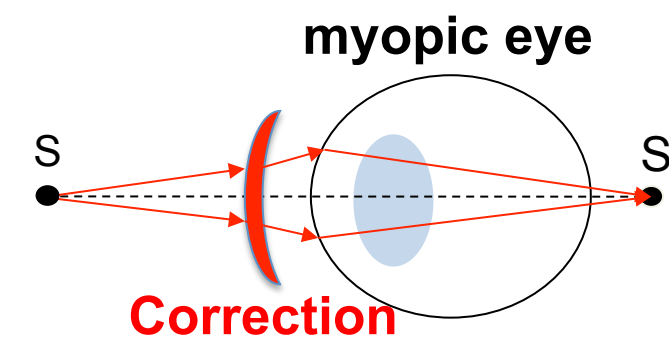


### Purpose

Accommodative lag, which is usually larger in myopes than emmetropes or hyperopes, has been linked to myopia progression [1].

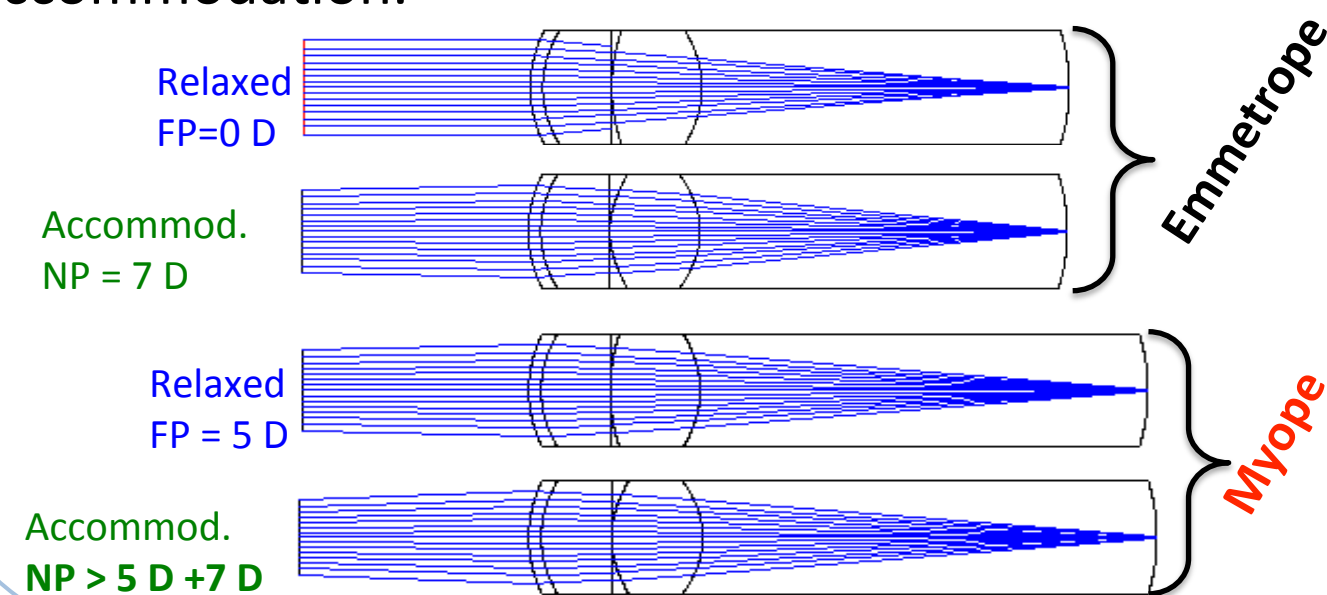
Our purpose is to account for myopic lag in terms of physiological optics.

