Size Matters
Saccades During Scene Perception

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Introduction

As programming of each saccade needs some time, it would be uneconomical to move the eye towards a target with several small saccades instead of a single long one. In consequence, saccadic amplitudes are expected to depend on object spacing in the visual field. Thus, if an image is scaled to different sizes, saccade amplitudes are expected to vary proportionally. This hypothesis might seem trivial. However...

... comprehensive reviews concluded that for scenes between 10 and 20°, mean saccade amplitude ranges between 2 and 4° irrespective of scene size [1], or estimated an average saccade length of 4° for scene viewing in general [2].

Empirical Part

Stimuli: 96 natural scene images, comprising landscape scenes, images of buildings, and populated city scenes, were prepared in four different sizes as shown below.

Size 1: 10 x 7.7°
Size 2: 16 x 12.6°
Size 3: 25 x 18.8°
Size 4: 34 x 26.1°

Apparatus: The images were presented on a CRT display which subtended a viewing angle of 34 x 26°. Eye position was recorded with an infrared videobased tracking system (EyeLink™), with a sampling rate of 250 Hz and a saccade amplitude accuracy of 0.5°.

Procedure: Each of the 48 subjects viewed all 96 images. Each image was randomly presented in one of the four sizes. Images were presented in blocks of 8 images, for 5.5 s per image. After each block, subjects solved a recognition task, which was designed to provide subjects with a well-defined task.

Results: In the first graph, saccadic amplitude histograms are plotted separately for the four image sizes.

Note that the mode remains the same for all image sizes, while mean and median values are directly proportional to image size: see figure below, panel a) and b).

Conclusions:

Effects of image size on saccade amplitude distribution

Image size has no effect on the peak of saccadic amplitude distribution. The modal amplitude is between 0.8° and 1° irrespective of scene size. The visuo-motor system seems to have a propensity for making saccades in this range. It might be economical to place the next fixation in the parafocal range of the last one if there is anything of concern at this place in the stimulus.

Mean and median amplitude is directly proportional to image size. For image viewing studies, these values can be predicted with good accuracy by a simple linear equation. For our data, the approximate equation is:

\[
\text{Mean saccade amplitude} = 0.18 \times \text{max. image extent} + 0.41\,\text{deg} \\
\text{Median saccade amplitude} = 0.14 \times \text{max. image extent} + 0.51\,\text{deg}
\]

Relative to image size, mean and median amplitudes are longer on smaller images. This is suspected to be an effect of the fact that in small images, more of the total information can be captured with a single foveation.

Example: In the larger image (left), an additional short saccade is needed to capture approximately the same information as in the scaled down image (right).

Image size seems to be the dominant factor influencing saccade amplitude. Even when saccade amplitude data from experiments are very heterogeneous in terms of stimuli, tasks, and measurement equipment, the effect of image size is largely overpowering possible effects of such other factors.

References: