Influence of optical blur on eye movments in a free viewing task

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Purpose: To assess the influence of optical blur (spherical and cylinder defocus) on fixations, saccades and microsaccades in a free viewing task.

Methods: Monocular eye movements were measured using an eye-tracker (Eyelink 1000, SR Research, Canada) at 500 Hz on 11 healthy subjects with a mean age ± SD of 26 ± 3.8 years. All subjects had best-corrected visual acuity of 0 logMAR or better. All non-emmetropes were corrected with soft contact lenses during the experiment. Each subject was shown monocularly 22 different images during 3 seconds each at 80 cm distance for 7 different levels of optical blur (154 trials). 21 out of the 22 images represented a realistic color scene with some depth cues and only 1 image was comprised with 5 tumbling E letters on a white even surrounding. The 7 levels of optical blur were: 3 levels of spherical defocus (0 diopters (D), +0.5D, +1D) and 4 levels of cylinder defocus (-0.5Dx180°; -1.0Dx180°; -0.5Dx90° and -1.0Dx90°). Each level of optical blur was generated using one trial lens held at 9 cm in front of the participant's eye. A 9-point calibration was performed for each level of blur and subject to compensate for the lens' magnification, which changed the visual field from 14.7° to 16.8°. Images were presented in random order of blur magnitude. Participants were told to free-view each image.

Results: Seven variables were analyzed with a Friedman test considering all levels of optical blur. Values obtained (interquartile range (IQR), Friedman p-value) were: median duration of fixation 266.0 ms (74.75, p=0.87), median duration of saccades 34.0 ms (7.00, p=0.82), median amplitude of microsaccades 0.15° (0.11, p=0.42), median amplitude of saccades 2.3° (0.54, p=0.60), median number of fixations 9.5 (2.25, p=0.38), median number of microsaccades 7.5 (5.25, p=0.56) and median number of saccades 8.5 (2.25, p=0.38). Median (IQR) post-hoc statistical power of all seven variables was 0.99 (0.00).

Conclusions: Our results suggest that fixations, saccades and microsaccades are not influenced by low levels of spherical and astigmatic defocus in free viewing tasks. It is hypothesized that free viewing tasks is masking a potential effect of optical blur in ocular movements. Future studies might investigate whether optical blur affects ocular movements in activities with higher demands of visual acuity or higher cognitive demands (e.g., reading).

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: