Objective estimation of visual acuity with preferential looking

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PURPOSE
A novel preferential looking (PL) procedure that uses quantitative analysis of visual scanning parameters is presented.

METHODS
Nine adult subjects were presented with a set of 14 visual stimuli (stimuli included three uniform gray fields and one field with black-and-white square wave gratings) spanning the range of spatial frequencies from 1.5 cyc/deg to 35.1 cyc/deg (1.3 logMAR to -0.07 logMAR). A remote gaze-tracking system was used to monitor the subject's eye movements and the relative fixation time (RFT) on the grating target. Subsequently, a four alternative forced-choice psychophysical test (4AFC) was performed with the same visual stimuli.

RESULTS
For visual stimuli for which the gratings' positions in the 4AFC test were identified correctly in 100% of the trials (reliably discriminated), the mean RFT was 72.5% ± 9.0%. For stimuli for which the spatial frequencies were higher than the subject's psychophysically determined visual acuity (VA) threshold (nondiscriminated), the mean RFT was 25.3% ± 8.5%. Using three repeated trials at each spatial frequency and a VA detector based on the conditional probability density functions of the RFT, the average VA was underestimated by 0.06 logMAR (range, 0.00-0.20 logMAR).

CONCLUSIONS
In adults, automated quantitative analysis of visual scanning patterns can be used to estimate VA objectively and rapidly (210 seconds) with a mean error of 0.06 logMAR. The novel approach may form the basis for PL procedures that are more objective and more accurate than the traditional clinical PL procedures.