We aRe happy

Virtual Reality – Yesterday, Today, Tomorrow~~, Toyota~~

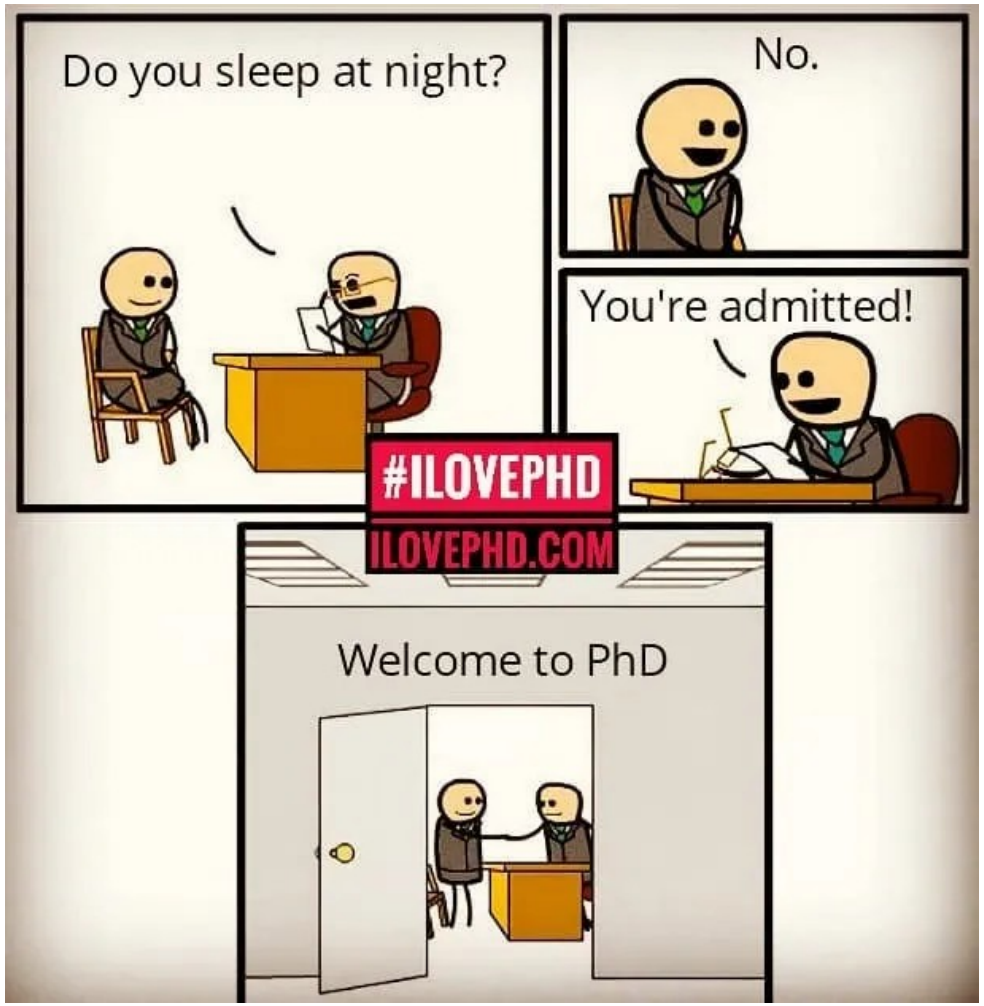
David Kuťák, 27th of March 2024

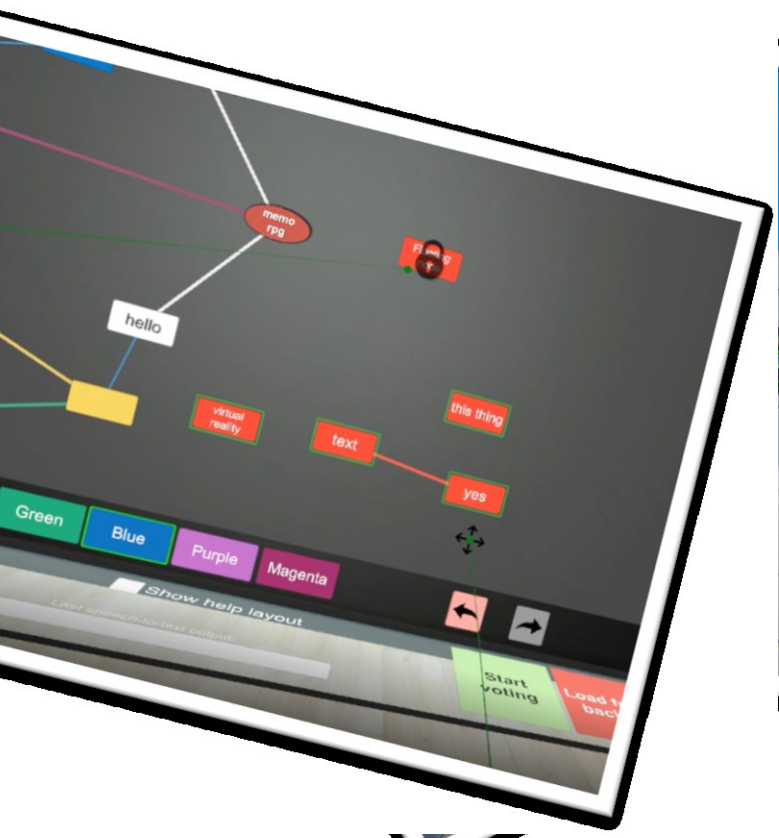
VISITlab

Speaker Introduction

- PhD-in-progress-soon-to-be-finished
  - Here at FI MUNI
