MEMORY-GUIDED EYE MOVEMENTS

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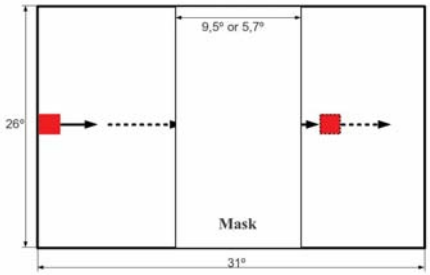
Smooth pursuit eye movements (SPEM) have been observed two phenomena - prescribing and continuing, if the stimulus abruptly gets lost. Then short-term memory guides eye movements with saccadic eye movements.
Fukushima, et al., /1/ research results show, that SPEM parameters are different among children with diverse learning abilities in memory-guided tasks. We choose to use the idea of smooth-pursuit task with time gap from Jonikaitis /2/ to make a simple memory-guided saccade task.
The aim is research the eye movements among children with learning disorders.

Method

In our experiments is a foursquare (size 0,5°), which horizontally goes across the computer screen rightwards. Distance between the screen and eye is 60 cm. The velocity is changed within 5°/s and 10°/s. In the middle of the screen is a not transparent mask 5° or 10° wide. The task is to fix a gaze to square and follow, while it goes across the screen. When the square disappears behind the mask, participant imagines the motion and continue to follow. In other side of the mask participant tries to catch again the square and follows after it till the edge of the screen. Meanwhile gaze position is recorded.



1. att. Experiment

Results

The eye pursuits to the stimulus with SPEM, when stimulus disappears there are saccadic eye movements. (2.Fig.) Fixations between saccades are ~300ms. In this time the frontal eye field in the brain is programming the next saccade. During the time gap, when stimulus is behind the mask, eye continues to pursuit, but now it tries to imagine the trajectory of stimulus. Vertical gaze position has not significantly changes during this task.

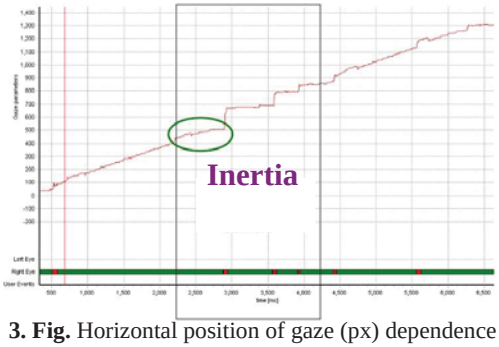
2. Fig. Horizontal position of gaze (px) dependence of time (ms)

1.tab. Eye movement horizontal velocity

Eksperiment	a	b	c	d
Before the mask	5,7	5,7	5,24	5,53
During inertia	2,39	3,1	1,13	0,76
Behind the mask	8,6	6,86	7,08	8,63
After the mask	5,12	5,7	5,37	5,13

In Table 1. the velocity of SPEM before and after the mask is similar. While stimulus is behind the mask, the velocity increases, and in the other side of stimulus eye waits ~200ms. The velocity of the stimulus is 5,1 °/s.

When the stimulus goes behind the mask, there is an inertia, where eye continues the SPEM. During this inertia the velocity decreases almost twice. When the velocity of stimulus is 5°/s, the inertia is 600ms long. The brain activity processes induce this decreasing of eye velocity, because during this time is programmed a new saccade.



3. Fig. Horizontal position of gaze (px) dependence of time (ms)

Conclusions

Memory-guided eye movements depend on the velocity of stimulus and the width of mask.
Eye can accurately pursue to the stimulus, if the velocity of stimulus is between 5° and 10°. In the beginning of the mask we observe an inertia, and then saccadic eye movements lead the eye in the other side of mask.
The movements area of inertia and the accuracy of memory-guided eye movements could use for children vision research.

References

1. Fukushima, J., Tanaka, S., Williams, J.D., Fukushima, K. Voluntary control of saccadic and smooth-pursuit eye ir children with learning disorders. *Brain & Development.* 2005. Nr.27, p. 579.-588.
2. Jonikaitis, D., Deubel, H., de'Sperati, C. Time gaps in mental imagery introduced by competing saccadic tasks. *Vision Research.* 2009. Nr.49, p. 2164.-2175.

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