

Interaction between primary and secondary spherical aberrations and its impact on retinal image quality through focus

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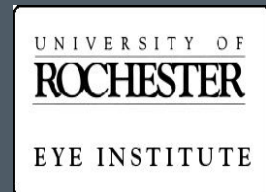
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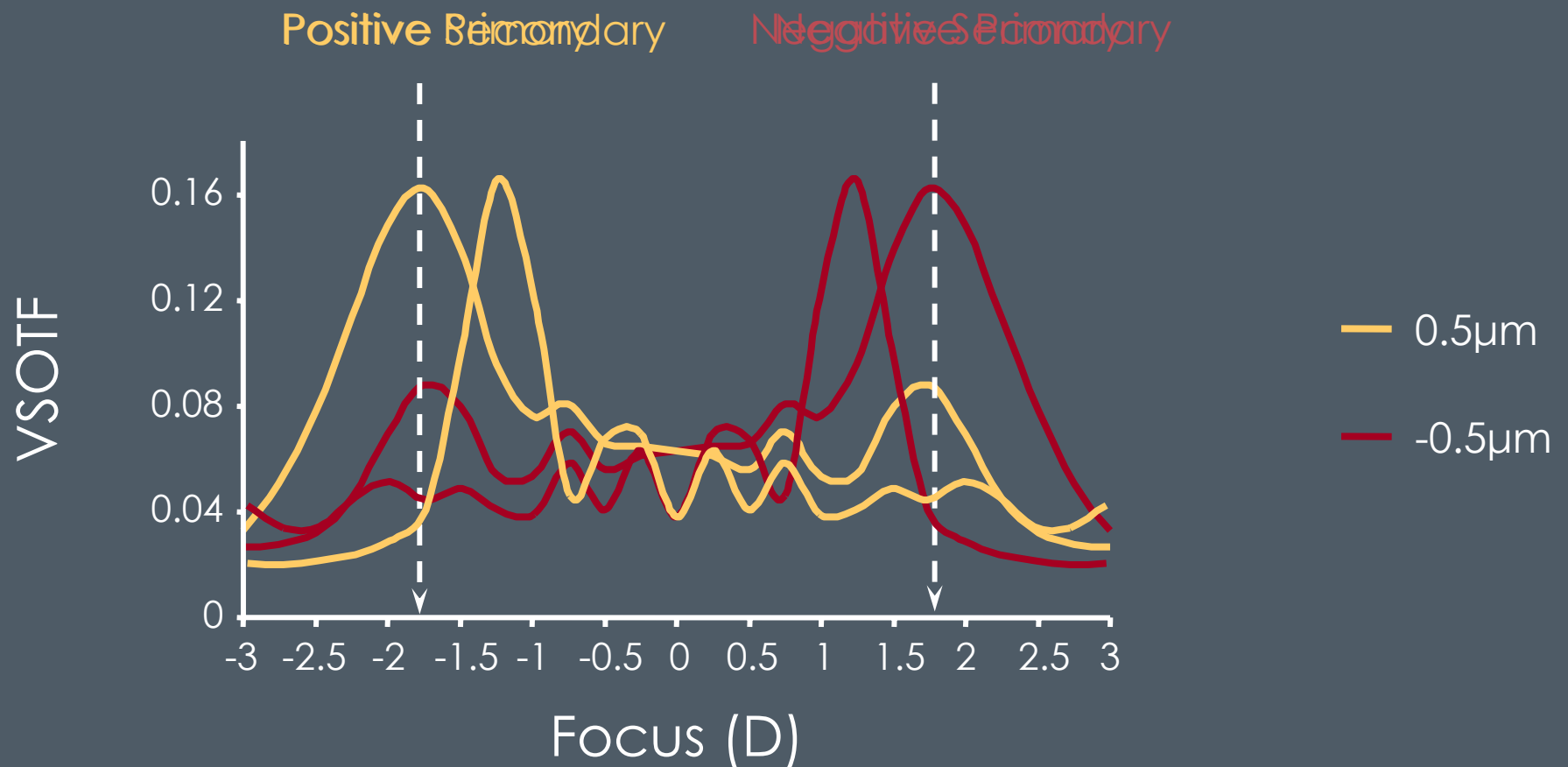
Goal