  - Virtual reality & molecular visualization
  - Especially DNA nanotechnology :)

- Three main areas of interest
  - Virtual reality
  - Molecular visualization & modeling
  - Games (development)

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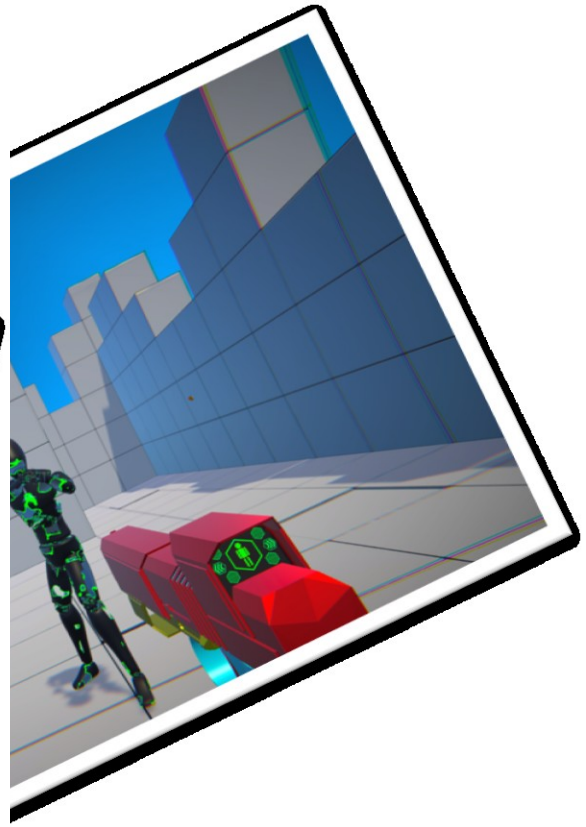

