Background
Reliably detecting glaucomatous progression using current white-on-white perimetric methods (SAP) often takes upwards of eight visual field tests. In this study we used computer modeling to quantify the decrease in variability required in current techniques that would lead to detection of progression in fewer visits.

Methods
The variability of threshold estimates of a true threshold $t$ was modeled as a Gaussian fitted to 10,000 applications of the Full Threshold algorithm to a patient with false response rates of 1%, and a psychometric slope as described in Henson et al [1]. Figure 1 shows that this model accurately reproduces known test-retest data of SITA [2]. Improved perimetric procedures were simulated by reducing the standard deviation of the fitted Gaussian in steps of 10% from the original.

We classified progression in two ways: pointwise linear regression (PLR) on individual locations, and linear regression on Mean Defect (MD) (data not shown on this poster, see third reference). Both techniques used criteria that had 95% specificity at all time periods determined by simulation of 1000 subjects stable at 30dB.

Results
Figure 2 shows the number of years of testing required to achieve various true-positive rates at 95% specificity (true negative rate) using PLR on locations beginning at 30 dB, with testing either twice or thrice per year. More comprehensive data is included in our related paper (to appear, currently online [3]).

Figure 3 shows the standard deviation of a Gaussian that models error for various procedures other than those used to generate Figures 1 and 2. The ZEST procedures are those we have used previously in related work [4].

Conclusions
Progression of 1 dB per year can be detected 2 to 3 visits earlier using a procedure with 40% less variability than current procedures.

It is unlikely new testing algorithms combined with Size III white-on-white targets alone can create the reduction in variability required: alternate stimuli may be required.

The methods adopted in this paper can be applied to analyze new perimetric techniques prior to lengthy and expensive clinical trials in order to determine their utility for classifying progression.

References

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