

Virtual Reality Perimetry

National Academy of Science

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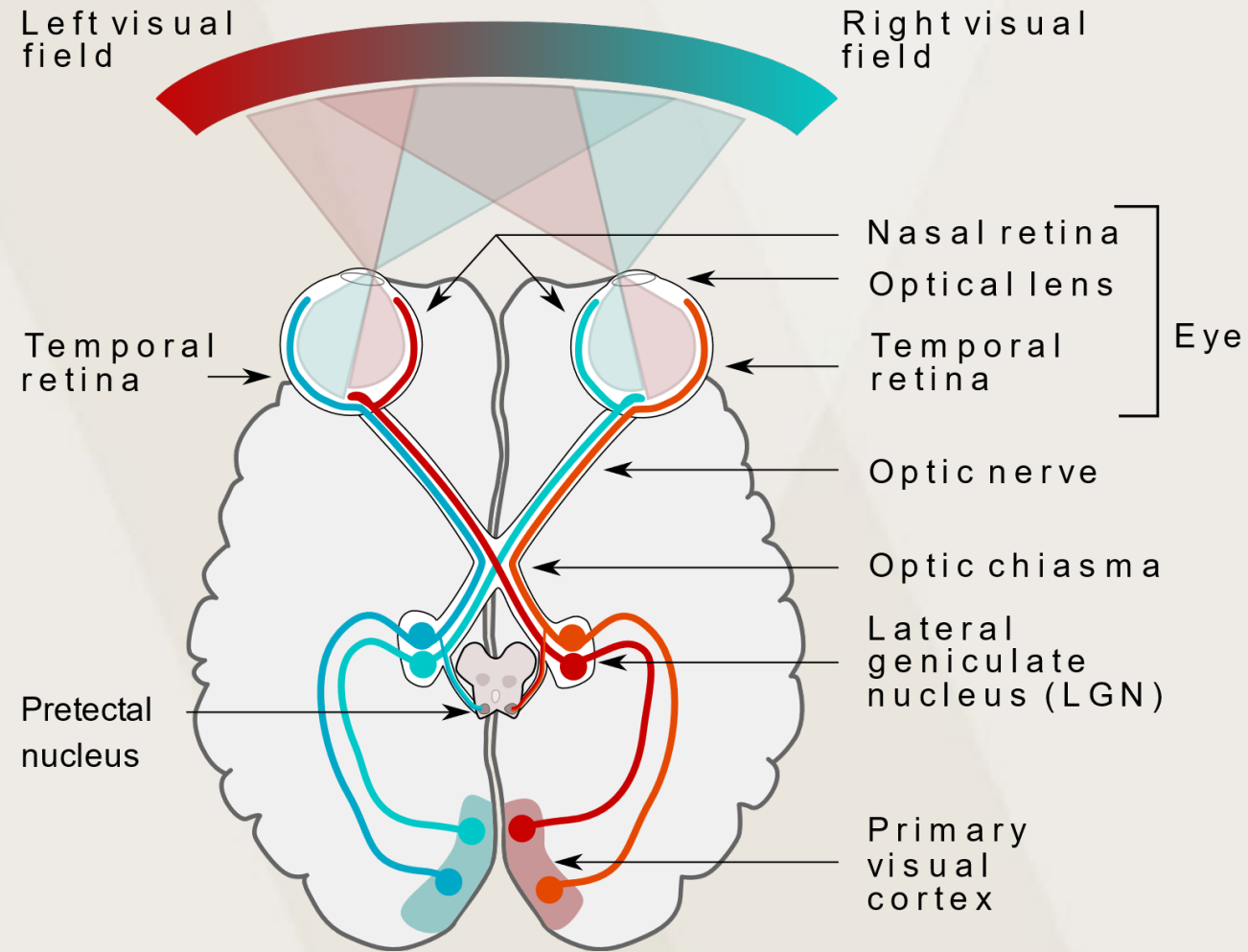
Associate Vice Chair for Clinical Affairs, Vanderbilt Eye Institute



