322-B0567

OBJECTIVE AMPLITUDE OF ACCOMMODATION AND REFRACTION USING A NEW WAVEFRONT METRIC DEPENDING ON PUPIL RADIUS

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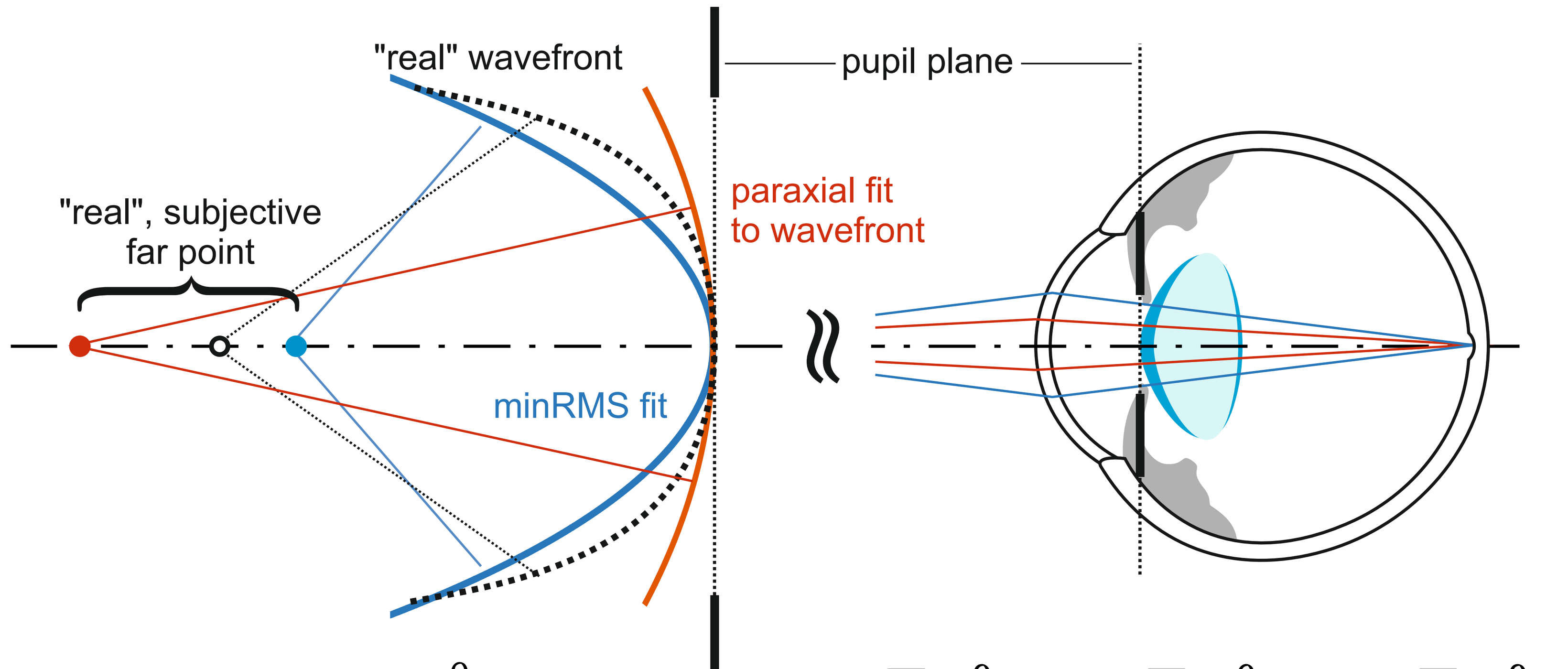
Traditional objective refraction metrics depend on the objective pupil radius r_0, but they don't take into account the subjective pupil radius that the subject has during clinical subjective refraction, and in typical daily conditions.