- Multifocal intraocular lenses have been shown to contain higher order spherical aberrations.
- To investigate the interaction of primary (Z_4^0) and secondary (Z_6^0) spherical aberrations with defocus
 - Impact on through focus retinal image quality (RIQ)

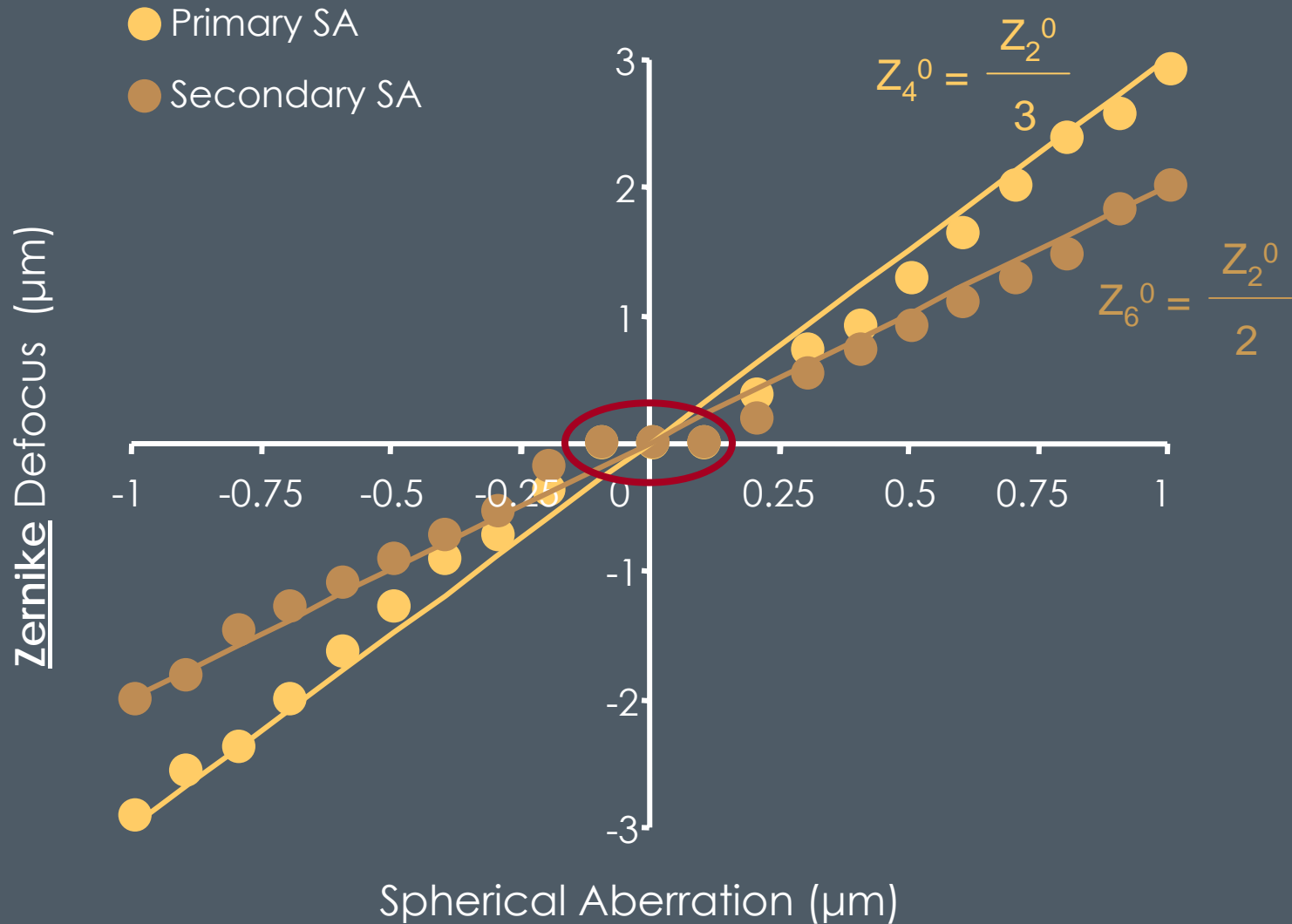
Methods

- Visual Strehl ratio based on the optical transfer function (VSOTF)
- 4.5mm pupil diameter, monochromatic light
