

# For Whose Eyes Only: The Ethics of Eye Tracking In Virtual Reality

**Brian Moynihan MBA | MSIS | MA**

Head, Health Technology & Informatics  
University Libraries - Health Sciences Library  
University of North Carolina at Chapel Hill



# Varied Uses of VR in Healthcare

- **Psychology** – relaxation (meditation), facing trauma (PTSD, fear of heights, flying, snakes, etc.), anxiety (public speaking, revealing HIV status), smoking cessation, eating disorders, autism (social cognition)
- **Inpatient use** - pain management, overcoming loneliness and depression, motivating movement, patient education
- **Education** – going impossible places (blood stream, molecular bonding, anatomy, etc.), empathy, telestration
- **Physical training** – athletics, fitness, physical rehabilitation
- **Professional training** – surgical planning and practice, practicing CPR and Heimlich maneuver, radiology
- **Rehabilitation** - stroke, vision disorders, attention, balance, memory

# Uses for Eye Tracking

- **Cognitive assessment** – concussion, cognitive decline, Autism spectrum disorder, depression, anxiety, Parkinson’s disease, dyslexia, ADHD, OCD, Alzheimers, etc.
- Use in **various settings** – ICU, post-operative, army base
- Neuro-ergonomics: **mental effort** and **cognitive workload** (e.g. for EHR systems)
- **Empowering interfaces for the disabled**: ALS, paraplegia (e.g. control computer or speech synthesizer)
- **User interfaces** for improving realism & presence (as with avatars), hands-free interfaces, and increased efficiency
- **Improving interface design** for websites, medical devices, spaces.

# Eye Tracking Metrics and Visualizations

Studying visual attention, emotional arousal and valence

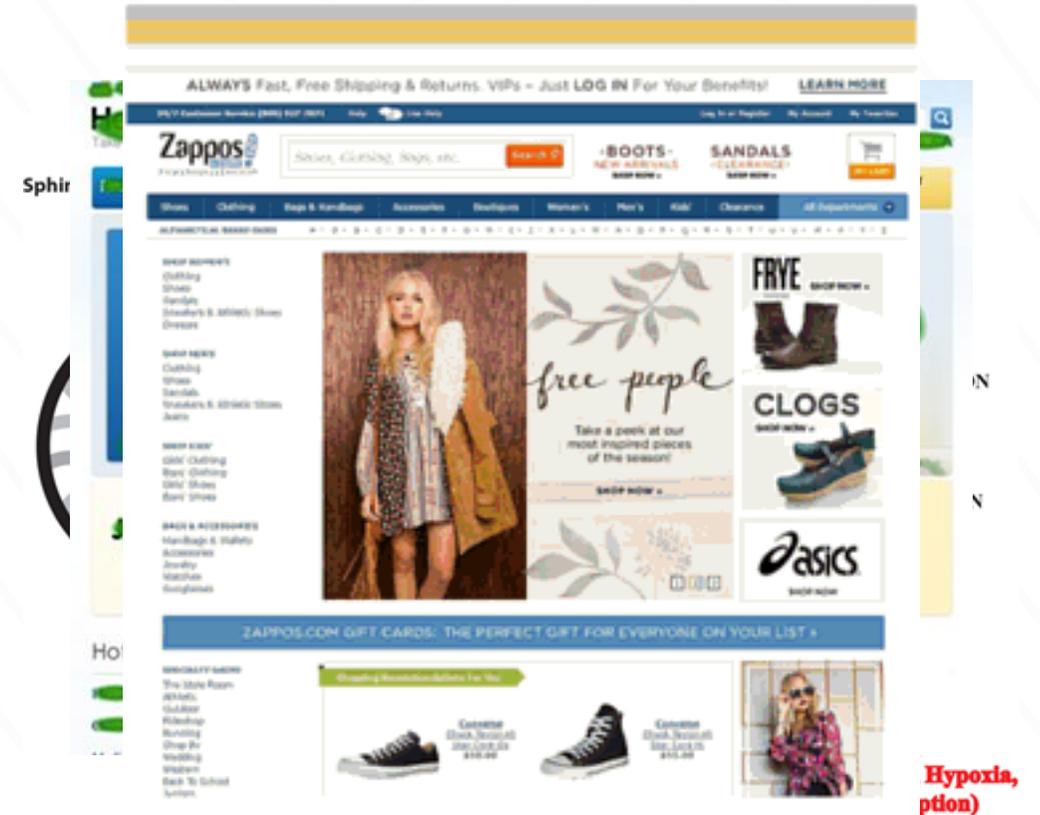
## Metrics

Pupil size and diameter, saccadic movement  
gaze direction, focus, fixation count, dwell time  
blink rate

