

National Institute of Allergy and Infectious Diseases

Health Innovations Conference

Virtual Reality for Biomedical Research – Why now?

20 March 2019

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NIAID



National Institute of
Allergy and
Infectious Diseases

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OCICB/OSMO



Vocabulary

360° Video

filmed

real world

demonstrates existing experience

viewer is a passenger

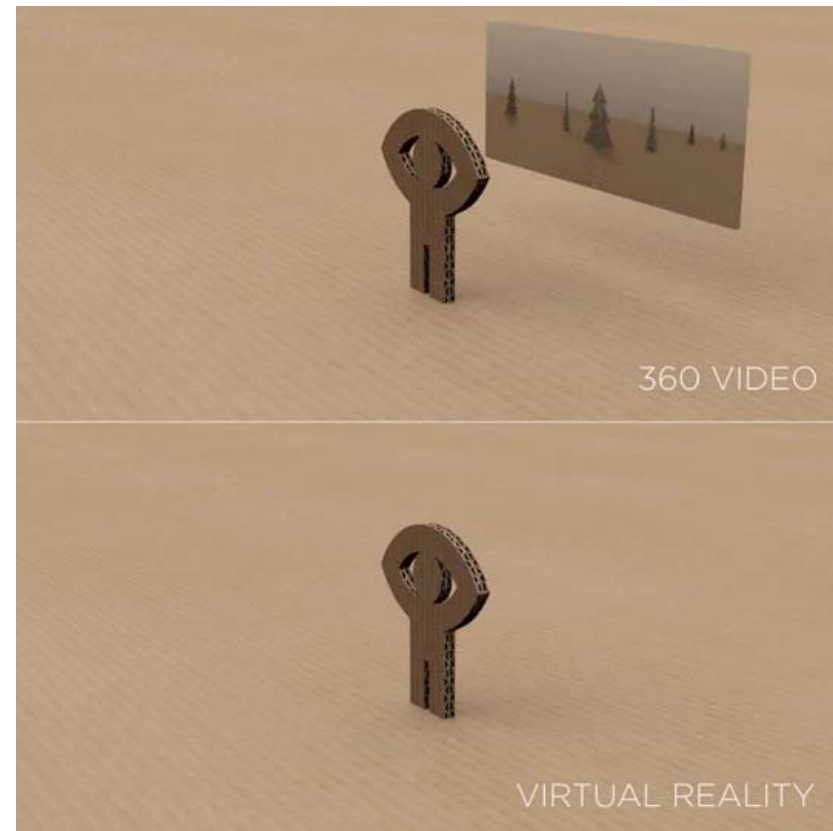
Virtual Reality (VR)

similar to game production

digital environment

creates new experiences

viewer can move and touch



David Smith, WVU Reed College of Media; Mariana Malashniak, N-iX; <https://www.globalaccess.co.za>

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VR and Related “Realities”

VIRTUAL REALITY (VR)

Completely digital environment

Deep
concentration;
research;
individual learning

AUGMENTED REALITY (AR)

Real world with digital
information overlay

Contextual actions;
group learning

MERGED REALITY (MR)

Real and the virtual are intertwined

Increased
retention(?)

VR makes you feel like you're present and experiencing things
you may never get the opportunity to experience in real life.

Fully enclosed, synthetic experience
with no sense of the real world.

