

The Next Generation of Diagnoses and Treatment: Virtual and Augmented Virtual Reality

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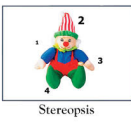

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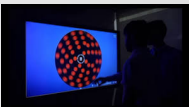
- Financial ownership/interests in **Computer orthopter, VTS 4, HTS**
- Consultant for **Magic Leap**
- Consultant for **Alcon**
- Board of directors of **Treehouse**
- Consultant for **VTI – Natural Vue lenses**
- Consultant for **EYENOVIA**

Financial Disclosure

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- **VTS-4**
 - Ocular Motility
 - Pursuits and Saccadics
 - Vergence
 - First, Second, and Third Degree Targets
 - RDS in operant conditioning paradigm
- **Sanet Visual Integrator**
 - Touch Activated Rotator
 - Programmable Metronome
 - Tachistoscope
 - Numbers/Letters/Word Saccades
 - Eye-Hand Visual Abilities

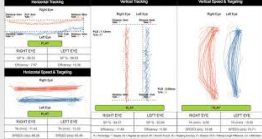





Computerized Vision Therapy

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- Pursuits, saccadics with eye tracking
- 90 Hz using Tobii
- Patient needs to be calibrated and in the perfect position
- Minimal of training techniques
- Abnormal in learning, TBI, stroke, etc



Right Eye

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- **Virtual reality** is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, **virtual reality** is primarily experienced through two of the five senses: sight and sound. No proprioception




Virtual Reality

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Vivid Vision

- Oculus driven virtual reality
 - Amblyopia
 - Binocular vision



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- Interactive games
- Bright target in front of the amblyopic eye
- Dim target in front of the "good eye"
- Increase contrast in front of the good eye, and dim the amblyopic eye

Amblyopia Treatment

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- Interactive
- Feedback
- Fading in of the good eye stimuli
- Binocular in a monocular visual field
- Patient involvement
- Game format

Positive

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- No idea where the eyes are looking
- No idea if the patient has NRC fusion or ARC fusion
- Chance of developing irretractable diplopia
- Does not integrate the artificial world with the real world
- Technology that might not be there in the future
- Even Oculus admits, they can not survive on the gamers only
- Need to move to Augmented Reality
- Reasons Why We Have Waited for the Technology to get there
- No integration with the real world - NOT IN SPACE

What is bad

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- Integration of virtual reality with the real world
- Potential to change the world
 - Replaces computers
 - Replaces television
 - Changes education, surgical training, industrial repair, and the list goes on
 - Follows you or is spatially attached

Augmented Virtual Reality

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Two Competitors - Magic Leap and HoloLens 2

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- Magic Leap is smaller in size
- Teether computer
- Larger field of view
- Eye tracking
- Gestures and hand tracking
- Needs adaptive optics
- Already supported by a partnership with ATT for 5G
- NBA contract
- Raised 5.5 Billion \$\$
- Holo lens
- Can wear glasses
- Power of Microsoft
- Large military grant
- Already used by industry
- Limited number
- Expensive \$3500
- Holo Lens 1 2016
- Holo Lens 2 2019
- BUT can not get it!!

Which is Better

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- 2 D sustained accommodation and converge, no flexibility
- Mild errors become magnified
- Virtual Reality has more symptoms
 - Dissociation of acc/verg

Accommodation is at the plane projection and vergence is where disparity is created



Why More Asthenopia w Virtual Reality

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- Asthenopia from mismatch of accommodation and vergence is a real concern of Magic Leap and Hololens
- Different planes of accommodation
 - How many
 - Makes instrument bulky
- Adaptive Optics
 - Liquid crystal lenses
 - Can change instantly between +10 and -10
 - Currently bulky
 - Regional moving lenses with the eyes


Solving the Mismatch

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- Adaptive Optics would solve
 - Mismatch problems
 - Refractive problems
 - Create a method of accommodative therapy within Augmented Virtual Reality

Adaptive Optics

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Magic Leap

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- Real world pursuits and saccadics
- Monitor eye movement
 - Auditory and visual feedback
- Independent of head movement
- Gesture responses for hand eye coordination
- 3 dimension hand-eye coordination tasks including touch

What Can We Do With VR

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- Benefits of synoptophore, troposcope, and VTS4 with monitoring of eye movement and eye position
- Measuring retinal correspondence constantly, with changing stimuli
- Integrating virtual targets with the real world
- Ability to flash and change brightness

Real World Phase Different Haploscope

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- First, second, degree targets in a real world setting
- Eye position monitoring
- Small thumb print
- RDS in operant conditioning paradigm
- Large fusional targets
- Small fusional targets
- Game format for interest

Can Do Everything VTS Can Do

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- Eye tracking allows accurate pursuit and saccadic therapy
- Eye tracking allows eye tracking therapy either dependent or independent of head position (image stable to the world or to the instrument)
- Eye tracking with integrated gestures (None of this can be done with right eye)
- Do not have to worry about alignment problems

Can Do A lot More

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- Ability to follow the patient
- Eye tracking to make sure they are fusing
- Eye tracking to make sure they have NRC
- Responses by eye movement
- More game format

Vergence Tasks

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- Automated phoria measurements
- Automated motor fields
- Automated vergence testing
- Automated NRC/ARC testing
- Automated Saccadic and Pursuit Testing
- Automated Visual Perceptual Testing
- Automated therapy

Eye Tracking Allows

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- Automated visual acuity
- Automated color vision
- Automated visual fields
- Automated stereo testing
- Automated confrontation testing

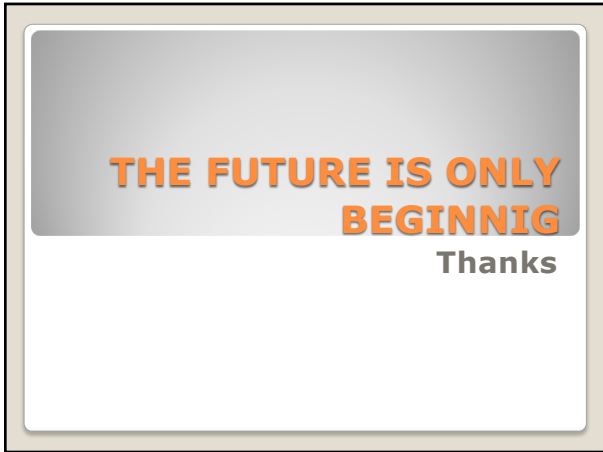
VISUAL SCREENING

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- Oculus
- Facebook
- Google
- Microsoft
- Magic Leap

Shake Out of Winners and Losers

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