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Some features of eye movements during reading and retelling the text by people with stuttering

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Abstract

The connection between cognitive processes and the movement of the human eye during the reading and retelling the text is investigated. A series of experiments were performed, in which people with normal speech, people with stuttering and in the treatment stage of stuttering took part. The results of the experiment were fixed by the eye tracker and the functional magnetic resonance tomograph. The statistical processing of the tracking data was performed, which discovered stable differences of fixation duration in groups of participants when performing test tasks.

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Keywords: eye movement features, stuttering people, eye tracker

1 Introduction

While viewing images, reading text and solving other problems, person's eye movements reflect the cognitive processes occurring at that time [1, 2, 3]. Their track depends not only on the task being solved, but also on the individual activity of brain functioning systems. Hence we can make a conclusion: the eye movement features in a certain test provide some useful information about functional disorders of brain activity.

In this work, we examined eye movements of stutterers. It is known that they have problems with synchronization of the work of neurons in the anatomical Broca's and Wernicke's areas. How is this functional disorder reflected in the eye track while reading and retelling the text? What characteristics of track distinguish stuttering people from people with normal speech?

Numerical analysis as a way of eye movement research was proposed by A. Jarbus [4]. In our study, we believe that gazepoint movement of people with functional disorder of brain activity has features related to the nature of the functional disorders. A series of experiments were carried out to confirm this hypothesis. In the executed experiments, people with stuttering and

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in the treatment stage of stuttering took part. People with normal speech participated in the experiment for comparative analysis.

The main goal of this research is to identify characteristics of eye movement that show whether it is possible to describe the degree of disorder of brain activity caused by stuttering, to make practical conclusions about the effectiveness of treatment and to monitor a person's condition after completion of treatment.

In this paper, we will focus on a statistical analysis of one of the characteristics of eye movement - the duration of fixations. In the experiment several statistical characteristics of the fixation duration, which distinguish people with normal speech and stuttering, are revealed. The characteristics found have shown statistical significance, so that they can be considered as a basis for further research.

2 Experiment description

Experiment was performed in fMRI camera. Data were recorded using a magnetic resonance tomograph (Magnetom Verio 3T (Siemens, Germany)) that was synchronized with eye tracker (EyeLink2000). Summarized analysis of fMRI and eyetracker data will be presented in further works.

During the experiment, the participant reads or retells a text. The participant sees it on the screen through a mirror that is attached to the coil. The coil fixes the participant's head to avoid interference. Depending on the task, participants need to read the text or retell it aloud, and then to themselves.

The experiment consists of four cycles of tasks. Totally there are 5 tasks:

- Task 1: Reading out loud,
- Task 2: Reading to oneself,
- Task 3: Retelling aloud,
- Task 4: Retelling to oneself,
- Task 5: Rest.

Figure 1 shows the scheme of the first cycle of the experiment, the duration of which is 6 minutes. The horizontal time axis is divided into 30-second intervals. Task numbers are indicated above intervals. In each of the four phases of the cycle the participant consistently performs the following tasks: "reading out loud", "reading to himself", "rest". The second cycle includes four phases in which tasks are performed: "retelling out loud", "retelling to himself", "rest". The third and fourth cycles repeat the sequence of tasks of the first and second cycles.

The group of participants included a total 13 people (9 men and 4 women) with good eyesight (without lenses), with the leading right hand. There were ten stutterers, three of them were being treated according to the method of Professor L. Arutyunyan. All participants stuttered for an average of 26 years. They had light (3 people), medium (5 people) or severe stuttering (2 people). Three participants were with normal speech. The average age of subjects was 28 years. The participant group involved 5 students, 7 employees and 1 unemployed. All participants gave informed consent to take part in the study.