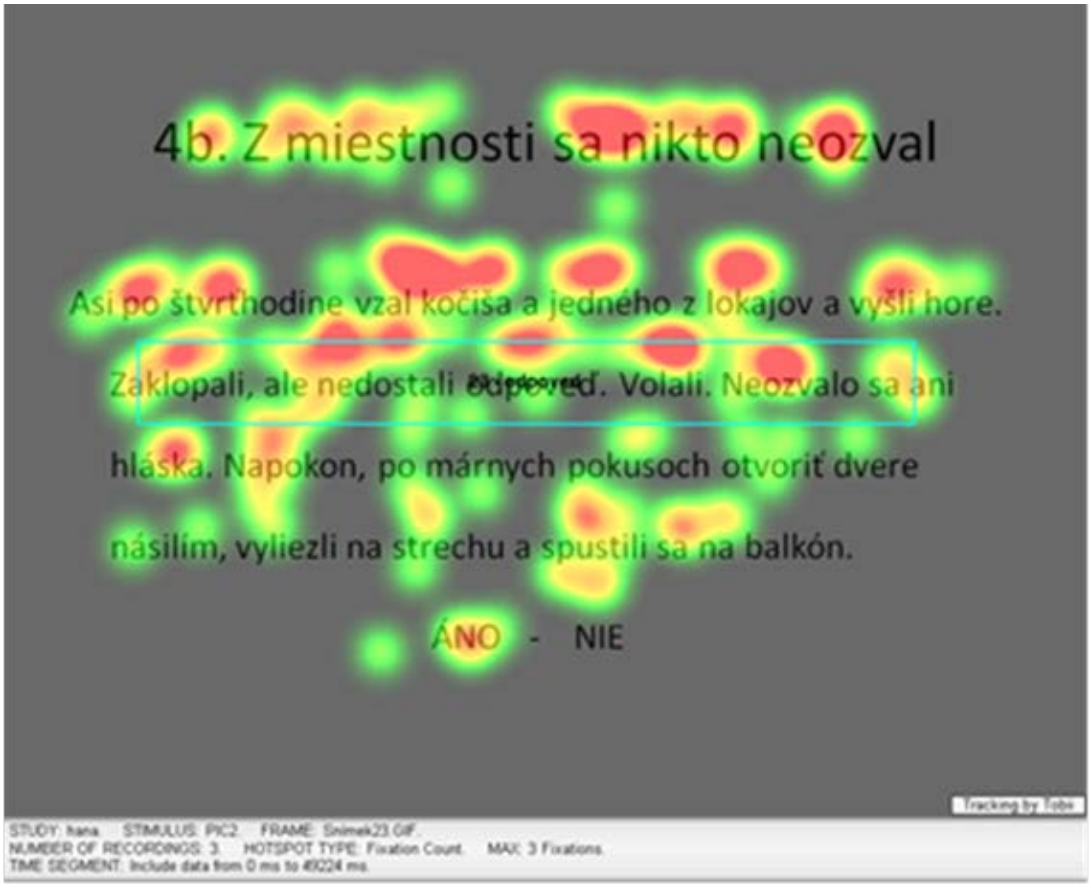
This task of the reading experiment was to explain the idiom with the meaning "being clever". The difference between this task and the two above mentioned is that in this case no part of the excerpt presented to readers explained the meaning of the idiom; this task was purely memory/knowledge based. It is a creative and witty play with the word by the translator, using the name "Filip" and a figurative word "filip" describing good brains, intelligence; following Wilde´s word play, using the word "earnest" and the name "Ernest" in the original text. The participants of the experiment performed this task with 90% success.

3.5 Decide whether the statements are true or false.

This part of the experiment consisted of three true/false items, for illustration one of them and its hot spot analysis is presented in this paper.

The tasks were designed and presented so that the answer was available for the readers on screen but different lexical units were used to express the same idea. The aim of these tasks was to follow the eye movements of participants of this experiment in order to follow the steps they take when identifying relevant part of the text.

The readers avoided making fixations at the areas of interest containing the correct answer and tried to find the correct answers in other parts of the text. Their average successfulness was only between 60 and 70 per cent; which makes this task one of the more difficult for the participants of the experiment.



Hot spot analysis 2: Reading comprehension task - yes/no question

3.6 Organize following sentences to chronological order

The aim of this task was to learn how much information the participants store in their short-term memory and how they proceed when they perform this type of text, requiring the organization of data into chronological order (Wolfe and Woodwyk, 2010).

