

The parameters of saccadic eye movements in horizontal scanning tasks

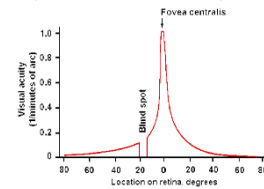
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Saccades

- Saccades are rapid, abrupt eye movements whose function is to bring new objects of interest to fovea: a 1.0° wide region of retina that is responsible for sharp central vision.



http://michaeldmann.net/pix_7/blndspot.gif

Saccade programming

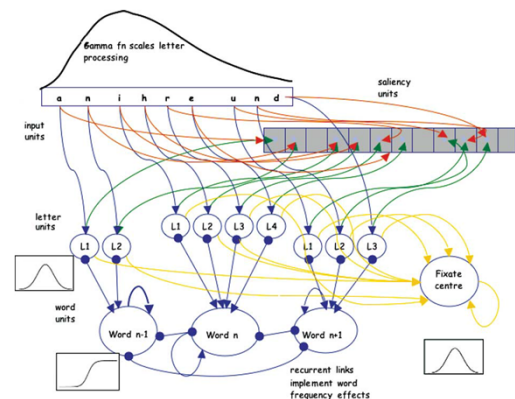
- Saccade programming can be influenced by both endogenous and exogenous processes;
- The competitive integrational model of saccade programming states that the exogenous and endogenous signals both compete at the Superior Colliculus where the gaze transfer is being generated

Exogenous signals

- Local competition across image space and feature scales results in feature maps for luminance contrast, color contrast and orientation contrast;
- Saliency map describes basic visual features than can capture and guide covert and overt attention and gaze direction;
- Attention is allocated to locations in the scene according to the salience of the computed map

Endogenous signals

- Gaze shifting can be influenced by shift of attention to a certain stimulus;
- When attention is allocated to an object, the object can be recognized, and its spatial parameters are computed for possible motor actions such as saccades.



R.G. Reilly, R. Radach, Some empirical tests of an interactive activation model of eye movement control in reading, *Cognitive Systems Research* 7 (2006), p. 34–55

- The goal of this research work is to determine to what extent does the visual information and the ongoing cognitive processes influence gaze transfer parameters in horizontal scanning tasks.

Experiment

- 7 students aged 22 to 26 with no refraction error;
- Eye movements were recorded by IViewX High speed, SMI Germany gaze tracking system
- Analysis of the data was performed by BeGaze and Microsoft Excel.



http://www.korea-lifetech.co.kr/bbs/data/neurological/HISpeed_full.jpg

Stimulus

- 6 different tasks were applied to analyze the characteristic eye movement parameters

N1

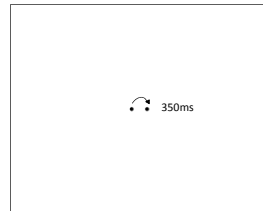


N4

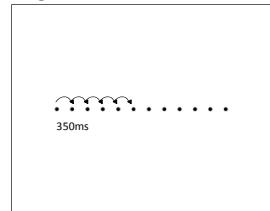


Stimulus

N2

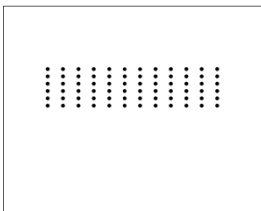


N3



Stimulus

N5

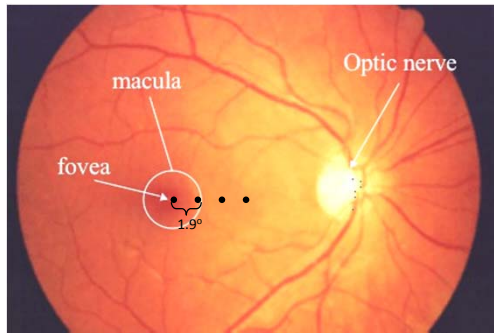


N6



Experiment

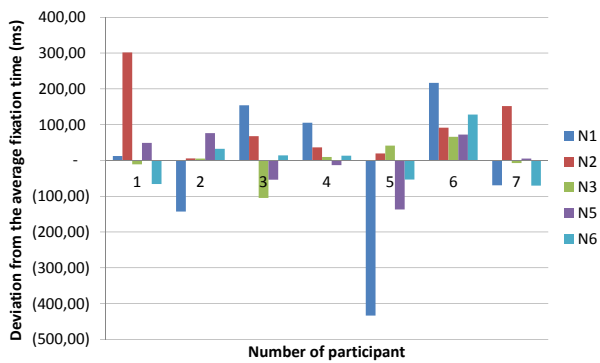
- Only the horizontal component of gaze transfer was analyzed;
- The data of the first and the last line of the text and the set of dots was not analyzed;
- When scanning 2 dots only the fixations on the left side were taken into account.



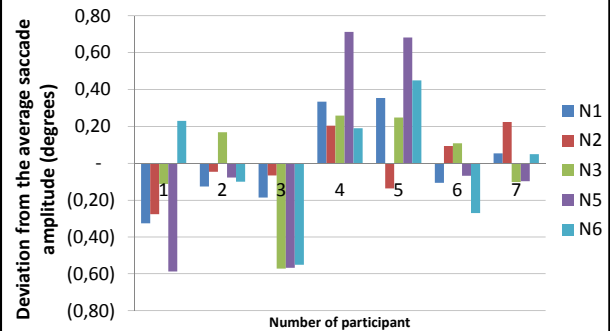
<http://www.ssc.education.ed.ac.uk/courses/Pictures/cgil12.jpg>

Fixation duration	1	2	3	4	5	6	7	Average
N1	752,1	596,8	894,2	845,5	306,4	956,5	670,5	717,4
N2	654,2	358,1	420,3	389,1	372,2	443,9	504,6	448,9
N3	352,7	368,6	258,6	373,2	405,0	429,5	356,4	363,4
N5	383,9	411,5	281,0	322,0	197,9	407,5	340,4	334,9
N6	213,4	311,8	293,6	292,5	225,7	407,5	208,9	279,1

Deviation of each participants average fixation time from the average fixation time in group



Deviation of each participants average saccade amplitude from the average saccade amplitude in group



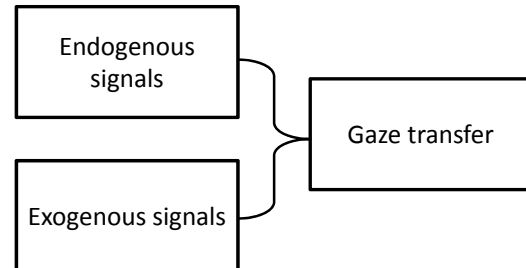
Task	Mean fixation duration (ms)	Mean saccade amplitude (°)
N1	739	1.9
N2	352	1.8
N3	363	1.8
N4	281	1.6
N5	335	1.7
N6	279	1.9

Results

- The longest information processing for all of the participants was observed when they were alternatively scanning two horizontally placed dots;
- It seems that adding semantic meaning to the horizontal scanning task and making the task similar to reading decreases the time necessary for information processing and programming the next gaze transfer;

Results

- By knowing the frequency of reappearing stimuli, it is possible to transfer gaze to the necessary position without additionally programming eye movement after the stimuli appears.



Conclusions

- Contribution of top-down information processing or endogenous signals to gaze transfer programming can be observed in tasks, where stimulus reappears with a certain frequency, in tasks where gaze transfer is similar to reading and when the task contains semantic information.

Thank You for Your attention!