DIFFERENT METRICS PREDICT SLIGHTLY DIFFERENT EQUIVALENT SPHERES FROM THE SAME WAVEFRONT DATA



$$M_{minRMS} = \frac{-4\sqrt{3}C_2^0}{r_0^2} \qquad M_{paraxial} = \frac{-4\sqrt{3}C_2^0 + 12\sqrt{5}C_4^0 - 24\sqrt{7}C_6^0}{r_0^2}$$

Purpose: To develop an objective refraction formula based on the ocular wavefront error expressed in terms of Zernike coefficients and pupil radius, that would be an accurate predictor of subjective spherical equivalent (SE) for different pupil sizes

We propose a new metric, that fits an equivalent sphere to the ocular wavefront at the centre and at a variable distance *"t"* between the centre and edge of the pupil. The optimal fitting distance t_{opt} is obtained empirically from a dataset of 308 eyes.

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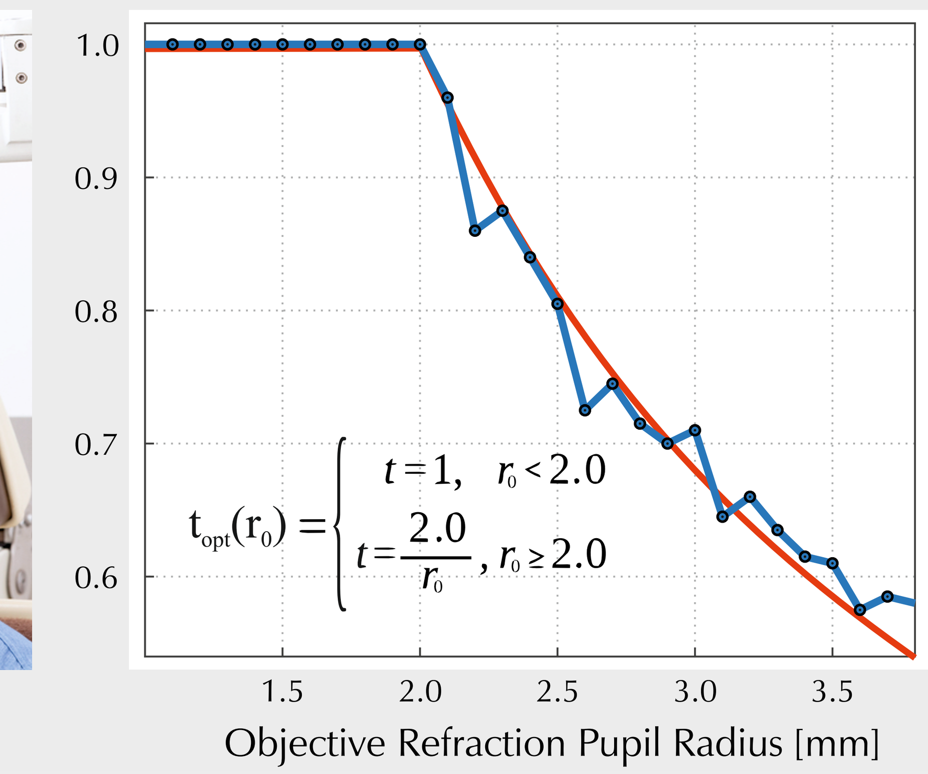
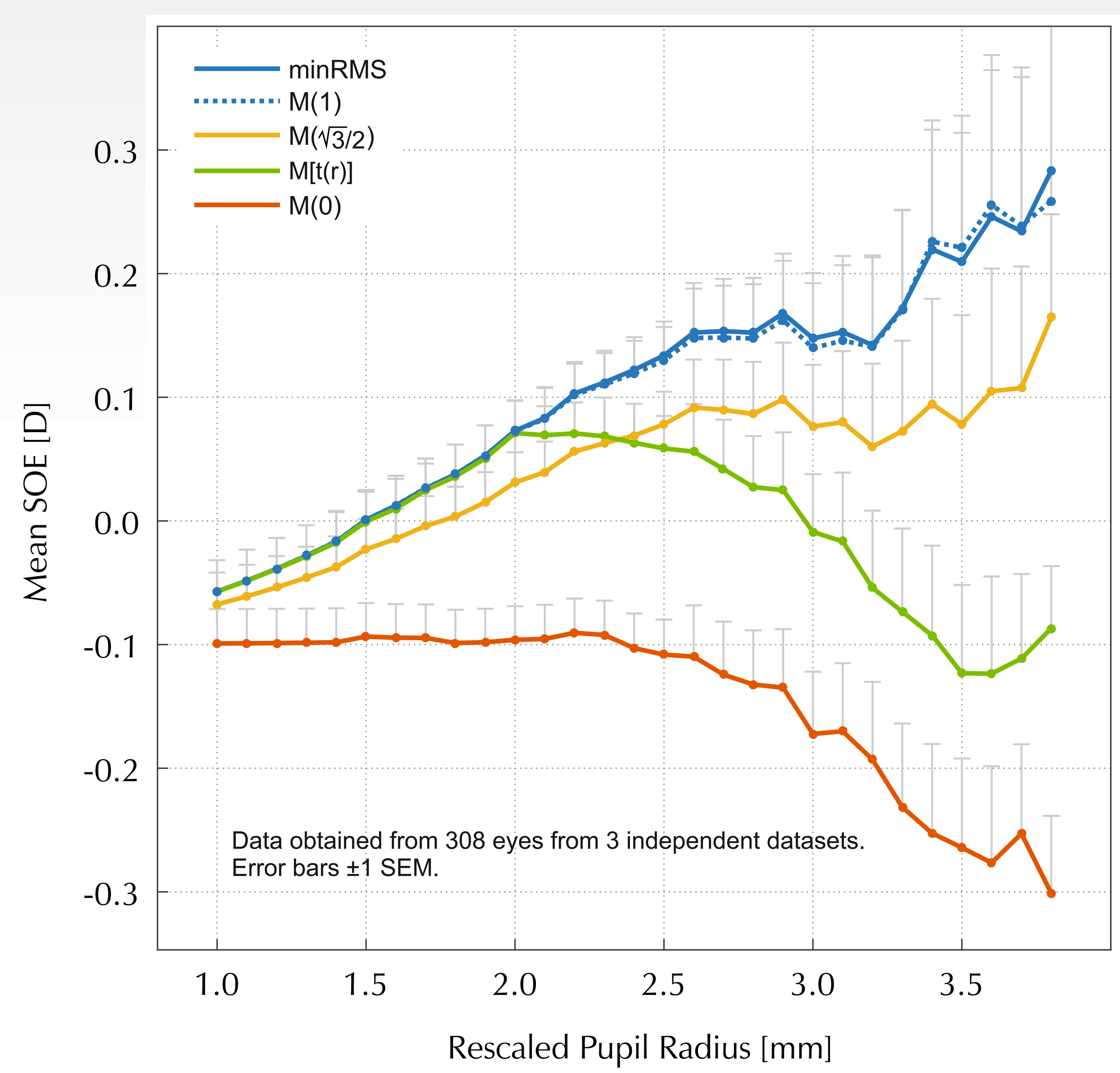
NEW, GENERAL OBJECTIVE REFRACTION METRIC