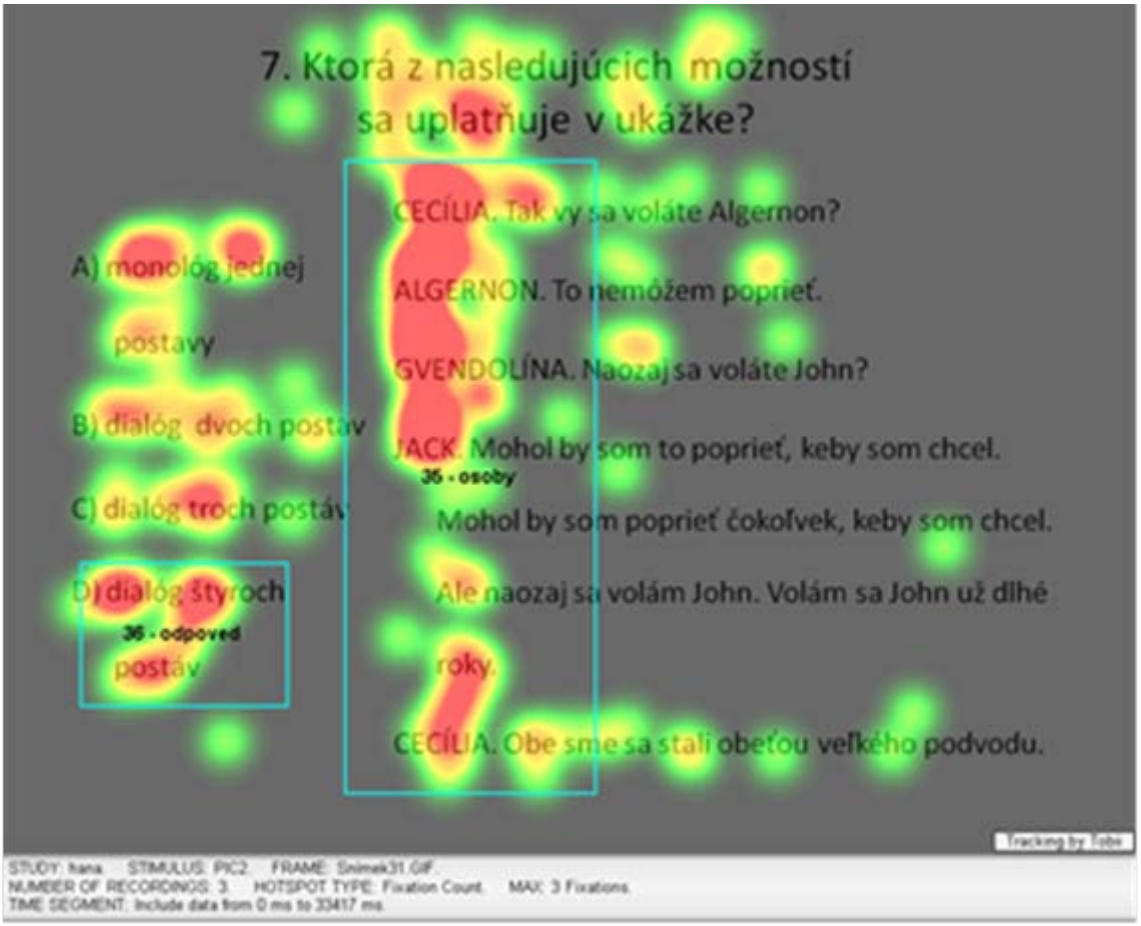
This task contained four complex compound sentences rich in information and the hot spot analysis showed that the second part of the sentence was read only once. After that, the readers worked with only first halves of the sentences in order to make chronology.

This type of memory based task was performed with relatively high score.

3.7 Identify the form of the following excerpt.

The aim of this task was to identify the number of characters present in excerpt of dramatic play in order to learn how aware the readers are of the organization and layout of dramatic text. They were presented five utterances and were offered options one up to four participants in the dialogue.

The predefined areas of interest were on the left side of the text, where author introduces the speakers of utterances. This part of the text was paid less attention than expected; the readers tried to learn the number of character involved in the dialogue in the text itself. This may lead to conclusion that the participants of the experiment were not satisfactorily familiar with the structure of the dramatic text and suggests that the readers are not trained to read it because dramatic texts are not primarily written for reading.



Hot spot analysis 3: Reading comprehension task - structure of dramatic text

After verbal description of the tasks and their aims, comprehensible quantitative table follows:

Item type	*Correct answer* ✓	*Wrong answer* *x*	*No answer*	∑
Metaphor identification/ explanation	8/7	2/3	0	10
Blank space substitution	7	3	0	10
True/false items	6/7/7	4/3/3	0	10
Genre recognition	10/7	0/1	0/1	10
Correct order	8	1	1	10
Idiom explanation	9	1	0	10
Main idea formulation	8	2	0	10

Table 1 Quantitative results of the reading task performance

3. CONCLUSION

The aim of this experiment was to learn the reading behaviour of the Czech and Slovak readers, while performing reading comprehension tasks related to literary text. Most of the conclusions of previous research in the field of reading comprehension can also be applied to readers in different languages, irrespective of the structural arrangement of the text.

The general conclusion of these comprehension tasks is that Czech and Slovak readers have problems with items requiring creativity and active work with the text. Of all the tasks given to participant of the experiment, the one that requires attention were the true/false items, where only six or seven participants of ten performed the task satisfactorily. Readers were asked to find the answer for the question in an excerpt of the text, which was in the text with use of different lexical items. Readers applying unsuitable reading strategy completely overlooked key parts of the text which were identified as areas of interest, containing the answers and read different parts of the text. On the other hand, memory based tasks were performed with very high score.

Reading comprehension tasks were not answered in the quality that was expected from university students. Participants in general performed better in memory based tasks; the tasks requiring the inventive approach and originality were more problematic for some of them. One can argue against the nature of the text which was presented on the screen and not on the sheet of paper, which always causes more problems in selection of the correct reading strategy (Dyson and Haselgrove, 2000). Also, the results of this particular experiment are limited to its participants.

Results of the experiment suggest that not only the reading behaviour and movement of the eyes are the crucial factor in text comprehension, as some of the patterns appear to be universal across the languages, but also the personal reading patterns of each reader have to be taken into the consideration.

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