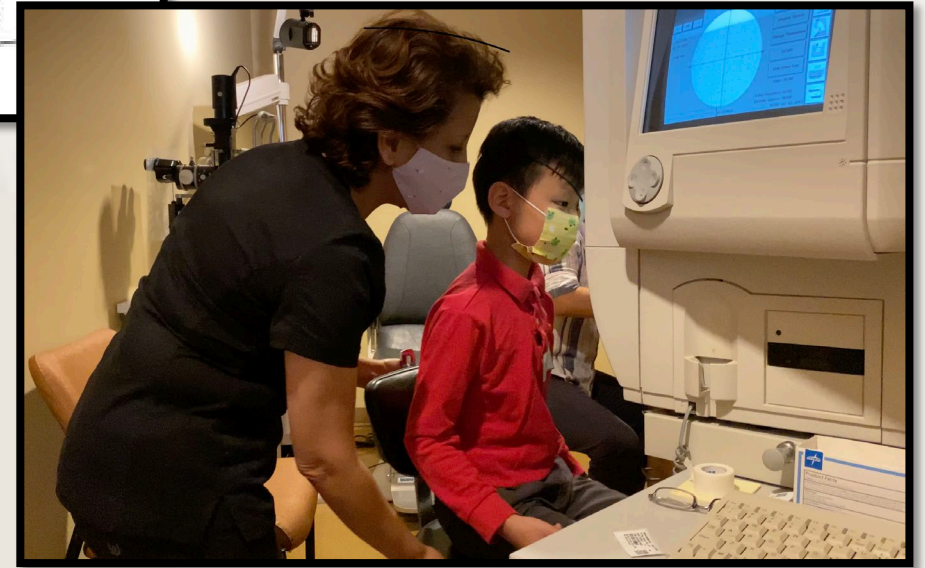
I have done unfunded research on the Olleyes VisuAll. 2 of the 7 instruments I have used in research were provided by the company.

No other financial disclosures.

Why is Perimetry important?



How do we do perimetry in kids?



Pediatric Perimetry

- What are the challenges?



Humphrey Field Analyzer



Study of Optimal Perimetric Testing In Children (OPTIC)

Normative Visual Field Values in Children

Dipesh E. Patel, BMedSci, PGDip,^{1,2,3,4} Phillippa M. Cumberland, BA, MSc,^{1,2} Bronwen C. Walters, BMedSci,^{2,4} Isabelle Russell-Eggitt, FRCOphth,² Mario Cortina-Borja, MSc, PhD,⁶ Jugnoo S. Rahi, PhD, FRCOphth,^{1,2,3,4,5} for the OPTIC Study Group*

Table 3. Average Mean Deviation (MD) Values by Age Group (Humphrey SITA 24-2 FAST)

Age (y)	Average MD Value (SD)
5–6	–3.22 (1.16)
7–8	–2.15 (1.42)
9–11	–1.85 (1.75)
12–15	–0.58 (1.05)

SD = standard deviation.

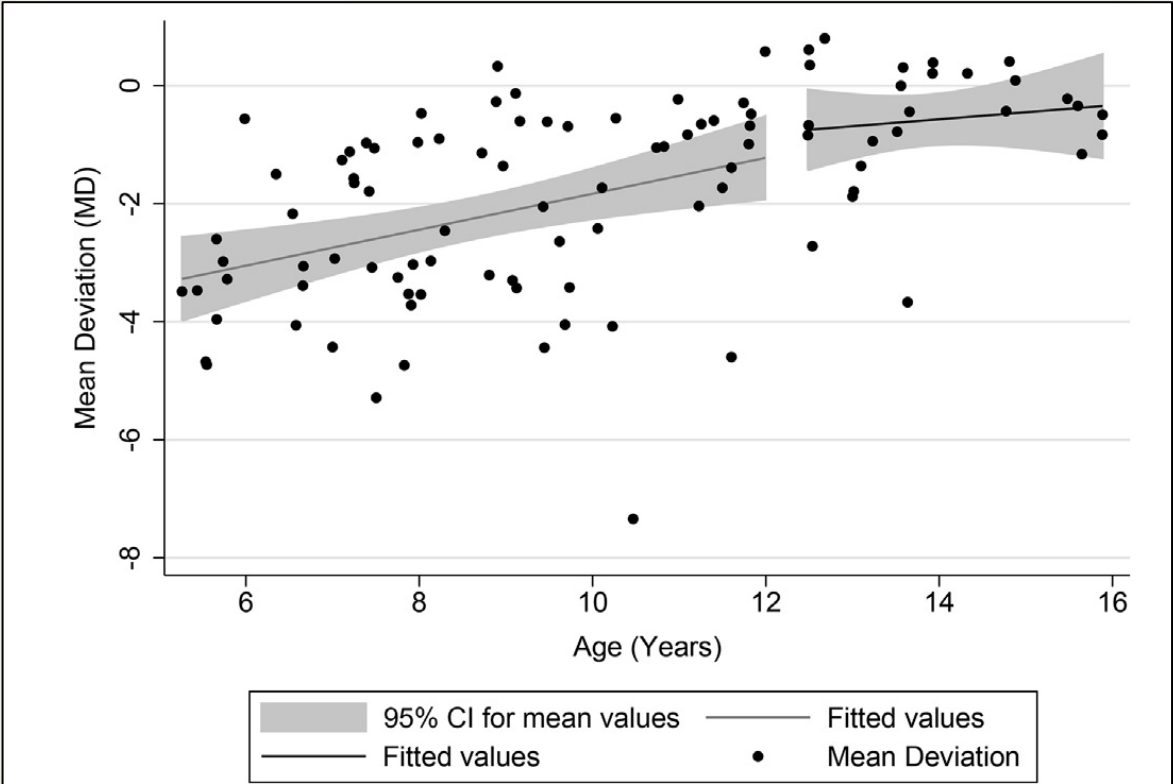


Figure 3. Piecewise linear regression of Humphrey mean deviation (MD) scores with age. CI = confidence interval.



