Sensitivity in imperfect eyes

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Visual sensitivity depends on:

1. How much light reaches the central photoreceptor,
2. and how much of that light gets absorbed by that receptor.

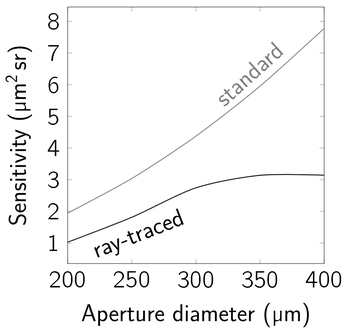
The standard model for sensitivity assumes that:

- All light that passes the aperture terminates at the central photoreceptor.
- On- and off-axis targets focus the same way.
- Light passes straight through the full length of the receptor.

But aberrated eyes break those assumptions:

- Imperfect optics defocus the light.
- Coma: changing the viewing angle changes the focus.
- Off-axis light does not pass through the whole receptor.

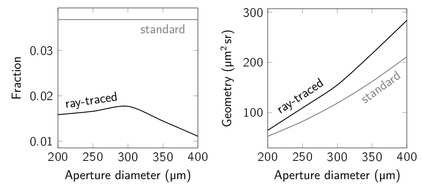
We used the eyes of scallops as an example of an aberrated visual system. The ray traced sensitivity of their eyes was much lower than the standard model one.

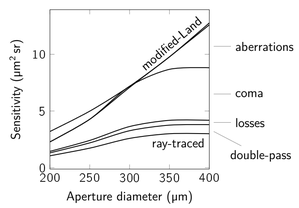


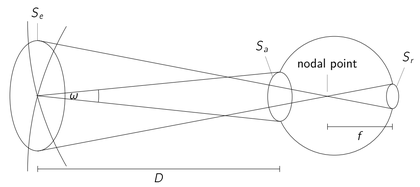
Calculating **sensitivity** in imperfect eyes may be **inaccurate**.

Ray tracing sensitivity is superior to the **standard model**.

Scan or take a picture for the original paper, ray tracer, and this poster







Adapted from Figure 3 in M. F. Land: Optics and Vision in Invertebrates.

total flux passing through pupil	$F_a = \frac{L \cdot S_e \cdot S_a}{D^2}$
retinal illumination	$E_r = \frac{F_a}{S_r}$
only if the nodal point is in the pupil	$\frac{S_e}{D^2} = \frac{S_r}{f^2}$
this follows	$F_a = \frac{L \cdot S_a \cdot S_r}{f^2}$
	$E_r = \frac{L \cdot S_a}{f^2}$
Geometry	$= \frac{\pi}{4} \frac{A^2}{f^2}$
Fraction	$= \frac{\pi}{4} d^2 \left(1 - e^{-kx}\right)$
Geometry × Fraction	$= \left(\frac{\pi}{4}\right)^2 \left(\frac{A}{f}\right)^2 d^2 \left(1 - e^{-kx}\right)$

M. F. Land: Optics and Vision in Invertebrates.