- Interaction of SA with defocus
 - Primary SA + Defocus
 - Secondary SA + Defocus
 - Primary SA + Secondary SA + Defocus
- Area under VSOTF
 - Through focus ranges

SA interacts with defocus to form peaks of RIQ with symmetry between positive and negative coefficients

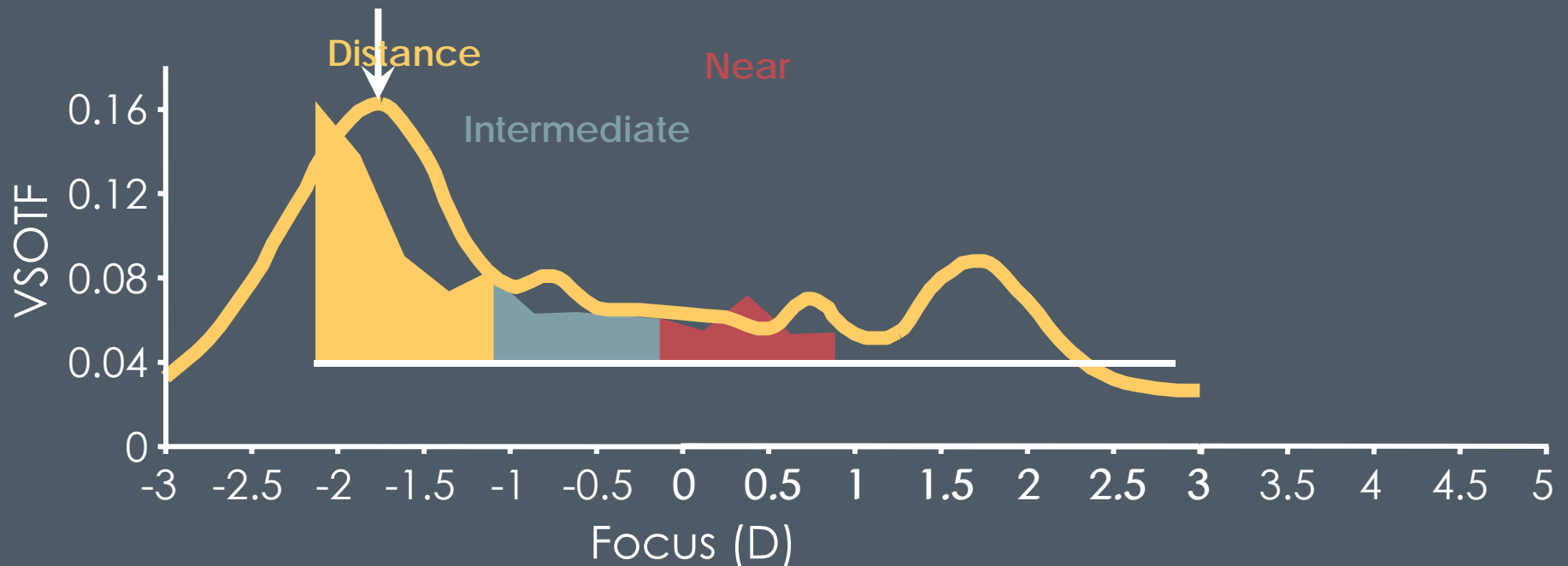


Primary and secondary spherical aberrations linearly interact with defocus to produce peaks of RIQ

