In: Kokinov, B., Karmiloff-Smith, A., Nersessian, N. J. (eds.) ***European Perspectives on Cognitive Science***.
 ISBN 978-954-535-660-5

Eye Movements in Syntactic Disambiguation in Russian Language

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Keywords: eye movements, eye-tracking, reading, syntactic ambiguity.

Introduction

The parameters of eye movements during reading (duration of gaze fixations, length of saccades, occurrence of regressions) can be used to infer real-time cognitive processing of a text by the reader (Rayner, 1998). If an incorrect interpretation of a syntactically ambiguous phrase is made, fixation times on the disambiguating word increase or readers make an immediate regression. A number of linguistic variables influence fixation time on a word or the pattern of eye movements. A large body of papers deals with syntactic ambiguity in English language. The syntactic ambiguity tends to be resolved differently (early vs. late closure) in different languages (Sekerina, 1997). This raises the question of different principles that may apply in the parsing of different languages. Eye-tracking technology provides online analysis of linguistic process. This approach was never used in Russian language.

Experiment

10 subjects participated in experiments. They read 40 sentences with syntactic ambiguity (equivalent example in English *"Someone shot* ***the servant of the actress*** *who was on the balcony"*, ***bold nouns*** compose syntactic ambiguity, test, T, Figure 1) and 40 without it (control, C) subtended of 50 cm from eyes. The line string width was 38 cm and consists of 25-27 characters. Gaze position was recorded by video eye tracker (250 Hz). We analyzed the differences between following eye movement parameters during reading of 2nd line string of T and C: 1) time of reading, 2) number of fixations, 3) number of regressions, and 4) fixation time. These parameters seem very representative as objective markers in psycholinguistics conception. Reliable differences between all parameters in reading T and C were revealed (Table 1).

Time spent for reading of line string in T was significantly longer than similar time in C. In fact this parameter represents an integration of number of fixations and fixation time. In turn, number of fixations depends on number of regressions. Number of fixations during reading of 2nd line string in T was greater than in C assuming that reading of disambiguating words often requires an immediate regression (Rayner, 1998). This assumption is proved by twice as frequent regressions when the subject met the ambiguity. The fixation time was longer in reading T in comparison with C. During the fixation the key features of concerned word are perceived and it takes less time for perception of well interpreted information.

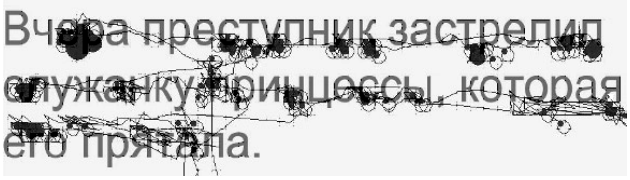

Figure 1: An example of T in Russian. The circles depict fixations. Two first words of 2nd line string compose syntactic ambiguity.

Table 1: Reliable differences between eye movement parameters during reading of 2nd line string of T and C. All data are averaged over all trials and all subjects. Significance estimates by Wilcoxon test.

Parameter	Median in T	Median in C
Time of reading (ms)	1219	1076
Number of fixations	4,47	4,16
Frequency of regressions	0,70	0,33
Fixation time (ms)	222	209

Conclusions

Our results give a proper estimation for syntactic ambiguity analysis in terms of cognitive functions. Significant value of our findings implies the possession of tools that can give the numerical evaluation of subject's mental activity.

Acknowledgments

Research is supported by RFBR grant № 09-04-00350.

References

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, 124(3), 372-422.

Sekerina, I. (1997). The late closure principle vs. the balance principle: evidence from on-line processing of ambiguous Russian sentences. In P. Costa (Ed.), *The Proceedings of the Second European Conference on Formal Description of Slavic Languages*. Universität Potsdam, Germany.