We start by asking : *If two young eyes have identical optics but different vitreal chamber lengths (VCL), which has a larger amplitude of accommodation?*



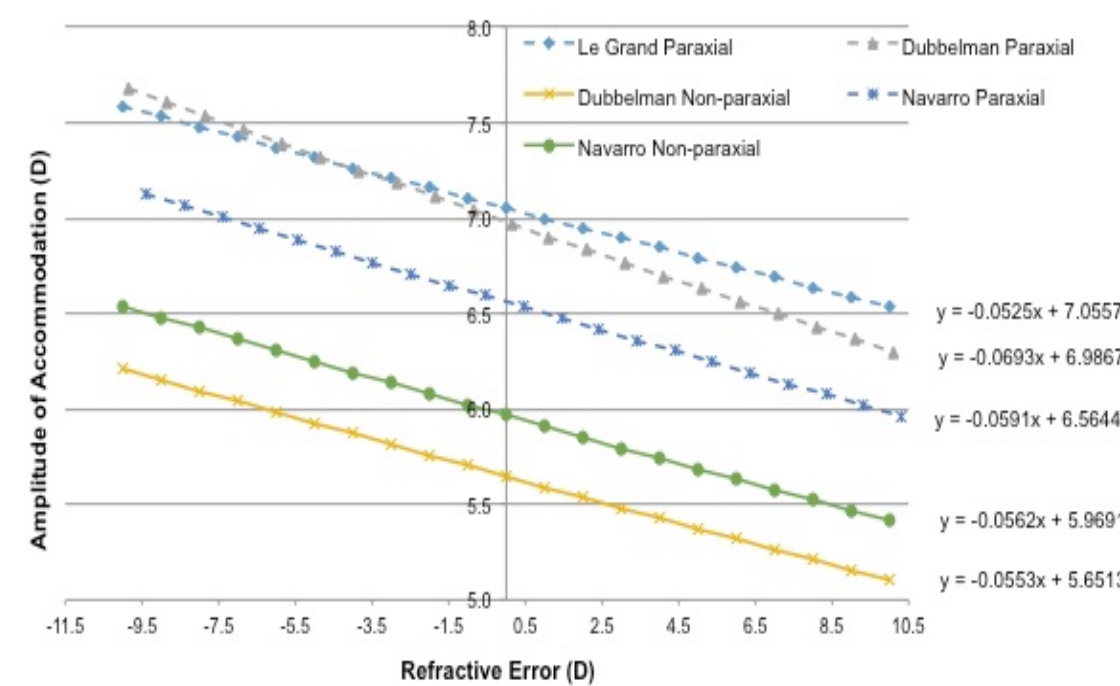
### Methods

We performed a general paraxial analysis and computer ray tracing calculations in three eye models with the same optics and the same changes of lens geometry during accommodation but different axial lengths. Accommodation, defined as a change in vergence of the foveal conjugate point in object space, was calculated without correction and again with refractive error corrected with a spectacle lens placed at a certain distance from the eye. Vergences to the retinal conjugate point was computed from the correction plane ( $AA_{CP}$ ) and also the corneal vertex ( $AA_{CV}$ ). Lag will show up when comparing the differences in target vergence and accommodation.