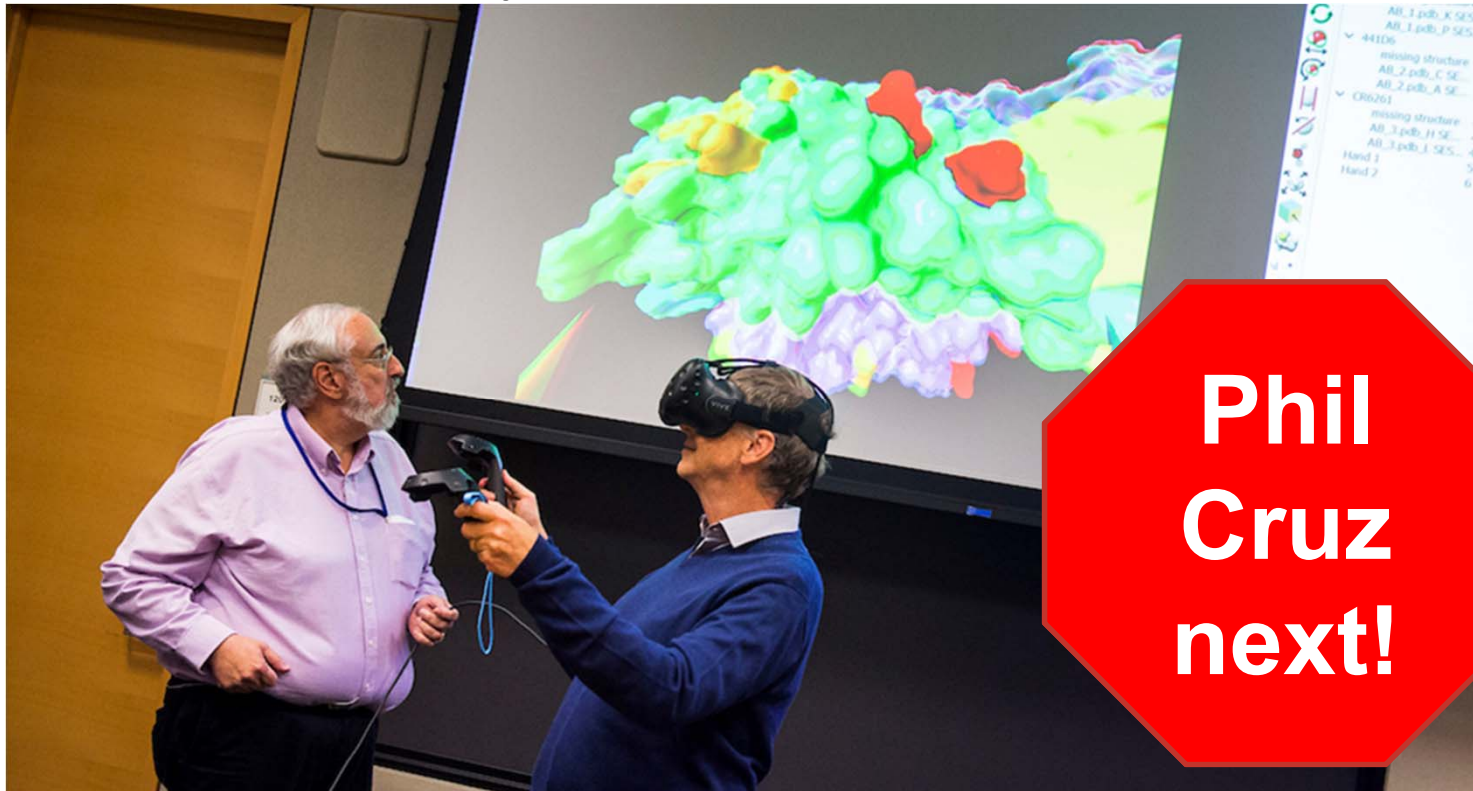
Real world remains central
to the experience, enhanced by
virtual details.

Interaction with and manipulation
of both the physical and
virtual environment.