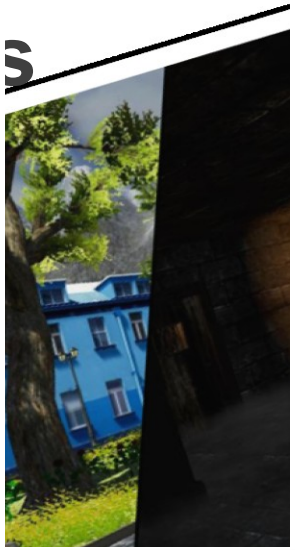

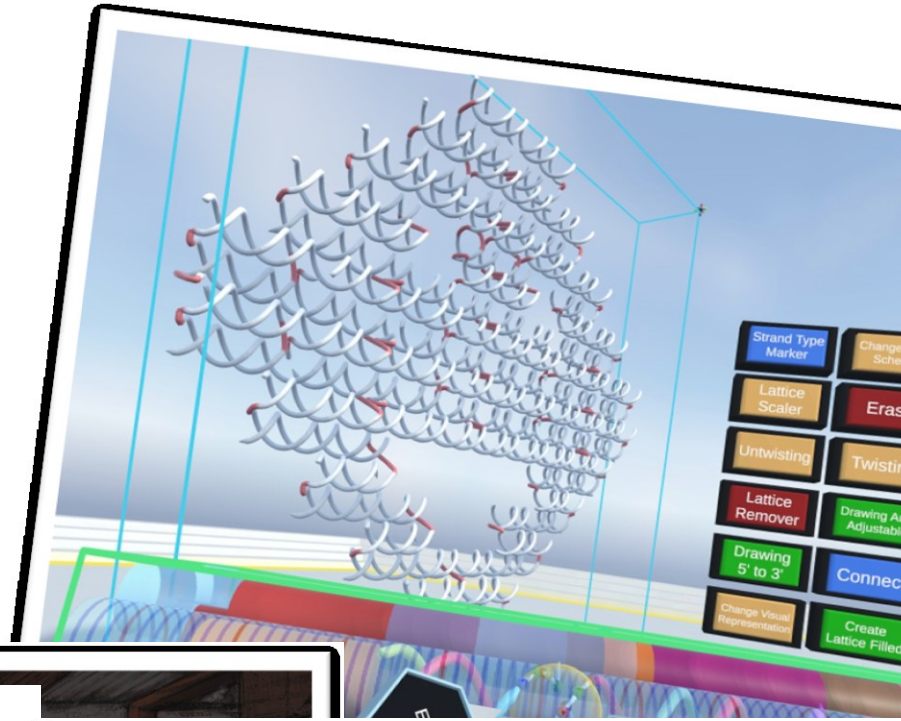
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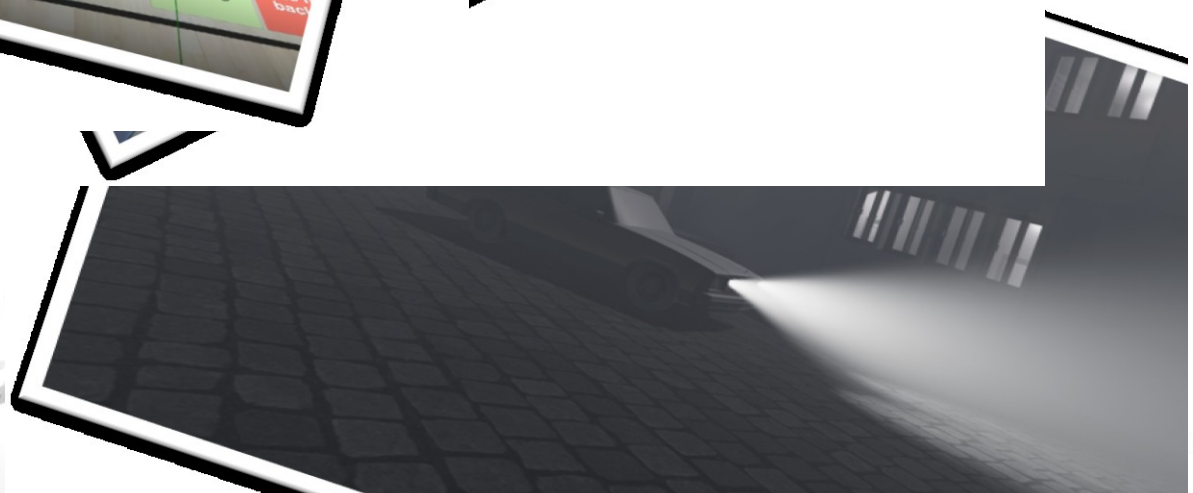
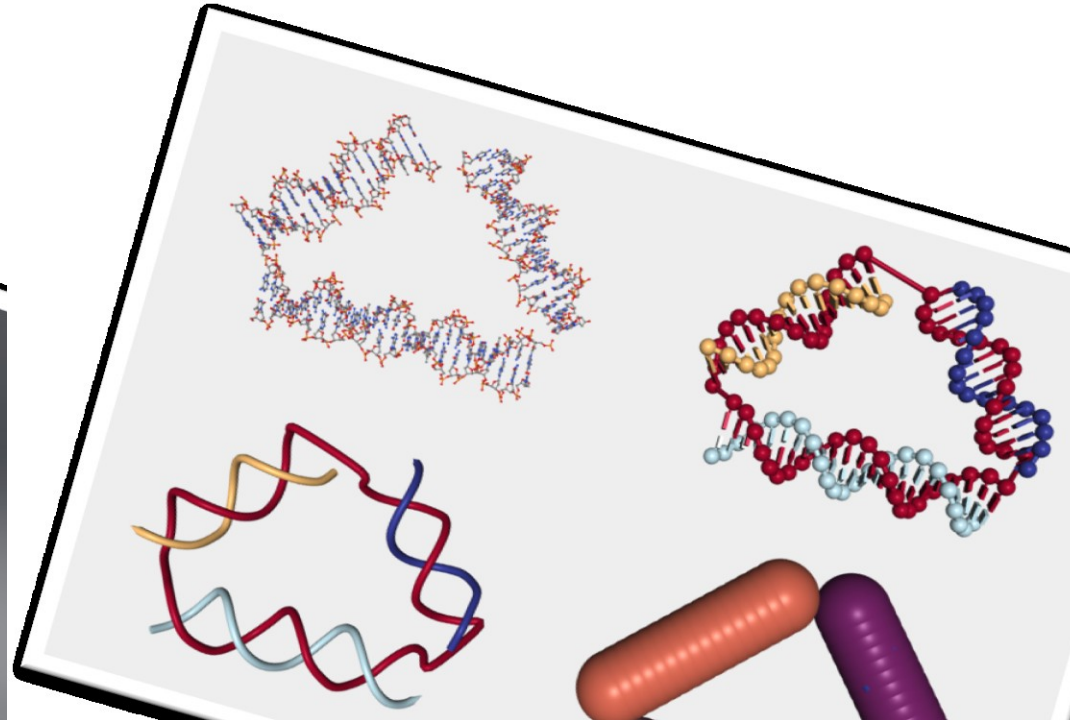
5' to 3'
Change Visual
Representation