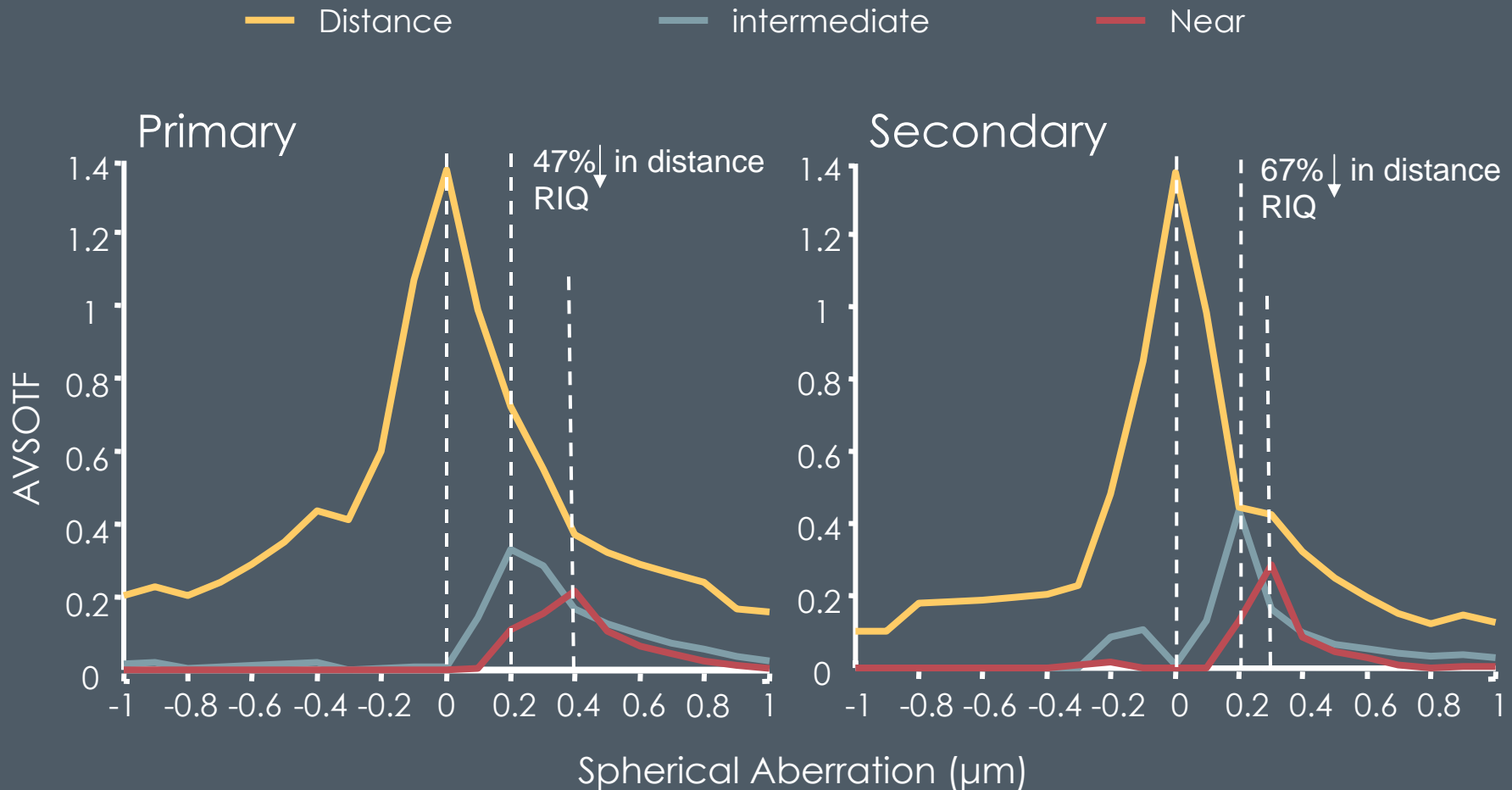


Defining depth of focus from peak VSOTF

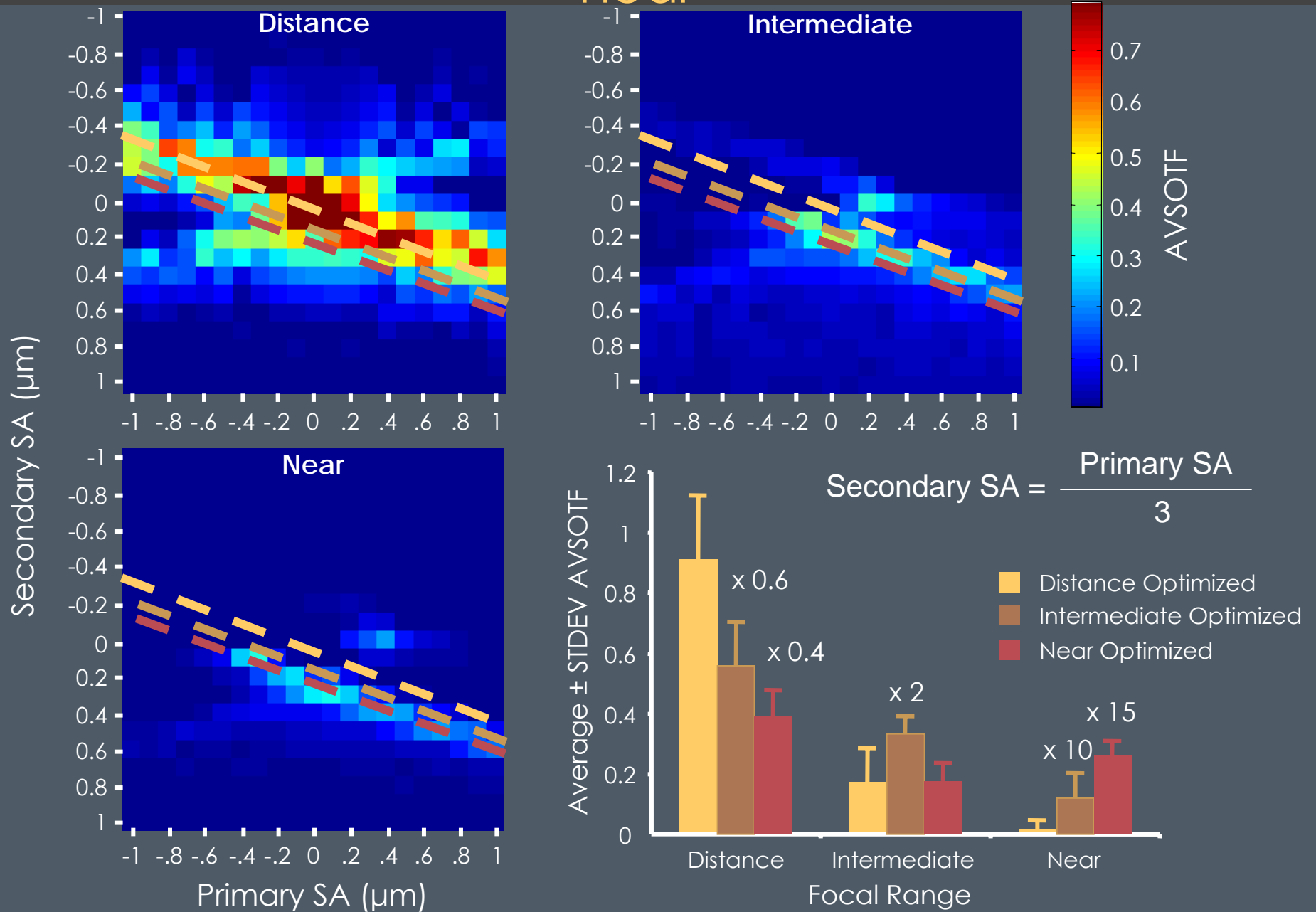
- Aberration interaction set so distance peak always optimized
- Depth of focus (DOF) achieved when VSOTF $\geq 0.04 \approx 20/40$ Snellen VA