<https://www.extremetech.com/extreme/249328-mixed-reality-can-take-augmented-reality-mainstream>, http://mgl.scripps.edu/projects/tangible_models/

VR @ NIAID Since 2015

Scientific discovery, communication, and collaboration



https://nihrecord.nih.gov/newsletters/2017/06_30_2017/story4.htm

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Healthcare Applications of VR

- Autism
 - Addiction recovery
 - Chronic pain management
 - Exercise & rehabilitation
 - Distraction for fearful and pediatric patients
 - Mental illness: phobias, stress, anxiety, PTSD, depression
 - Alzheimer's and other cognitive deficits
- Training
 - Anatomy
 - Surgical planning & simulation
 - Other medical procedures
 - Provider empathy
 - Dangerous jobs
 - Emergency response
 - Virtual physician visits

VR Training for Biomedical Science

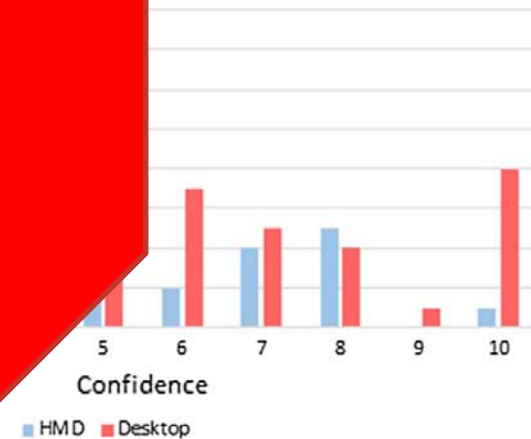
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**Aoua
Coulibaly
Wednesday
Morning!**

... learning and parallel
... take accelerate
... position and boost

Each Confidence



virtual reality journal; <https://doi.org/10.1007/s10055-018-0346-3>

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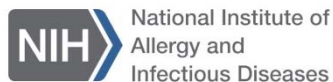
But why now?

“How we made virtual reality part of our students’ learning”
Preston College, 16 Feb 2019

“Virtual Reality Innovations Revolutionizing Healthcare in 2019”
Healthcare Weekly, 3 March 2019

“How virtual reality technologies are revolutionizing STEM learning”
Study International News, 7 March 2019

“Virtual Reality: THE Learning Aid Of The 21st Century”
Forbes, 15 March 2019



How did we get here?

History of VR

(Head-mounted display, computer-generated environment)