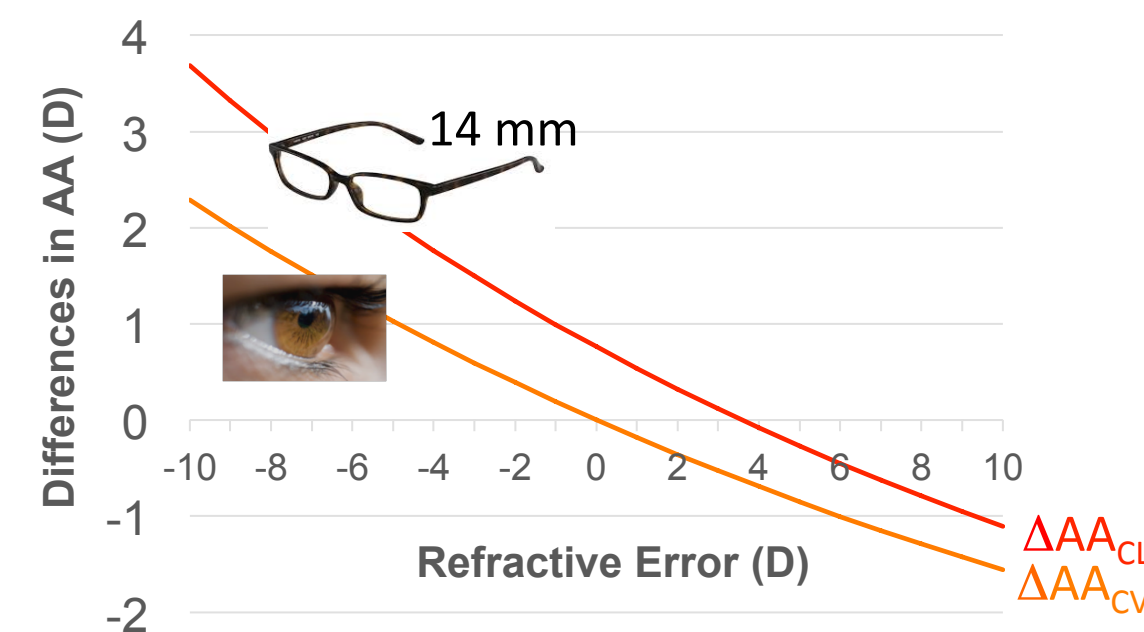
### Results

Internal effect

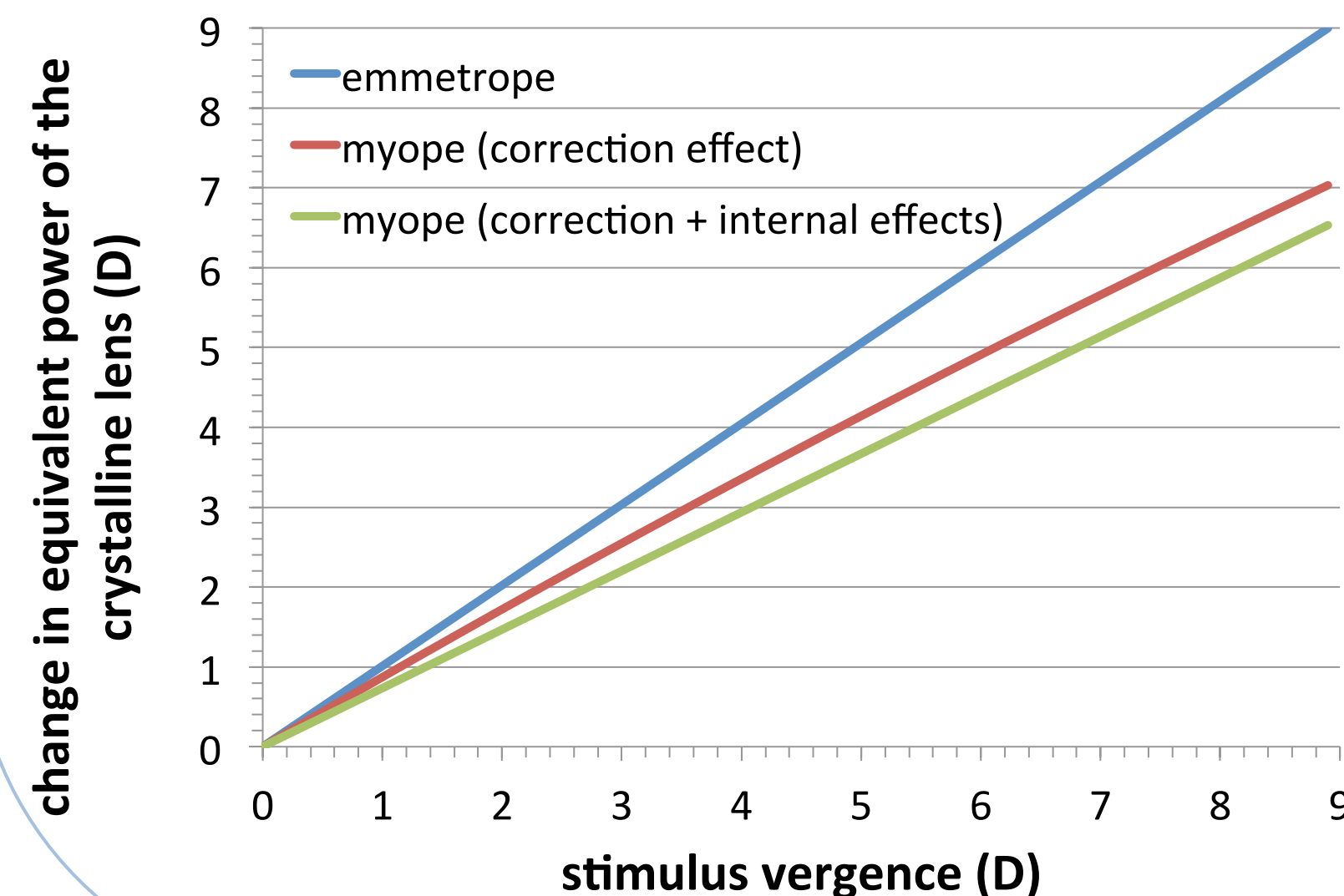


Amplitude of accommodation ( $AA_{CV}$ ) for three eye models (about 7 D of accom.) under paraxial a non-paraxial optics. Myopic eye models had a slightly larger AA than emmetropic or hyperopic models (about 1.1 D every 20 D of myopia).