Is There a Better Way?

New Kid on the Block:

Virtual Reality Perimetry

Advanced Vision Analyzer (Elisar Vision)

Heru VR (Heru, Inc)

Radius (Glaukos)

Smart System VR Headset (M&S Technologies)

VisuALL (Olleyes)

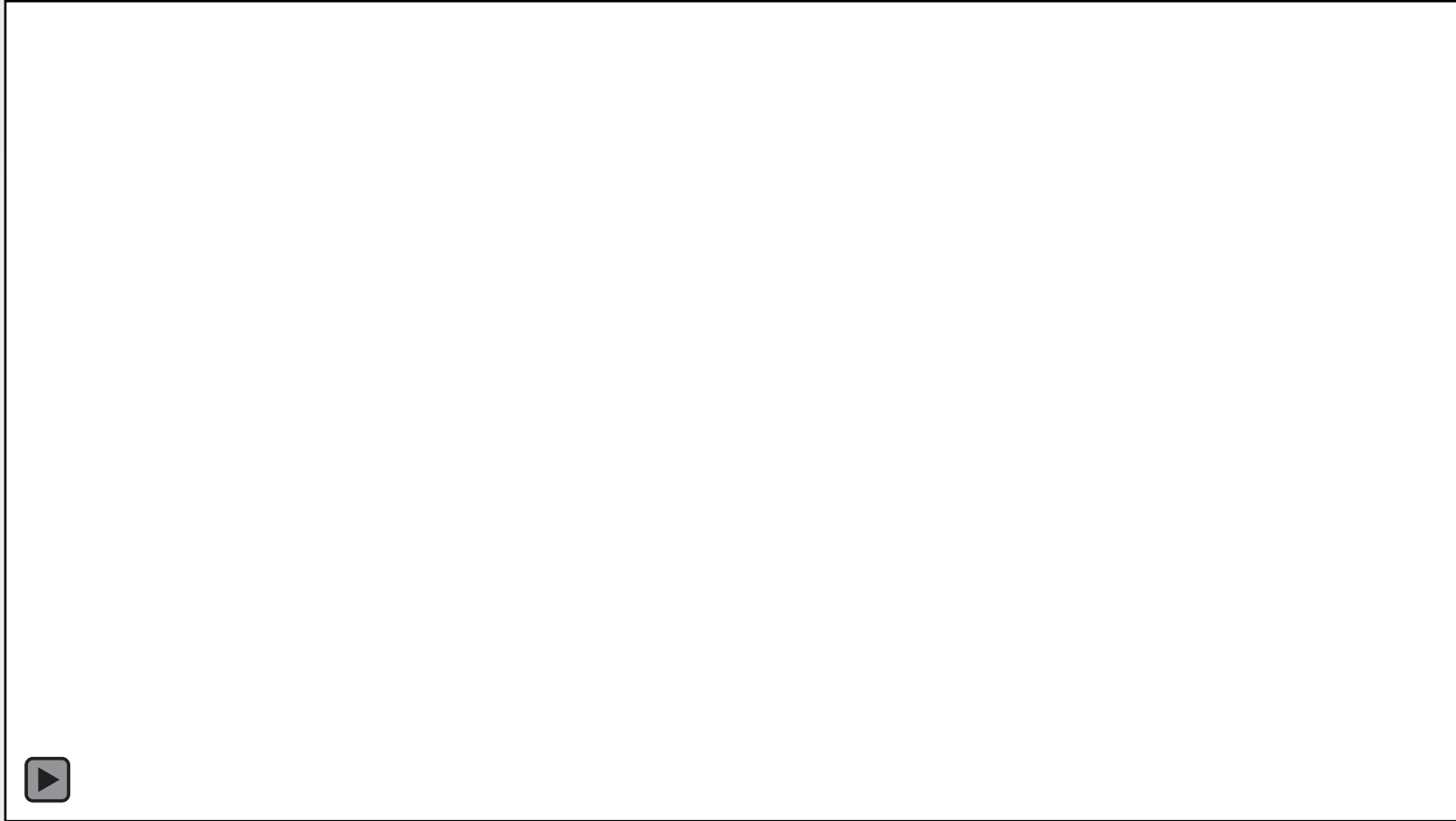
Vivid Vision Perimetry (Vivid Vision)

VF2000 (Micro Medical Devices)



VisuALL Kids (Olleyes)

Game-based format for kids



New Kid on the Block:

Virtual Reality Perimetry

What to *Love*:

- Portable
- Comfortable (compared to HVF)
- Creative test strategies can be employed
- Test runs automatically in headset
- Lower capital and space requirements



New Kid on the Block:

Virtual Reality Perimetry

What gives me *pause*:

- Hardware
 - Backgrounds aren't the same
 - Can't compare attenuation values 1 to 1
 - Challenge to dim pixel stimulus enough to detect mild changes

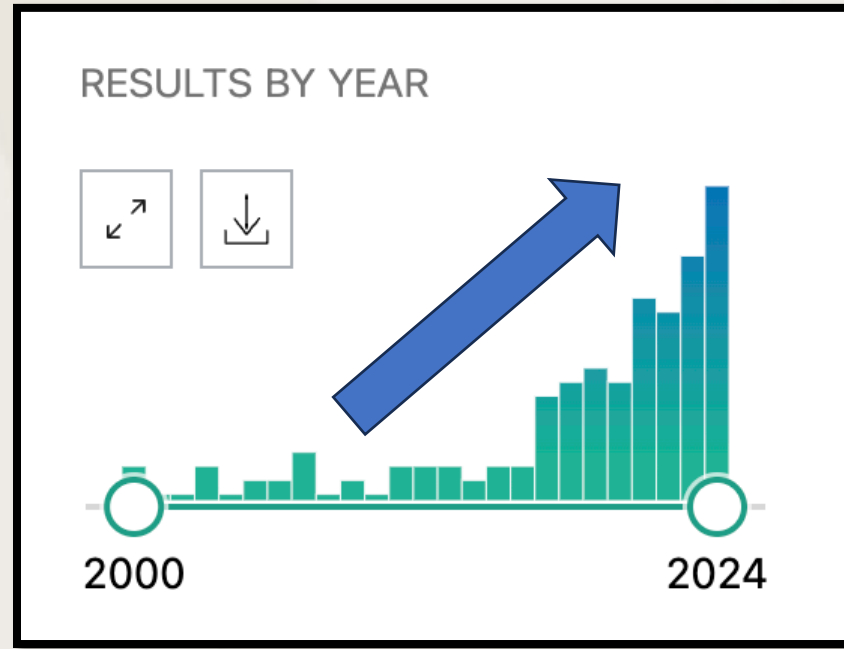


New Kid on the Block:

Virtual Reality Perimetry

What gives me *pause*:

- Validation/data



Study Design

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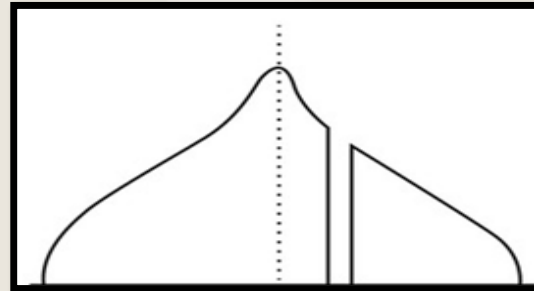
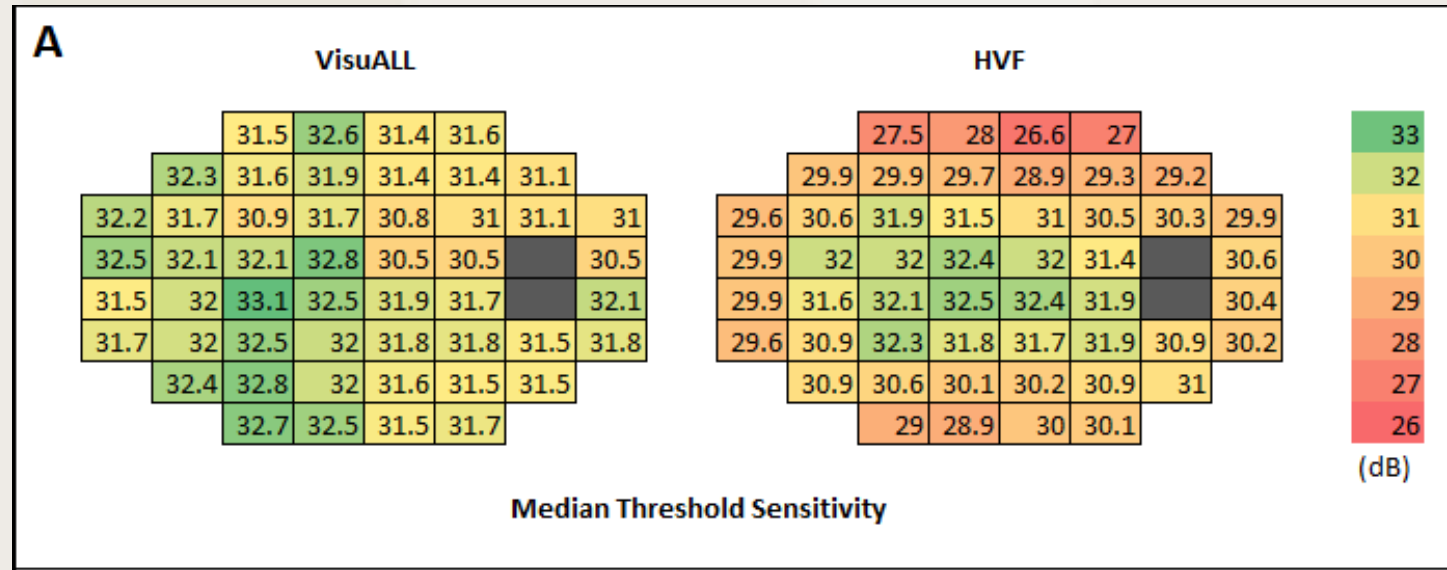
Glaucoma