1968



1985



1995



2012



1992



1995

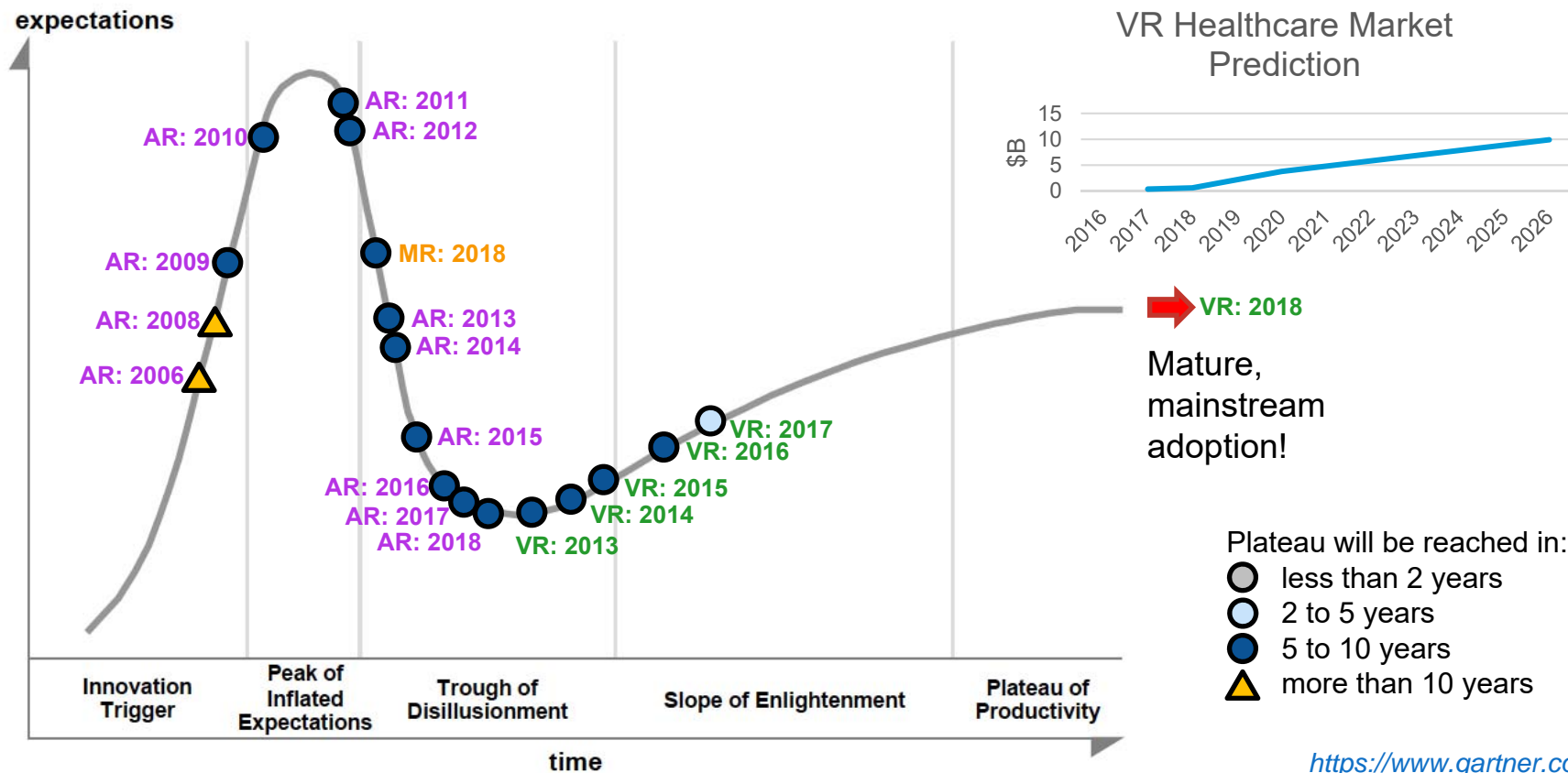


2003



2018

Gartner Emerging Technologies “Hype Cycle”



VR in South Africa

“SA provincial governments in talks to pilot virtual reality learning solutions in selected schools”

Business Tech, 5 June 2018

“Tshwane is banking on using virtual reality to teach and create jobs”

<https://www.htxt.co.za>, June 21, 2016



“Is virtual reality set to take off in Africa?”
CNN, November 2, 2015



Cameroon . Egypt . Kenya . Mozambique . Nigeria . South Africa . Tunisia

Creating Our Future

April 20-22, 2018



Judith Okonkwo

@judithoko

<http://imisi3d.com>

<http://arvrafrica.com>



35+ teams



48 hours



7 Countries



\$15,000+



Technology Advances Make VR Viable

Goal is immersion (or “presence”)

Technology Advances

- High framerates
 - Cameras that capture at high frequency
 - GPUs that render and send new pictures to the display at high frequency
- High-refresh rate displays

Solution Provided

- Reduce flicker, smooth motion, avoid nausea

- High-resolution displays

- Less detectable pixels; greater fidelity

Higher Framerates Make Smoother Action

Can you tell the difference?



<https://www.youtube.com/watch?v=u11svil0BJE>

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Higher Refresh Rates Make Smoother Action

Practical human level of detection is 250 Hz

Assetto Corsa @ ~800 fps, Pagani Zonda R @ 177 Km/h, recorded @1000fps



240 Hz

144 Hz

120 Hz

60 Hz

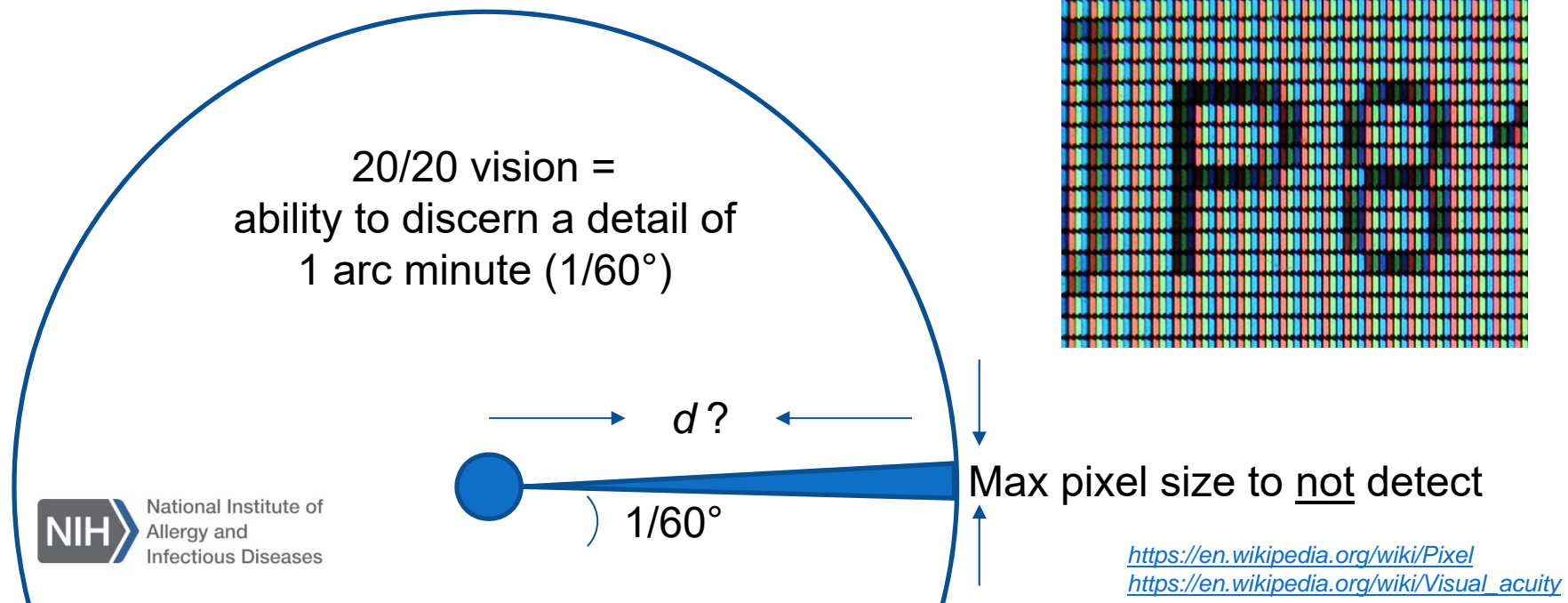
<https://www.youtube.com/watch?v=Q1cmhZs1P54>

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Human Visual Acuity

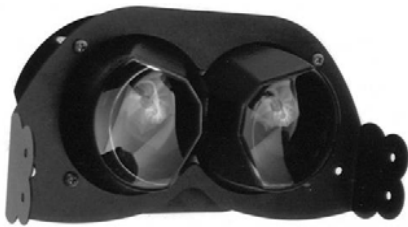
Displays with high pixel densities are now capable of displaying images which do not appear pixelated at normal viewing distances



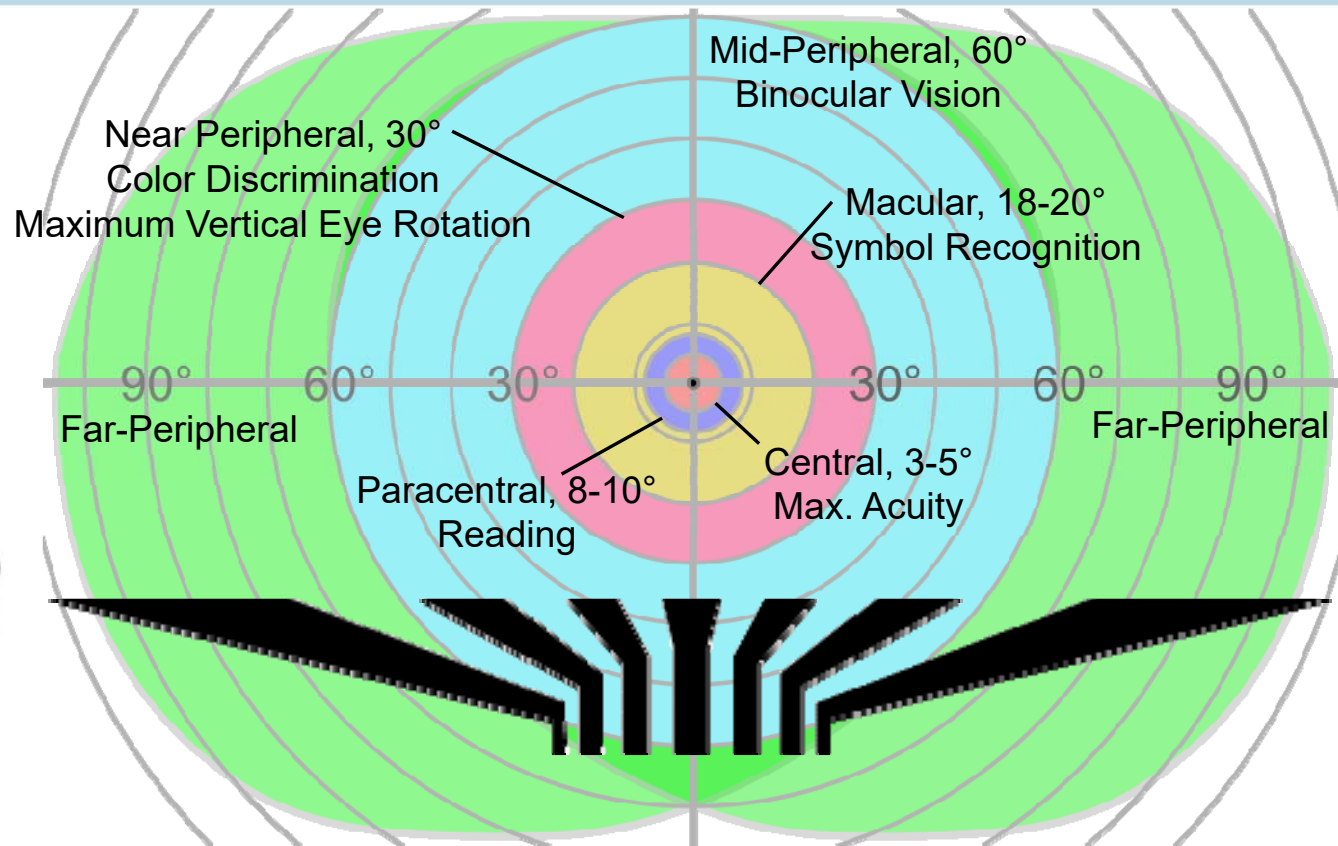
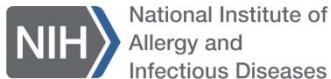
Acuity varies across field of view

The eye sees a lot, but moves around to see portions of it more clearly.

Lenses allow small display to reach full field of view; less pixels, but must be dense



