Influence of simulated blur on kinematic of eye movements

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Purpose: The goal of this study was to assess the influence of visual blur (defocus) on fixations, macrosaccades (>22º) and microsaccades (<1º). Is visual blur involved in adjusting eye movements at both large and fine scale?

INTRODUCTION:

Adequate attention has not been given from an optometric point of view on the effect of visual blur on the properties of ocular movements. Even though, a study has been performed using impoverished synthetic stimuli (a circular target) which is far away from the everyday viewing of natural scenes. In this context, microsaccades have been shown to have an important role in adjusting the visual blur. [1]

We think that the assessment of the properties of microsaccades and macrosaccades in natural defocused images may lead to some potential clinical applications in optometry to objectively assess the perception of blur.

METHODS

- A database of eye movements recorded on 168 natural images at 5 different levels of blur (using a low-pass filter) on 64 subjects was used. [2]
- All images were presented in random order of blur magnitude and participants were told to move their gaze freely across each image during 3 seconds.
- Monocular Eye-Data were obtained with the Eye-tracker ETL 400 ISCAN (240 Hz, <1º).
- We established the amount of dioptric blur matching the Gaussian blur.
- The properties of the macrosaccades, fixations and microsaccades [3] in blurred images were measured.

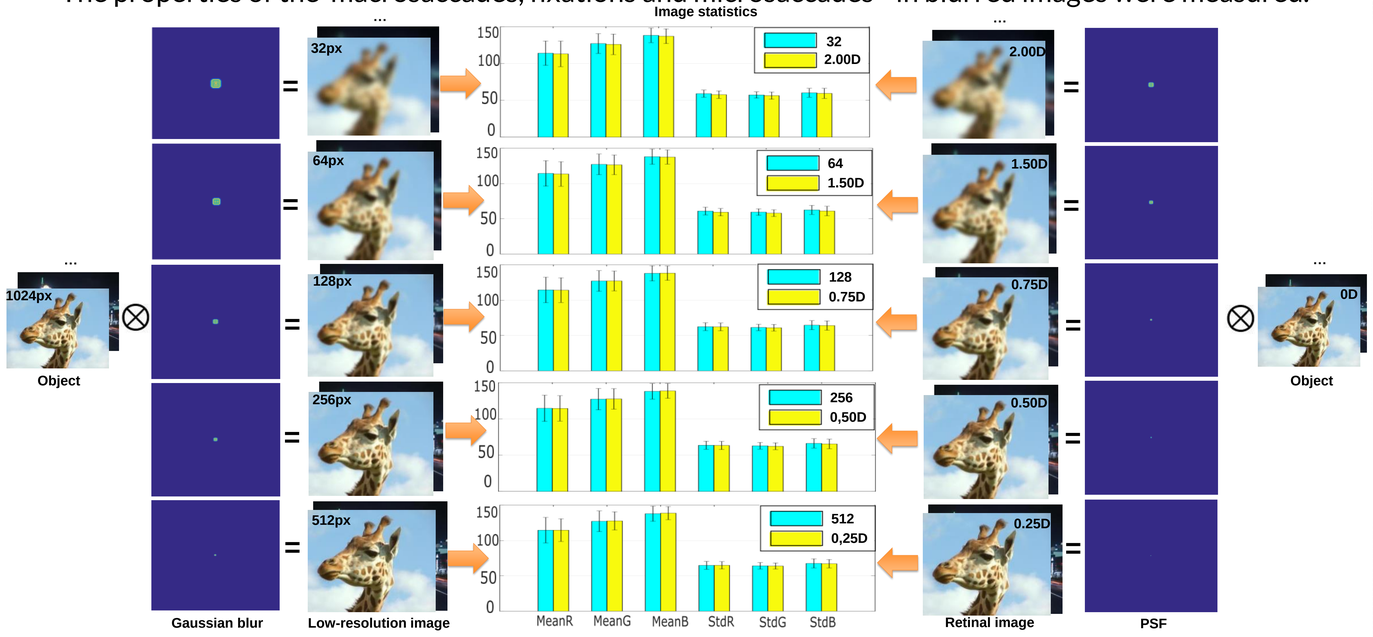

Figure 1. Representation of the two methods employed to generate the blurred images. (Left) Simulated blur applied by a low-pass filter and (right) dioptric blur achieved by convolving the corresponding Point Spread Function (PSF) on each image. The image statistics (mean, standard deviation, among others) were used to obtain the match between the two types of blurs. They were applied to each color channel: red (R), green (G) and blue (B).

RESULTS:

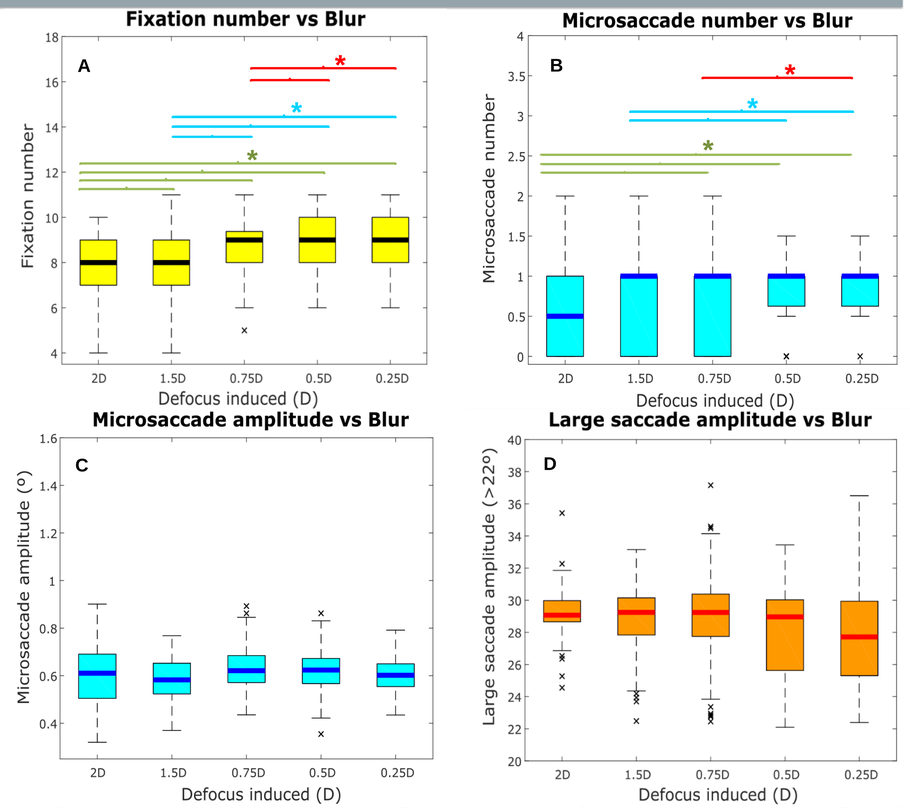

Figure 2. Results of the fixation number (A), microsaccade number (B), microsaccade size (C) and macrosaccade amplitude (D) as a function of blu
Statistical significant differences are shown in green for 2D, blue for 1,5D and red for 0,75D.

CONCLUSIONS:

- When blur increased:
  - ✓ The number of fixations decreased. It may be that fixations tend to be longer to extract the high frequency information of the scene.
  - ✓ The number of microsaccades decreased and there were a large variety of microsaccades. It appears that microsaccade production have a potential role in counteracting the increasing blur.
  - ✓ Macrosaccades amplitude (>22º) increased and all them were almost of the same size. Probably, we do more large exploratory saccades roughly of the same size in order to identify the gist of the scene.
- Ocular movements in this context of free-viewing could help to discriminate, objectively, the observer's perception of blur.

REFERENCES:

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