Correcting effect



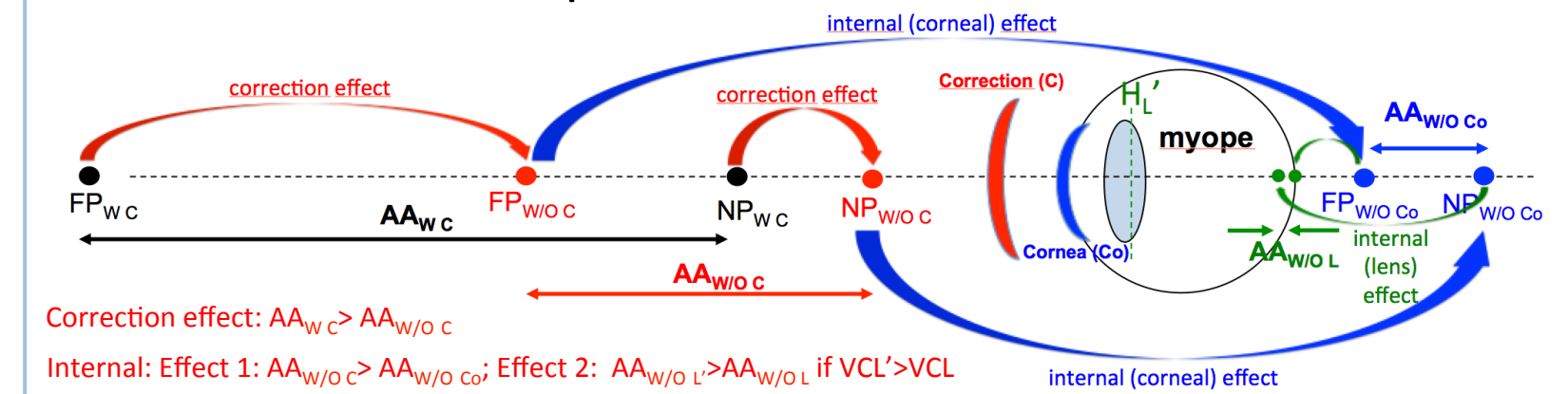
Change in AA of the corrected emmetropic eye when vergences are referred to the correction plane,  $AA_{CL}$  or corneal vertex,  $AA_{CV}$ . Myopic eyes have larger AA (between 4 and 5 D every 20 D of myopia).