Fun fact

- Two headsets owned now
  - PlayStation VR2
  - Meta Quest 3

- (1) One for games
- (2) Other for (game) development

- Point (2) did not yet happen :D

Outline

Topic Introduction → History of VR → VR nowadays → VR in the future

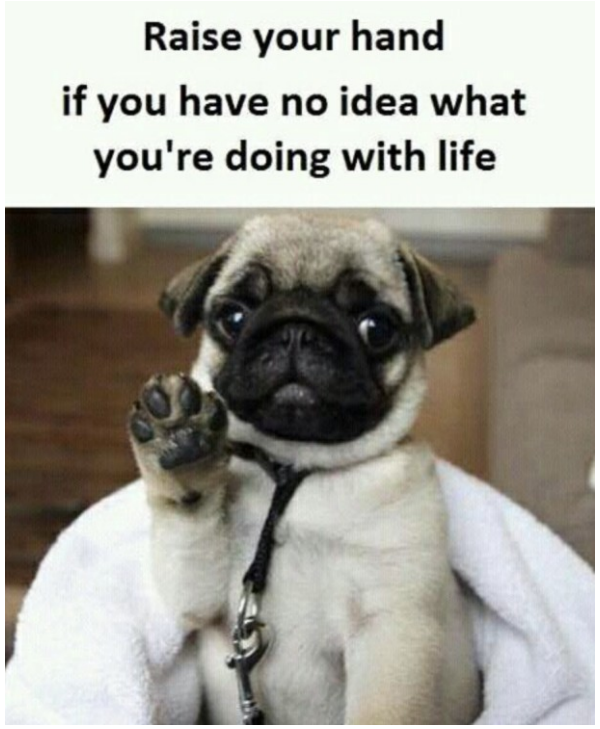



Images generated with craiyon.com

Q&A

Raise your hand if you have experience with VR

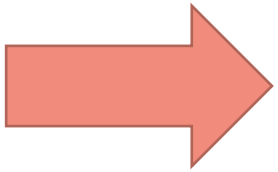
Feel free to share what you think about it




So it begins.

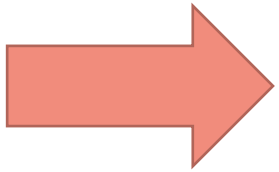
Why to talk about VR?

- It can help you or other people…



Why to talk about VR?

- … or it may not, as it is no magical formula.



Why to talk about VR?

VR is a technology and we **believe** that **this technology** may **benefit us**.

If this is not true, why to even bother?

What is a Virtual Reality?

What is a Virtual Reality?

"Virtual reality is a **simulated experience** that employs pose tracking and 3D near-eye displays to give the user an **immersive feel** of a virtual world." (Wikipedia)

"images and sounds **created by a computer** that **seem almost real to the user**, who can **interact** with them by using sensors" (Oxford Learner's Dictionary)

"a **computer-generated** digital environment that can be experienced and **interacted** with as if that environment were **real**." (The VR Book by Jerald)

"an **artificial** environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's **actions partially determine what happens** in the environment" (Merriam-Webster)

"vr is shit" (Pessoa Invisível, user of Facebook)

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Digital experience feeling like reality both audiovisually and interaction-wise

What is not a Virtual Reality?

