

EYE MOVEMENTS IN VISUAL SEARCH AND READING TASK

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Scanning of the visual scene is an important selective process in visual perception. During most visual activities, such as reading and visual search, our eyes do not move smoothly across the display, but rather perform a complicated pattern of fixations and saccades. High-speed saccadic eye movements serve the function of moving the fovea on to the part of array that we want to process in detail. [1] The latest studies reveal that the saccadic research in visual search tasks is essential in diagnosing glaucoma, defects of visual field [2]. Apart from that, systematic training of saccades and fixations serve as primary help for patients, who have problems with reading control, or have central vision loss and are forced to read using peripheral retina [3, 4]. Furthermore it should be noted, that in the last years the new hypothesis is widely reported that the eye movement patterns in reading are similar across a wide range of other visuomotor behaviour, for instance, in visual search [5]. Taking into account the above mentioned reasons, our main purpose of the present study is to determine whether there exists the possibility of construction of such visual search task that will be appropriate with reading in spatial and temporal characteristics.

Methods

Experimental design. Three types of task for each individual included text reading, visual search task and a text for purposes of visual search task. All texts were in Latvian. All stimuli were of the same structure. Each stimulus was 31.0° wide and 6.8° high and was fully displayed on the screen without time limit. Each letter subtended approximately 0.6° of visual angle at distance of 60 cm. The distance between lines was 1.5°.

Nemot vērā bīstamības faktu, kuģa personālam jāredz pozīcijas. Šorīt pasažieri pamodījās no skaja un diezgan biedējošā trokšņa. Cietušās personas gribēja uzzvanīt saviem tuviem draugiem.

Fig. 1. Reading task. A paragraph of four lines that contains 24 words. Silent reading.

Zknjv pšra švorlņrjrp rbūvi, jopk tnļzvīkso ktonpk iocļprujs. Prožs zolņvļojk švidmospn kņm oūszn tk vukeurļ ūpmršpokr vřjkoz. Poilmngs nūtrpļio tšukžip rklmoikj ukņpīu vlnštr mrpkhmšz.

Fig. 2. Visual search task. The four lines counted 163 letters. The task was to count the number of 'A's.

Ķerot mežā bioloģijas būtni, mūsu pārliecība neliek šaubīties. Tagad dzīvnieku trauksmes un sāpes ir cilvēku nežēlības cēlonis. Kreatīvs mednieks vēlējas izgudrot jaunas medību taktikas.

Fig. 3. The text for visual search. A paragraph of four lines (24 words). The task was to find the consequence of letters – a b c d e f g – among distractors.

Eye movements were recorded with an iViewX Hi-Speed 240 Hz IR device (Sensomotoric Instruments GmbH). The head position was held fixed. Overall seven individuals (age: 23-24 years old) participated in the experiment in accordance with the tenets of the Declaration of Helsinki. All individuals had normal vision without correction and all of them were native Latvian speakers. Statistical data analysis was made using MS Office Excel 2003 and BeGaze programs.

Results

| | Reading | Visual search | Text for Visual search |
|---------------------------------------|-----------|---------------|------------------------|
| Total number of fixations | 72 (19) | 79 (24) | 73 (20) |
| Mean fixation duration (ms) | 256 (21) | 252 (27) | 284 (13) |
| Number of rightward fixations | 50 (6) | 63 (12) | 61 (15) |
| Mean rightward fixation duration (ms) | 261 (19) | 264 (31) | 282 (16) |
| Number of leftward fixations | 22 (5) | 16 (6) | 12 (6) |
| Percentage of leftward fixations (%) | 31 (5) | 22 (4) | 16 (11) |
| Mean leftward fixation duration | 252 (25) | 255 (43) | 260 (27) |
| Mean saccade amplitude (°) | 1.9 (0.3) | 1.7 (0.5) | 1.7 (0.4) |

Table 1. Means and standard deviations of all individuals for the eye movement measures in three tasks. It is seen that the type of task does not affect spatial parameters of saccades (ANOVA, $p > 0.42$). However, temporal parameters are similar only in reading and visual search task – when the text is used for purposes of visual search, the fixation duration is significantly longer (ANOVA, $p < 0.03$).

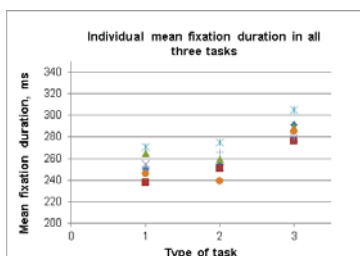


Fig. 4. Mean fixation duration in all three tasks (1 – reading, 2 – visual search, 3 – text for reading) for all seven individuals. As it was mentioned, interesting tendency is to be noted – when the text is used for the purposes of visual search, mean fixation duration is longer for each individual. Possibly, the lexical meaning of the visual stimulus served the function of additional distractor during visual search. Respectively, the text could be automatically proceeded as readable, what increased the complexity of the task and required focusing attention for longer period of time. However, this affect was not observed in the task performance efficiency (time and correct detecting of the letters).

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Conclusions

The visual search task may be designed in the way that the spatial parameters of saccadic eye movements will be appropriate with reading task. Still the certain experiment improvements are requireable and the number of individuals should be increased. The duration of fixations in the visual search task depends on its structure and the presence of lexical meaning.

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