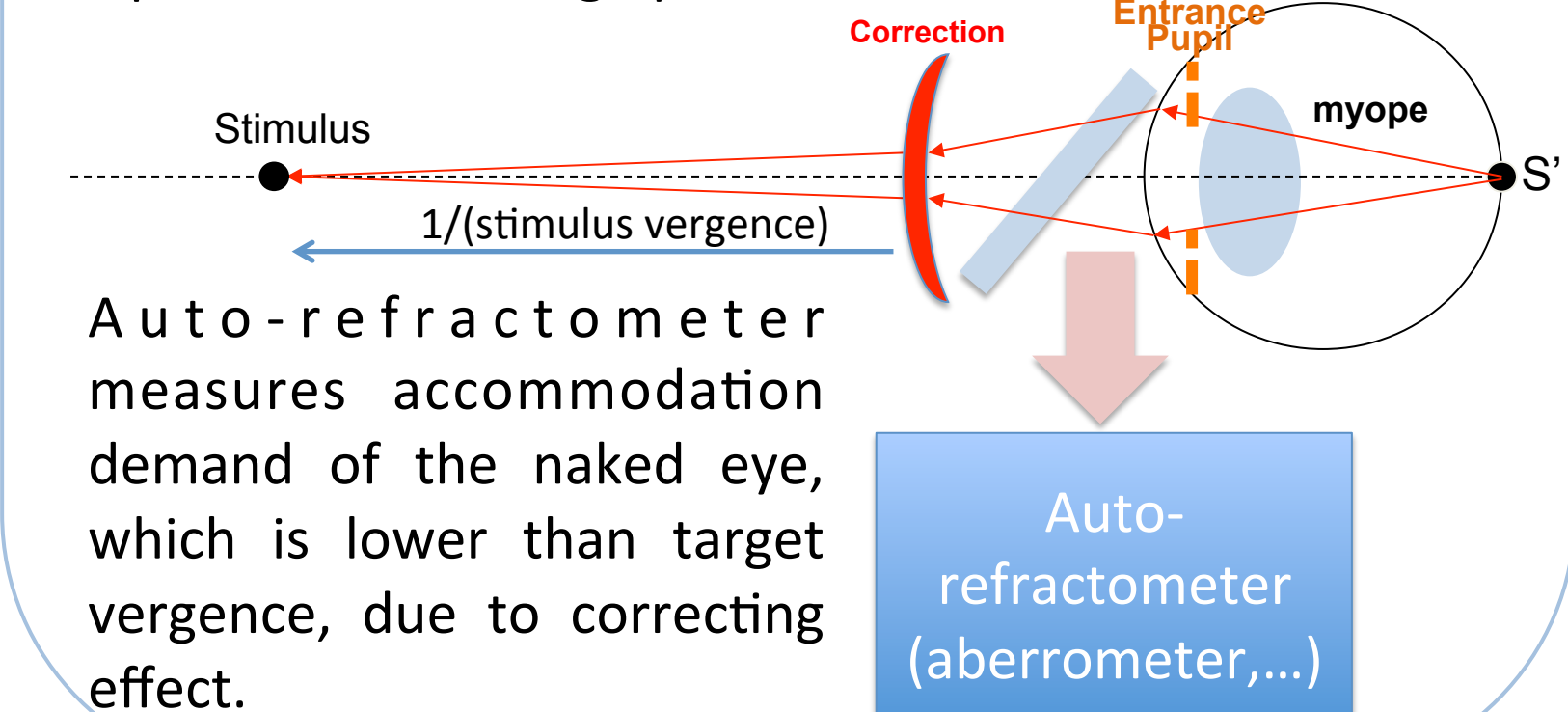
Computed accommodation response in terms of the change of power of the crystalline lens in an emmetropic eye and a 5D-myopic eye corrected with spectacles at 14 mm. For a certain stimulus vergence, the myopic eye does not need to change the lens power so much as the emmetrope.

### Discussion/Conclusions

**Explaining the effects:** Besides the well-known effect of the correction lens [2], there is another effect (internal) originated by the distance between the cornea and the lens principal plane ( $H'_L$ ), and its movement during accommodation respect to the retina.



**Explaining apparent larger lag in myopes:** Even if the eye accommodates perfectly to the target, depending how accommodation response is measured these two effects may affect the results showing a larger lag in myopes than in emmetropes. For instance, accommodation response is typically measured using an auto-refractometer analyzing rays leaving the eye, while target vergence is measured respect the correcting ophthalmic lens.



#### References:

- Nakatsuka C, et al. Jpn J Ophthalmol. 2005 May-Jun;49(3):189-194.
- Bennett & Rabbett's Clinical Visual Optics. 4th edition ed. Oxford: Elsevier; 2007. p. 125-153.

#### Funded by:

