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

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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
- Tobii VR Eye Tracking: https://www.youtube.com/watch?v=eB1NRku82hA
- Privacy & VR Eye Tracking: http://induecourse.ca/the-end-of-privacy-part-1-mind-reading/
- Biasing moral decision making with eye tracking: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4386374/
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