Eye fixations in reading: a new technique for evaluating visual performance.

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Background: Previous studies have examined the impact of contrast on reading performance by recording eye movements, revealing that both reaction times (RTs) in single-word tasks and fixation durations in reading are increased in low contrast. In this study we investigated the effect of contrast and print size on reading performance.

Methods: A group of 20 young subjects (age range: 22 to 36 years) participated in the experiment. All subjects had to read comprehensively single sentences from the Greek versions of Colenbrander Reading Cards (high, 100%, and low, 10%, contrast) at a distance of 40 cm. Eye-movement recording was performed with an infrared eye tracker (EyeLink II, SR Research Ltd). Data analysis included computation of the fixation duration and the number of fixations. Moreover, frequency distributions of fixation durations were analysed with the ex-Gaussian fitting, a convolution of a normal and exponential distribution that can characterize the location and shape of distribution.

Results: Analysis showed that median fixation duration was always slower when reading text of 10% compared to 100% contrast. In addition, median fixation duration, at 100% contrast, was not affected by changes in large print size (from 0.9 to 0.3 logMAR), while it increased for smaller letters (from 0.2 to -0.1 logMAR). At 10% contrast, the change in fixation duration was evident for larger sizes, at 0.4 logMAR. Test-retest repeatability was high and revealed no significant learning effects in median fixation duration, but only for small print size. Finally, ex-Gaussian resulted in a quantitative description of the fixation duration distribution.

Discussion: The study confirms the hypothesis that fixation duration can be used as a measure of reading proficiency and generally visual performance. Ex-Gaussian analysis could be used to distinguish oculomotor from cognitive processing. This analysis could be applied in clinical cases, e.g. following cataract surgery and other procedures used in presbyopia correction.