University lecture

What is not a Virtual Reality?

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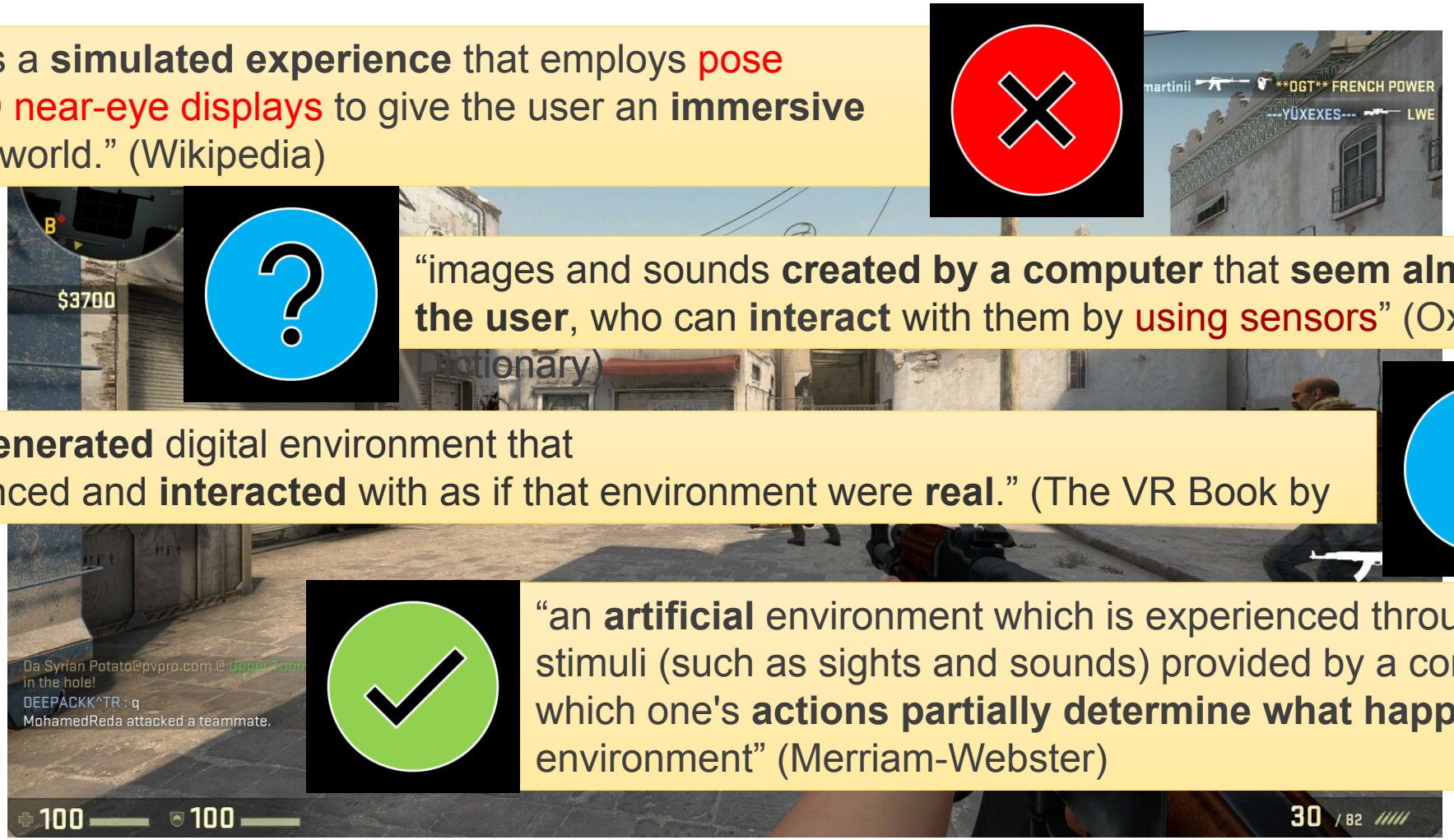

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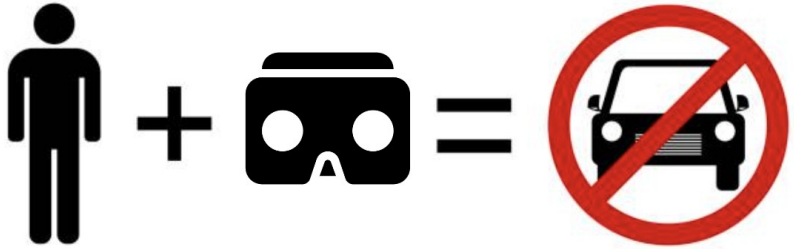
Counter Strike on a desktop PC. Or could it be?

