A computational approach to deriving the empirical frequency-of-seeing curves in patients with glaucoma

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Purpose

- To derive the empirical frequency-of-seeing (FOS) curves in patients with glaucoma from longitudinal visual field data using a probabilistic modeling.

Methods

- The Rotterdam Eye Study data (Bryan *et al.*, IOVS 2013) were used to prepare test-retest data for a hypothetical glaucoma patient.
- The test-retest data were modeled as a multinomial distribution generated from a biased die with 42-faces (<0, 0, 1, ..., 40dB).
- FOS curves, defined as cumulative gaussian function, were incorporated into the bias, based on the possible response sequences at four primary points (± 9°, ± 9°) during the Humphrey Full Threshold testing (Turpin *et al.*, Vis Res 2005).
- The parameters of FOS curves were estimated by a computer program written in the probabilistic programming language *stan* (https://mc-stan.org/).

Results

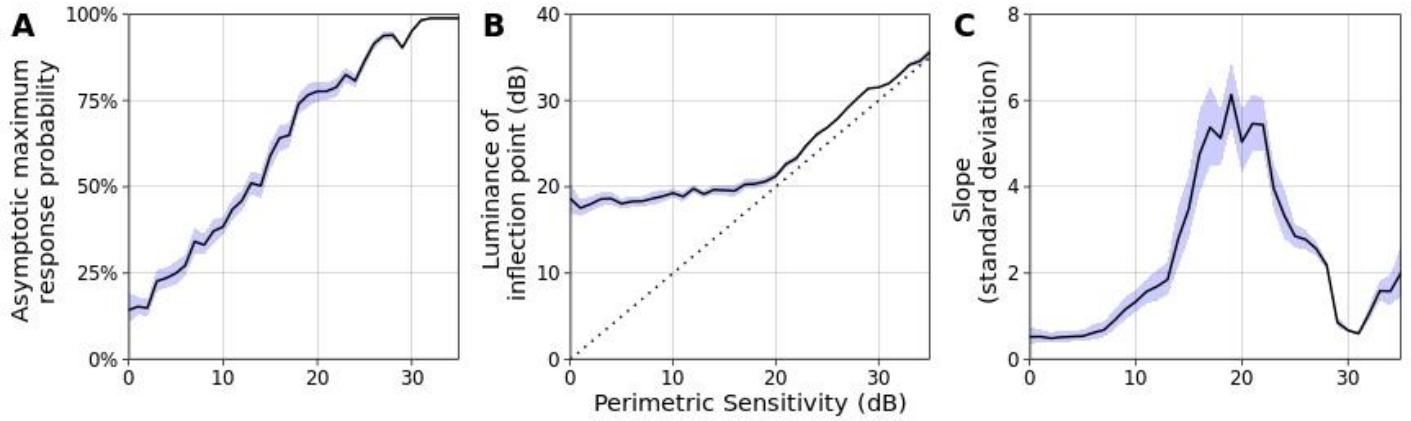

Fig 1. Changes in estimated parameters as a function of *true* perimetric sensitivity. The blue shade area represents the 90% credible interval.

As glaucoma progresses, (A) the asymptotic maximum response probability declined monotonically from 99% (35dB) to 14% (0dB). (B) The luminance of inflection point reached a plateau of approximately 19dB. (C) The standard deviation increased to a peak value of 6.13 at 19dB.

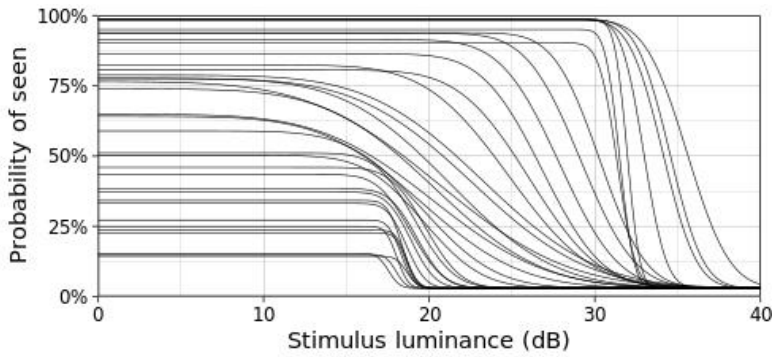

Fig 2. Overall changes of the empirical FOS curves in patients with glaucoma.

In moderate to severe stages, the psychophysical threshold for luminance increment was not changed substantially.

Conclusions

- These results show that visual dysfunction in glaucoma patients is distinctly different from previously proposed.
- Interestingly, the luminance increment threshold appears to be inherently limited.

The author has no conflict of interest to disclose.