1979: Large Expanse, Extra Perspective (LEEP)
Eric Howlett



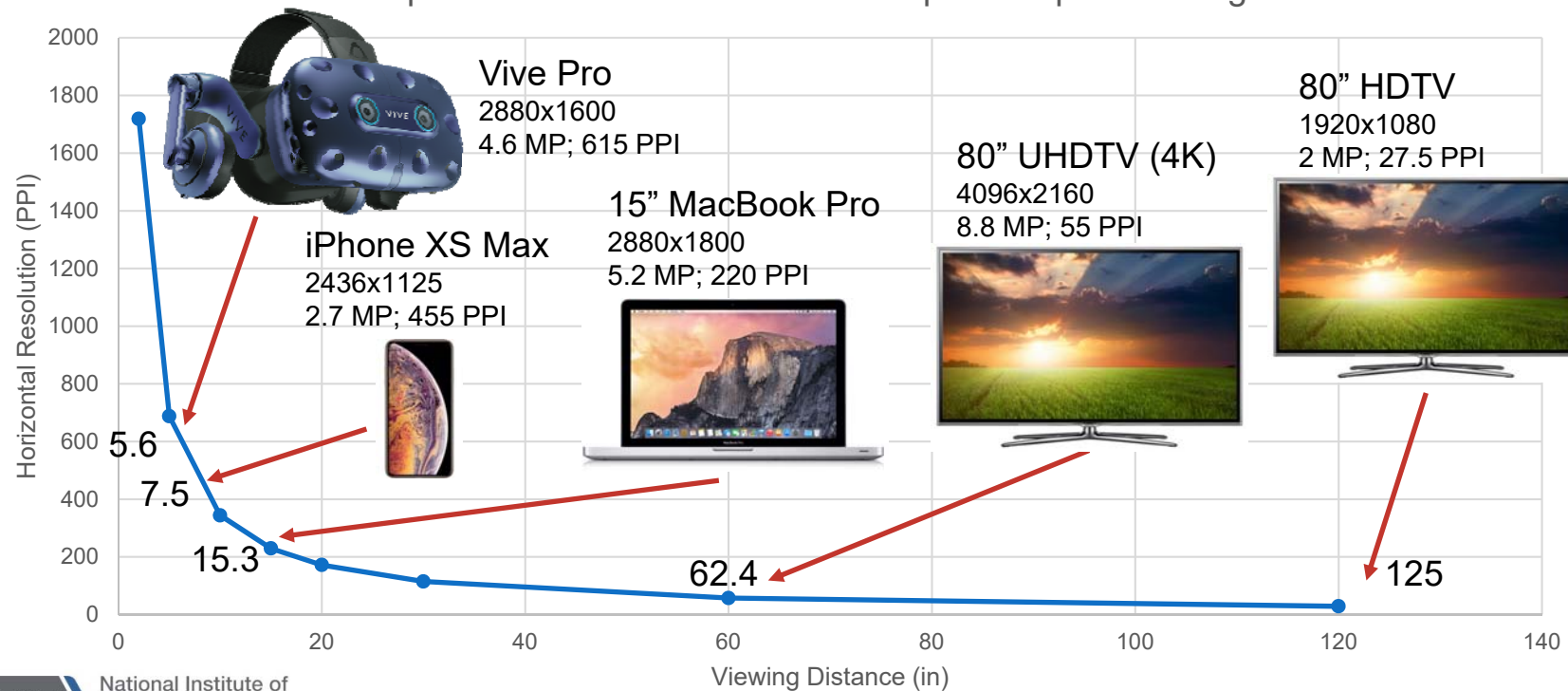
Adapted from https://en.wikipedia.org/wiki/Peripheral_vision and <https://www.flickr.com/photos/eric-delcroix/25212319313/>

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How many pixels do I need?

Resolution Required for Undetectable Pixels Depends Upon Viewing Distance



What's next?

Eye Tracking & Acuity-Based Rendering Ease GPU Requirements



<https://www.youtube.com/watch?v=Qq09BTmizRs>

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How much does it cost?



HTC Vive Pro
~\$1100 USD

NVIDIA RTX 2080 Ti
~\$1200 USD



**Total for best system available
<\$3000 USD**

Standard computer
~\$500 USD



Content creation must be easy!

• e n d u v o

**Steve
Garrou
!**

Conclusions

- VR has applications in biomedical science
- VR is a communication tool and learning and increase retention
- VR is a collaboration tool for discovery
- VR is viable now for advances
- VR has entered the mainstream of gaming
 - Technical advances
 - Affordability will increase
 - It will be more noticeable to students

**Catch a
demo at the
conference!**



VIRTUAL REALITY



IS FOR EVERYONE