Evaluation of Virtual Reality Perimetry and Standard Automated Perimetry in Normal Children

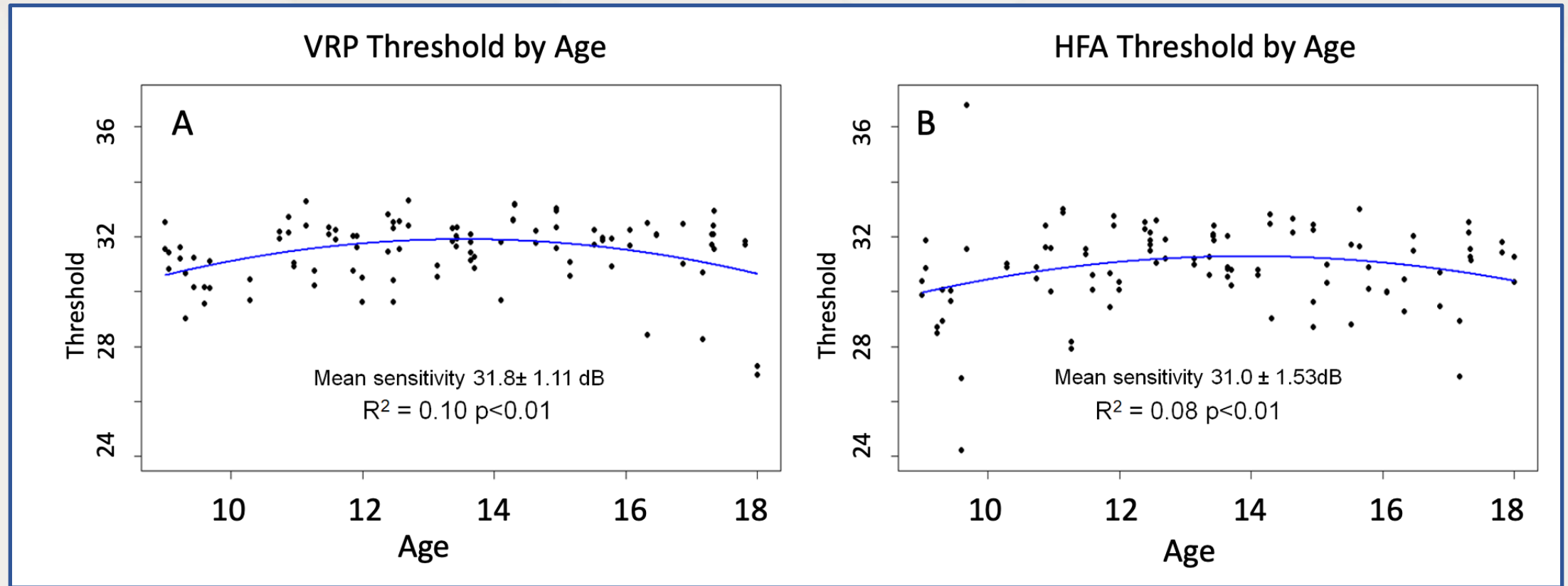
Sylvia L. Groth¹, Edward F. Linton^{1,2}, Eric N. Brown¹, Frini Makadia^{1,3}, and Sean P. Donahue¹

- 50 normal subjects ages 9-17 (mean=13 years, 50% female)
- Performed HFA SITA Standard 24-2 and Olleyes VisuALL pediatric threshold perimetry.
- Test time, reliability parameters, and effects of age, gender, and ethnicity were evaluated.
- Threshold sensitivities were established by percentile.
- Patient satisfaction surveys were administered