$$MTR = \frac{-4\sqrt{3}C_2^0 - 12\sqrt{5}C_4^0\left(t^2-1\right) - 4\sqrt{7}C_6^0\left(10t^4-15t^2+6\right)}{r_0^2}, \quad t = f(r_0)$$

The parameter t controls the position of the nodes at which the equivalent sphere is matched to the wavefront of the eye. The traditional minRMS and paraxial metrics can be obtained for $t=1$, and $t=0$, respectively. We used 3 independent datasets of subjective and objective refractions of normal eyes to find the optimum value t_{opt}.



MEAN SOE (Δ SUBJECTIVE – OBJECTIVE REFRACTION ERROR)



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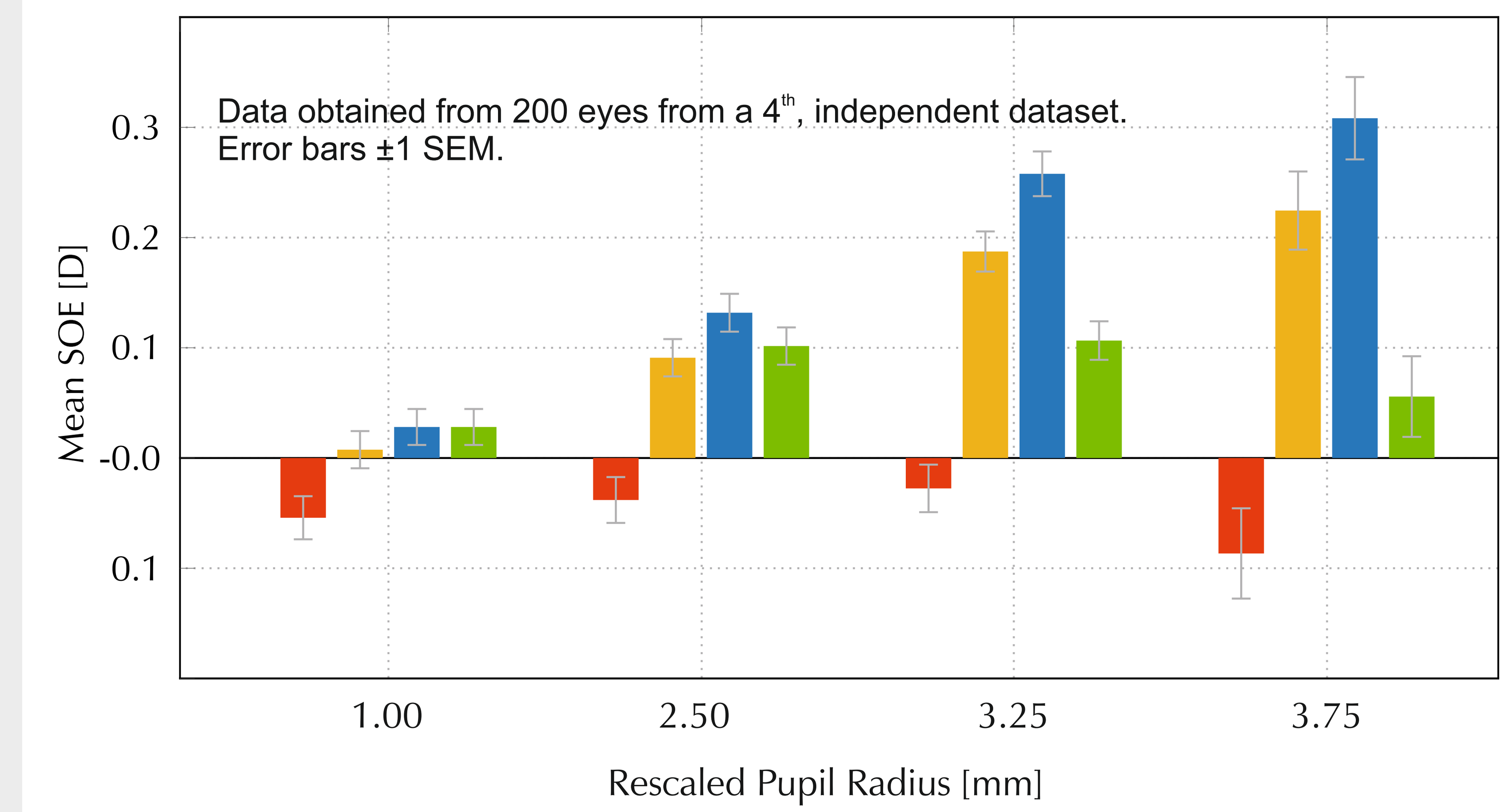
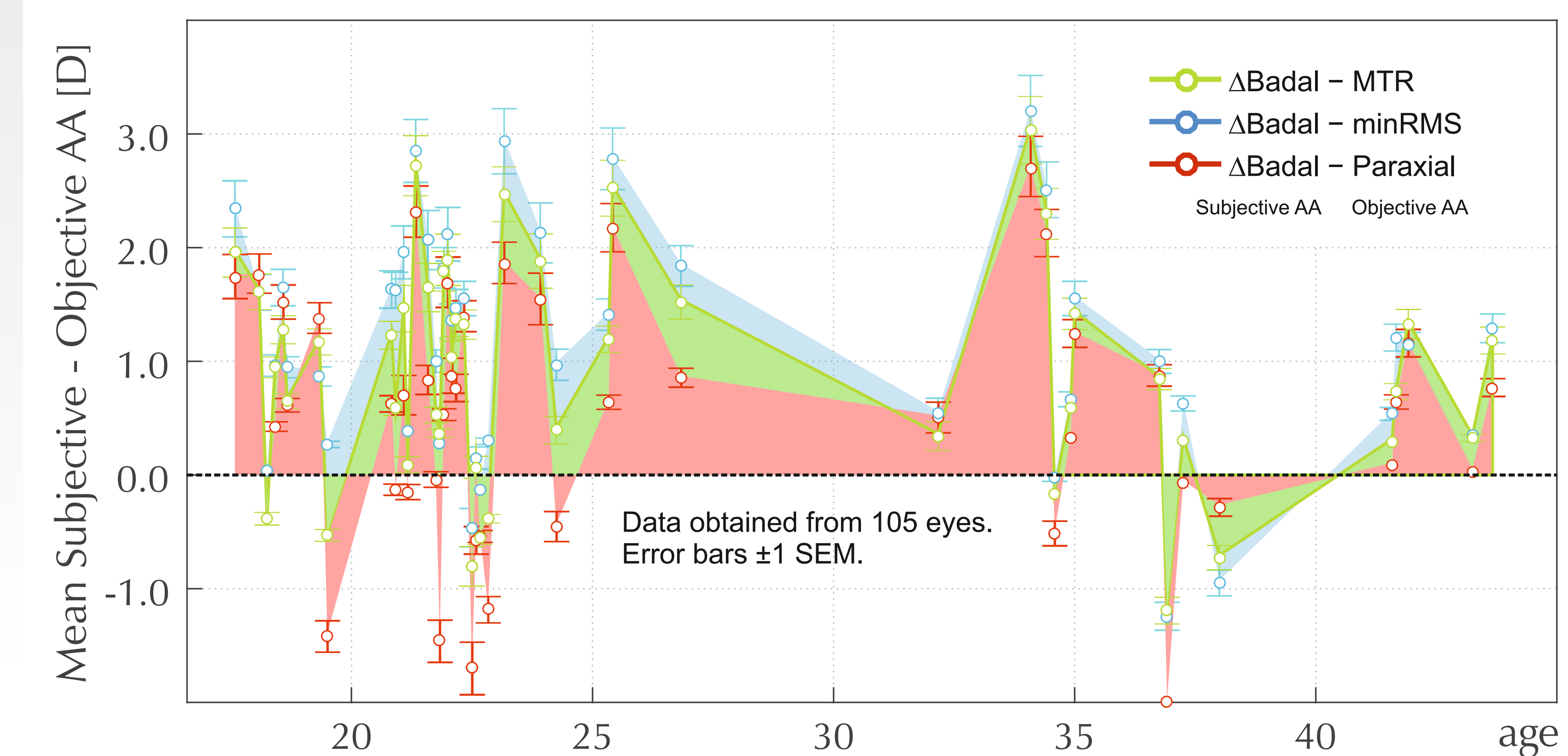
MEAN SOE Cycloplegic eyes with corrected LOA (low-order aberrations)



Δ SUBJECTIVE – OBJECTIVE AMPLITUDE OF ACCOMMODATION



Conclusions: For small pupil radii $r_0<2.25mm$, all of the wavefront refraction metrics are similarly accurate in predicting the equivalent sphere (mean $SOE<0.1D$). For large pupil radii, however, the mean absolute SOE error of traditional metrics increases beyond $0.25D$, which is clinically significant. The solution proposed in the study addresses this problem, and takes into account the effects of SA. The MTR wavefront refraction metric is designed to depend on the pupil radius, applying more or less weight to the SA coefficients in function of r_0.