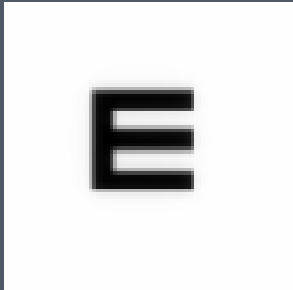
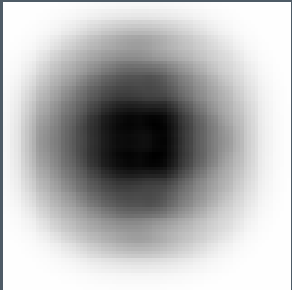
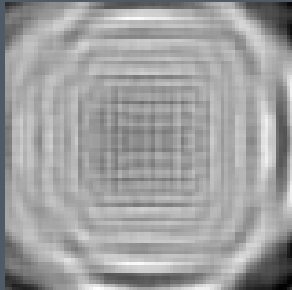
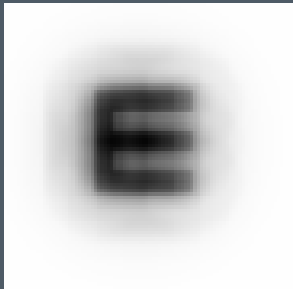
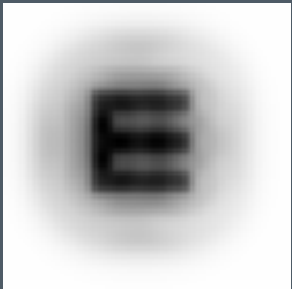
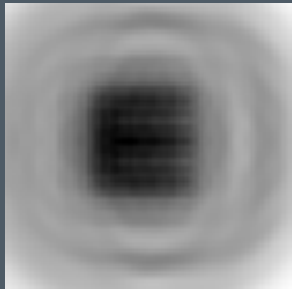
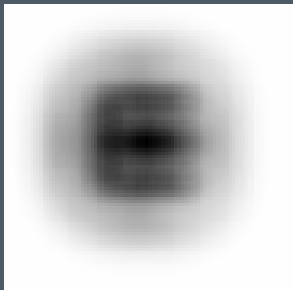
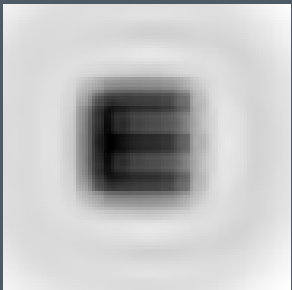
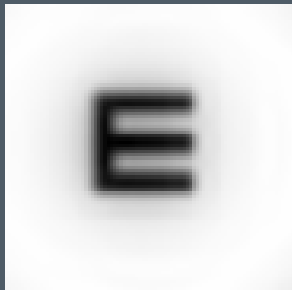
Decrease in distance RIQ a trade off to improve intermediate and near



SA's interact to form RIQ peaks for intermediate and near



Retinal image quality through optimized zones

	Distance	Intermediate	Near	Primary	Secondary
Distance Optimized				0 μ m	0 μ m
Intermediate Optimized				0.3 μ m	0.25 μ m
Near Optimized				-0.3 μ m	0.15 μ m

Conclusions

- Peaks of RIQ are formed when

$$z_4^0 = \frac{z_2^0}{3} \quad z_6^0 = \frac{z_2^0}{2}$$

- Interactions of primary and secondary spherical aberration can optimize retinal image quality and

$$z_6^0 = \frac{z_4^0}{3}$$

- AVSOTF can be a good predictor of through focus RIQ

Thank you!