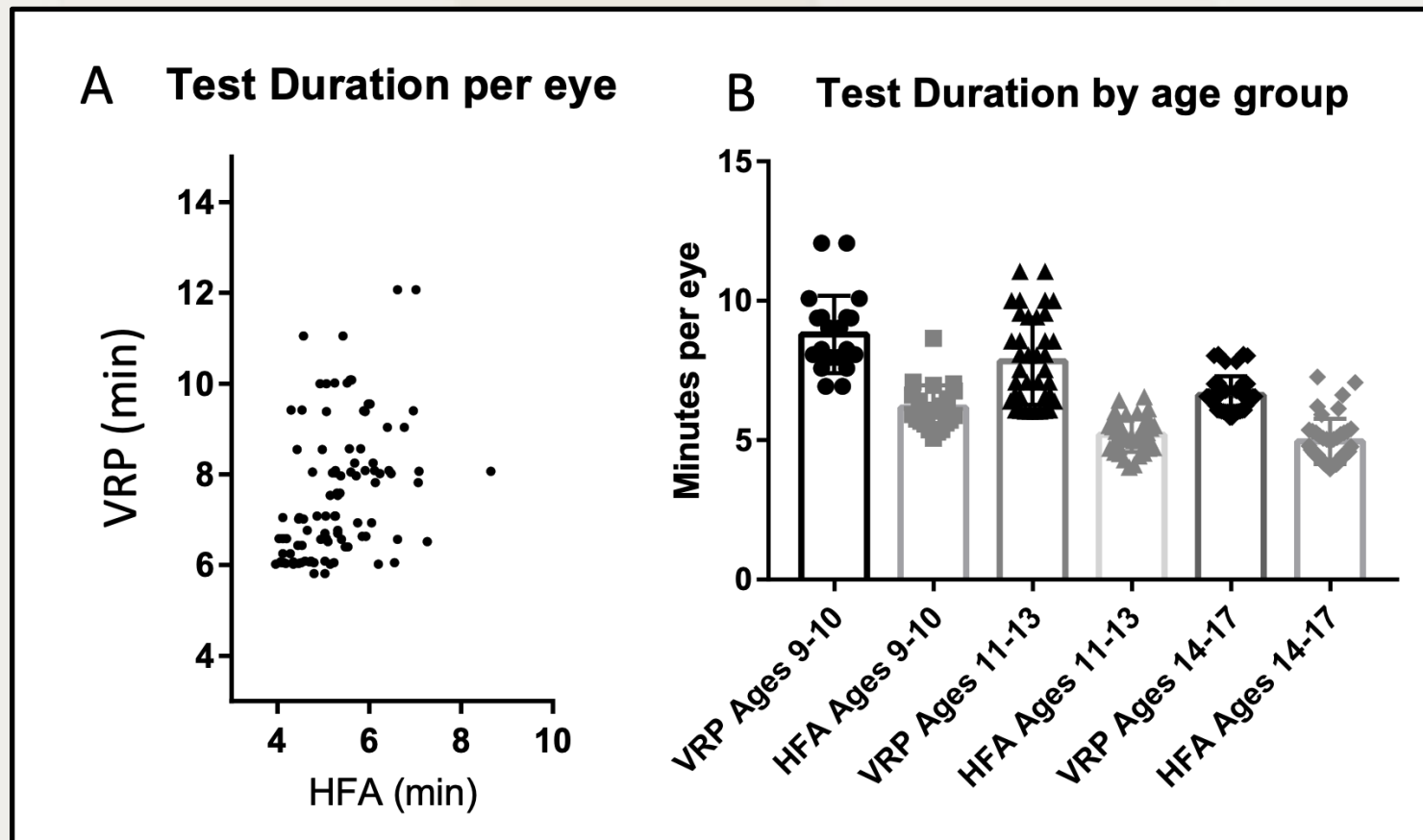
Comparison of median threshold sensitivity with a numeric heatmap



Parametric regression of mean threshold sensitivity by age found similar small age-effects with the VRP and HVF devices.



