# Stockholm Myopia Study: Inherent multifocality in the periphery?

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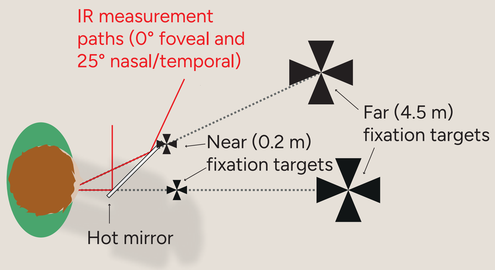
## Introduction

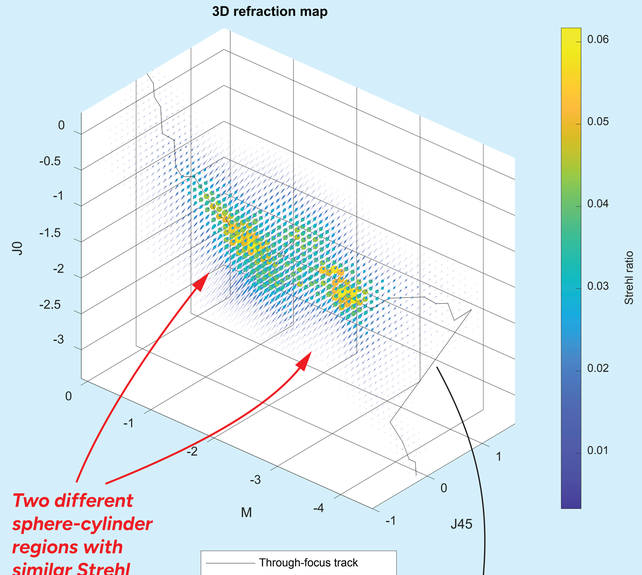
- It is not fully understood how peripheral image quality affects emmetropization, but animal studies and optical myopia control therapies suggest that peripheral defocus is important.
- Due to large higher-order aberrations (HOAs), peripheral refraction is often hard to define.

**Aim:** to evaluate the through-focus peripheral image quality of children, to investigate depth-of-focus (DOF) and implications for defining the peripheral refraction.

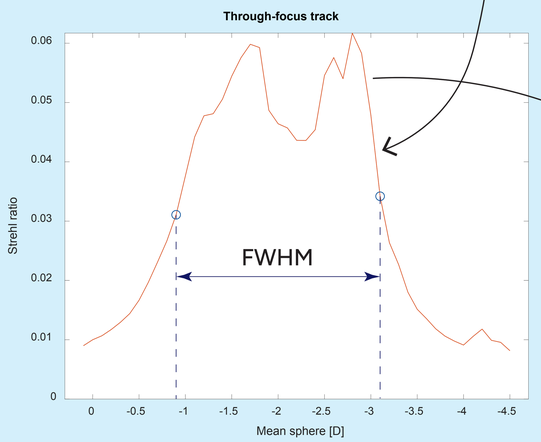
## Methods

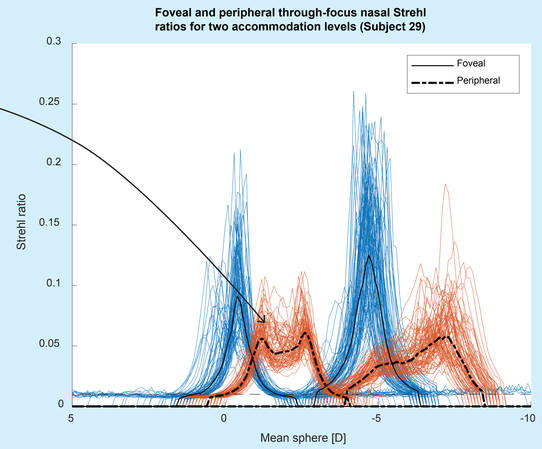
- 33 children aged 6- to 11-years-old
- Central and peripheral retinal image quality (25° nasal/temporal visual field) was measured with a dual-angle wavefront sensor for two different accommodation levels (0.22 D and 5 D).
- ~700 analyzed wavefronts per child




- For each wavefront, a **3D refraction map** was calculated
  - M, J0 and J45 were varied in 0.1 D steps
  - 10,000 combinations of M, J0 and J45 tested
- To assess the refractional depth-of-focus (DOF), the best Strehl value for each M value (varying J0 and J45) were extracted, yielding a **through-focus track** in the 3D map.
- The Strehl values in the through-focus track gives an indication of **multifocality**.




Median through-focus curves were calculated for each child and visual field/accommodation target.

## Results

- **Refractional DOF was larger in the periphery** compared to on-axis; on average the full-width-at-half-maximum (FWHM) was 0.8 ± 0.3 D centrally and 1.4 ± 0.8 D in ±25° angle with natural pupils (mean pupil radius 2.9 ± 0.4 mm).
- In five of the measured children the **peripheral FWHM was twice that of the central** for both the nasal and the temporal field at both levels of accommodation.
- Furthermore, **12 children had some inherent multifocality in the periphery**, with two distinct peaks in the through-focus Strehl ratio as judged by at least two out of three independent investigators.
- There was **no difference in pupil size** nor in maximum Strehl ratio between these 12 children and the other 21. However, the multifocality was only apparent with natural pupils; it disappeared when the wavefronts were scaled to 2 mm radius. **This indicates that HOAs, which increase with pupil size, are the main factor behind the multifocality.**

## Conclusion

Some children exhibited inherent peripheral multifocality, where **different sphere-cylinder corrections yielded similar Strehl ratios**. This multifocality could play a role in the process of emmetropization, but the relationship needs to be further investigated in a longitudinal study.

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