## Visualizations

Heat maps, scan path, fixation points, focus maps

**+ Additional biometrics:**  
heart rate, HRV, GSR, EEG, EMG, etc.



# Cost of Eye Tracking in VR\*

- HTC Vive room-scale VR with Tobii eye tracking: \$3,800
- Magic Leap mixed reality headset: \$2,400
- Fove standalone VR headset: \$500
- Lenovo Mirage Solo VR headset: \$400
- Eye tracking on iPhone / Samsung Galaxy IV: no additional cost

\* Note: capabilities vary



## \* Caveat

Many of these measures require use of a research grade sensor for data collection under controlled conditions.

We assume sensor tech will continue to improve, enabling higher quality data collection in more dynamic settings.

\* Note: capabilities vary



# So...

Rapidly falling costs

+ shrinking form factor

+ better sensors

+ better algorithms

---

—

= Technology that is more powerful

& potentially ubiquitous than ever before



# Dual Use Problem



# Ethical concerns with VR Eye-Tracking

- People don't understand the kind of information they are sharing - conscious and unconscious. (E.g. sexual preference, implicit bias, intoxication)
- Surveillance. Government entity, insurance companies, bad actors, etc.
- Use by companies whose business models that are fueled by the inverse of privacy
- Potentially inappropriate capture, storing, or sharing of this data

# Positive Steps

- Topic has started getting some attention (eg. Stanford VR Privacy Summit 11-8-18)
- Medical research has a model for ethical use of data that can be borrowed in other contexts
  - IRB
  - Consent
  - Privacy regulation: HIPAA
- Working towards limiting the collection, storage, sharing, and context of the data to appropriate use.

# Final Takeaways

- Used appropriately, eye tracking has enormous potential to improve human health, the work of providers, and many other areas, including health education, improving medical devices, development, and empowering the disabled.
- We have a moral imperative to look at not only what can go wrong with technologies, but also what damage we do by not employing them.

# Selected Sources & Further Reading

- Pupillometry in Clinical Care: <https://www.youtube.com/watch?v=2XWFmp8Hy00>
- Usability.Gov: <https://www.usability.gov/how-to-and-tools/methods/eye-tracking.html>
- Tobii VR Eye Tracking: <https://www.youtube.com/watch?v=eBINRku82hA>
- Privacy & VR Eye Tracking: <http://induecourse.ca/the-end-of-privacy-part-1-mind-reading/>
- Stanford VR Privacy Summit Interview: <http://voicesofvr.com/716-vr-privacy-summit-medical-insights-into-vr-privacy-health-benefits-of-biometric-data/>
- ACLU (2013): <https://www.aclu.org/blog/national-security/privacy-and-surveillance/privacy-invading-potential-eye-tracking-technology>
- Measuring emotion: [https://www.noldus.com/mb2008/individual\\_papers/FPS\\_eye\\_tracking/FPS\\_eye\\_tracking\\_deLemos.pdf](https://www.noldus.com/mb2008/individual_papers/FPS_eye_tracking/FPS_eye_tracking_deLemos.pdf)
- Implicit Bias: <https://www.latimes.com/science/sciencenow/la-sci-sn-black-boys-preschool-20160928-snap-story.html>
- Biasing moral decision making with eye tracking: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4386374/>
- Impact of opioids on pupillary light reflex: <http://anesthesiology.pubs.asahq.org/article.aspx?articleid=1936490>

# Contact

[moynihan@med.unc.edu](mailto:moynihan@med.unc.edu)