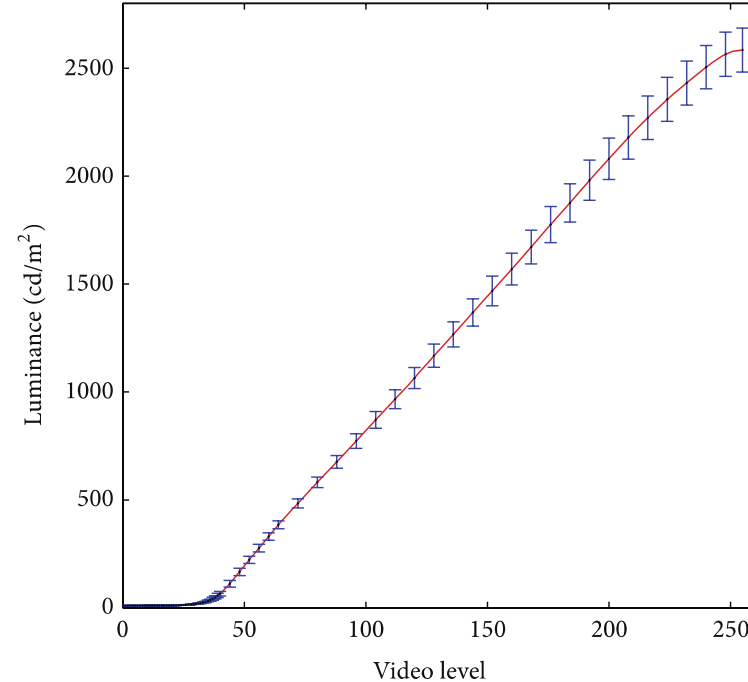
Test Duration



Age range	Mean HVF Duration (min/eye)	Mean VRP Duration (min/eye)
8 - 10 years	6 min 9 sec	8 min 48 sec
11 -13 years	5 min 12 sec	7 min 50 sec
14 -17 years	5 min 2 sec	6 min 37 sec

Technology limitations

- Creating an algorithm that balances reliability vs test duration
- Calibration of screens
- Leverage LED screens to display both sufficiently bright (small threshold value in dB) and sufficiently dim stimuli (large threshold value in dB)

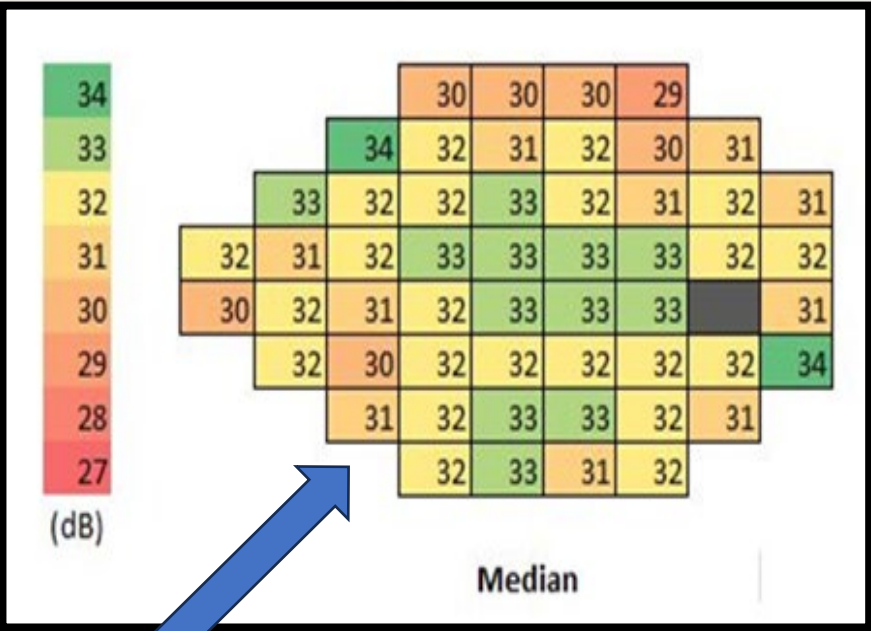
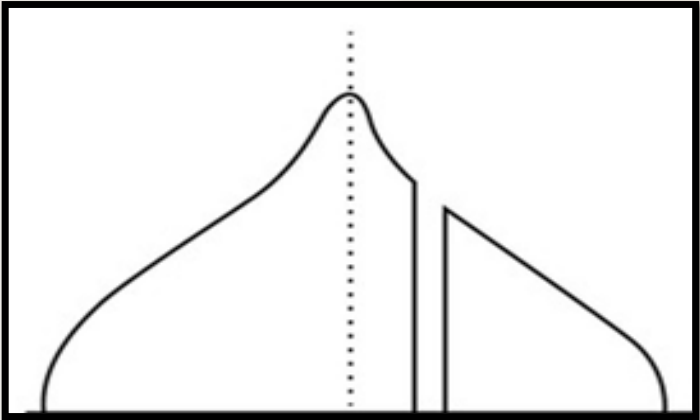


Follow-up Study Design

- 19 pediatric participants (8-17 y/o) with:
 - Healthy afferent systems
 - No substantial refractive error
- Each participant was tested twice using the VRP device.
- The primary outcome was threshold sensitivity at each 24-2 test location
- Secondary outcomes were test duration and agreement between the first and second tests.