What is not a Virtual Reality?

This is dangerous.



What is not a Virtual Reality?

- There are also other „realities“
- The definitions may differ

- **Augmented reality**
  - Augments digital data on top of real world data

- **Mixed reality**
  - Blends physical and digital worlds
  - Sometimes just used to refer to „both VR and AR“

In this talk, we focuses solely on **virtual reality**.

Immersion x Presence

- Two common „VR terms“
  - Wikipedia definition of VR: „(…) **immersive feel** of a virtual world“

- Immersion
  - Technical aspect
  - The extent to which **the technology** makes you feel surrounded by the virtual world
  - Aids to achieve the „presence“
- Presence
  - Subjective aspect
  - The feeling of „being there“ at the given moment

Immersion x Presence

Higher immersion

Immersion x Presence

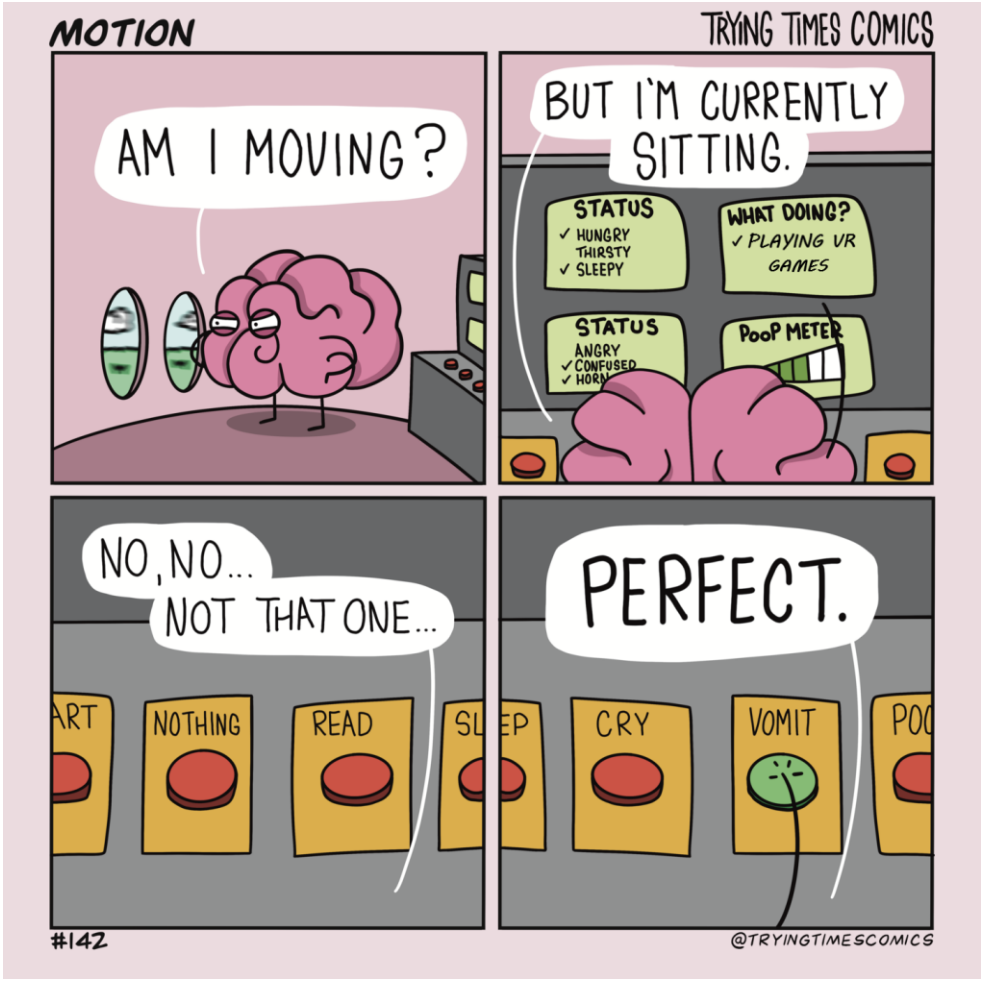
Higher immersion and also presence

Immersion x Presence

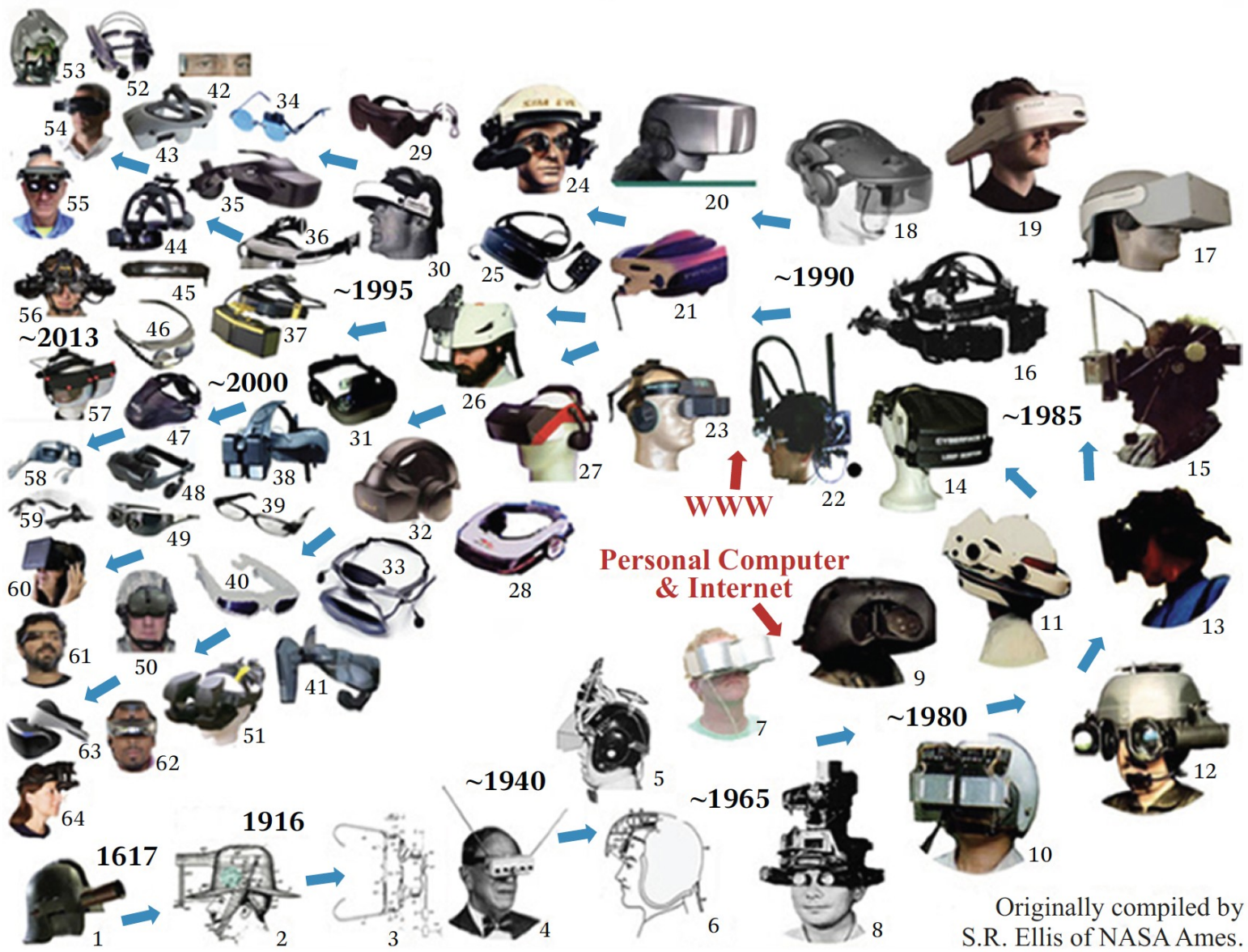
But what if…

Motion sickness

- You may feel sick or dizzy (or even vomit)
- Occurs when there is a conflict between senses
  - Eyes: “I am moving”
  - Body/inner ear: “I am sitting”
  - → problem
- You may experience when using VR
  - Depends on each individual,
  - and the application.