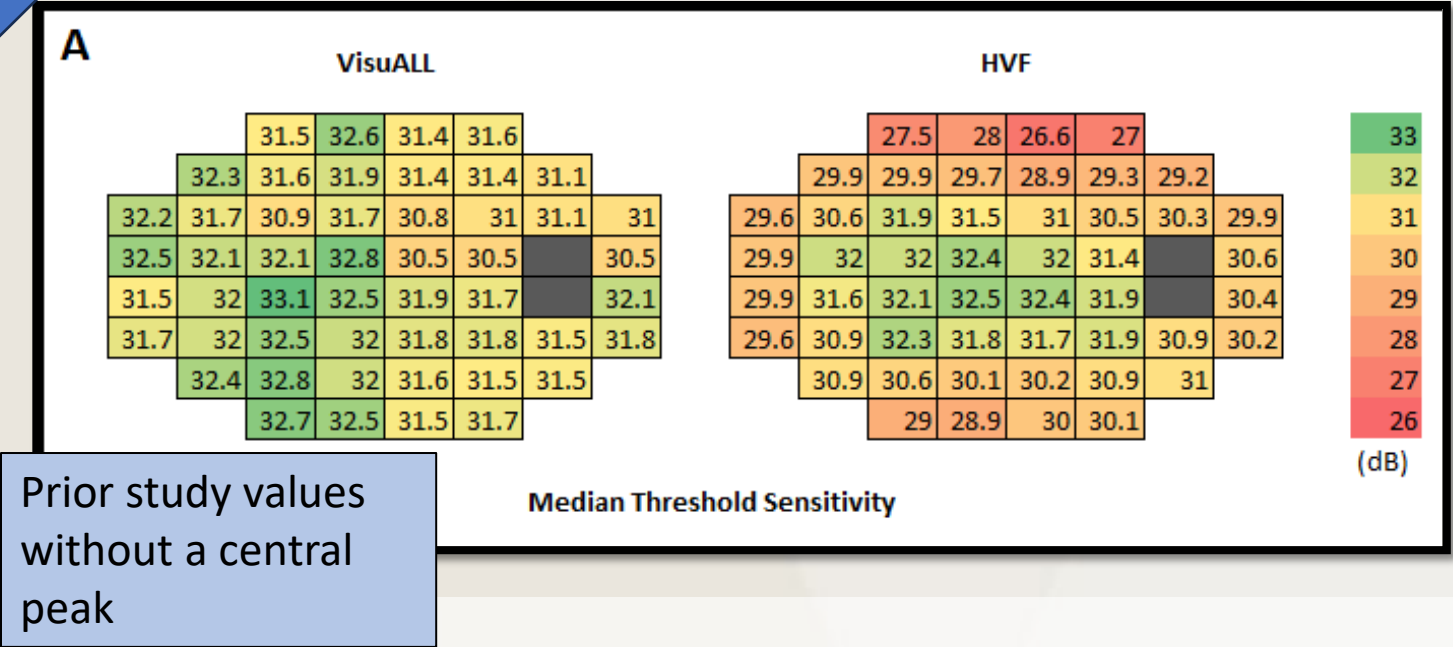
Mean age: 12.7 ± 2.5 years
Mean duration was 5.06 ± 1.5 min/eye.



Mean threshold for Test 1: 30.5 ± 4 dB
Mean threshold for Test 2: 31.3 ± 2.8 dB

The values were more tightly clustered with smaller variation in Test 2 suggesting a mild learning effect

Showing distribution of average sensitivities by location. Note the central cone of vision denoted by a light green cluster of the number 33.



Study Conclusions

The Olleyes VRP provides a reliable assessment of the visual field. It demonstrates minimal variability, and a short test duration, with only a mild learning curve

The testing strategies are DYNAMIC and improving all the time

Limitations: Small sample size, healthy volunteer children

Future Directions: Investigate the relative shallowness of central hill of vision and test unhealthy eyes

Performance of VisuALL virtual reality visual field testing in healthy children

Samuel Alvarez-Falcón, MD,^a Bo Wang, MD, PhD,^b Emma Taleb, BA,^a Nathan L. Cheung, OD,^a Chelsea A. Scriven, OD,^a Yos Priestley, OD,^a Mays El-Dairi, MD,^a and Sharon F. Freedman, MD^a



Major Articles

Performance of virtual reality game-based automated perimetry in patients with childhood glaucoma

Bo Wang, MD, PhD,^{a,b,*} Samuel Alvarez-Falcón, MD,^{a,*} Mays El-Dairi, MD,^a and Sharon F. Freedman, MD^a

Olleyes VisuALL: Adults

tvst

Article

A Virtual Reality-Based Automated Perimeter, Device, and Pilot Study

Mario Montelongo¹, Alberto Gonzalez², Freddy Morgenstern², Sean P. Donahue³, and Sylvia L. Groth³

tvst

Glaucoma

Repeatability of a Virtual Reality Headset Perimeter in Glaucoma and Ocular Hypertensive Patients

Rafaella Nascimento e Silva¹, Julia A. Kim¹, Yihao Li¹, Chen Chen¹, Anisa F. Chaudhry², Andrew R. Berneshawi², Miao Zhang¹, Adam Villarreal¹, Jocelyn Liu², Ann Shue², Dolly S. Chang^{1,2}, and Robert T. Chang²



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- There are many VRP devices available with unique strengths
 - Be sure to know what your device can do (Validation)
 - Strength will come when availability produces frequent repeatability
 - Pediatric-specific tests can cater to kids

Thank You

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