Virtual Reality – Hardware through time



Head-mounted displays throughout the history

Virtual Reality – Sword of Damocles

- 1968
- Attached to the ceiling
  - Head-tracking
  - Weight

Virtual Reality – VIEW by NASA

- 1980s
- Steroscopic display
  - Proper „HMD“
- Interaction gloves
- 3D sound
- Voice recognition

Virtual Reality – Sega & Nintendo

- 1990s
- “Failures“
  - Sega → prototype
  - Nintendo → bad sales

Virtual Reality – Nintendo Virtual Boy Commercial

1995 at its best :)

- I recommend to watch at home ☺

Nintendo continued

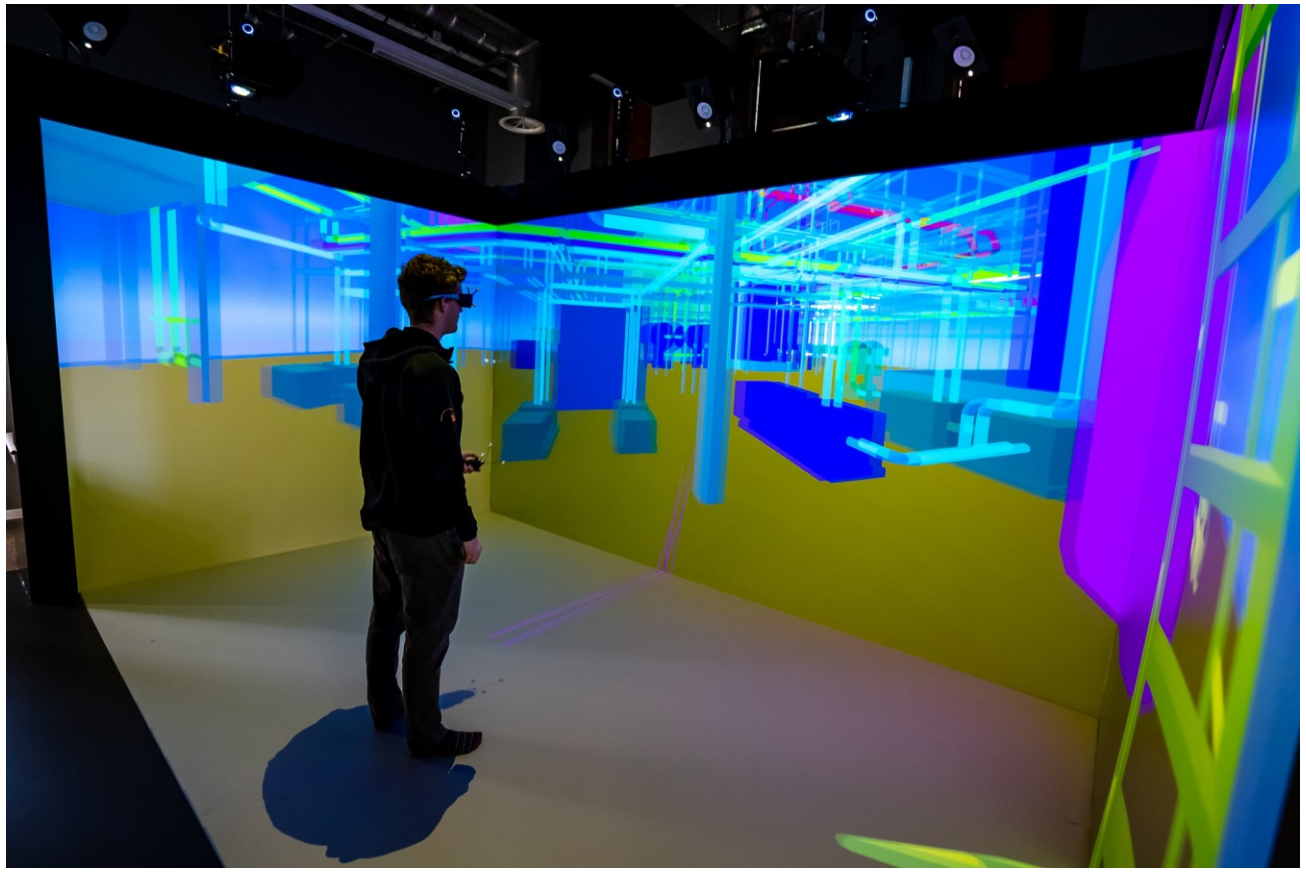
- 2019
- Another „shot“ at VR with Nintendo Switch
- VR is part of „Labo“ cardboard kit
  - Very cheap, 3DOF
- Accepted more positively than Virtual Boy…
  - … but no „major breakthrough“

Virtual Reality – CAVE

Virtual Reality – CAVE

Cave Automatic Virtual Environment

- 1990s
- Projections on walls
- Stereoscopic glasses
- Used to be popular
  - → natural collaboration
  - → being replaced by HMDs



Virtual Reality Today

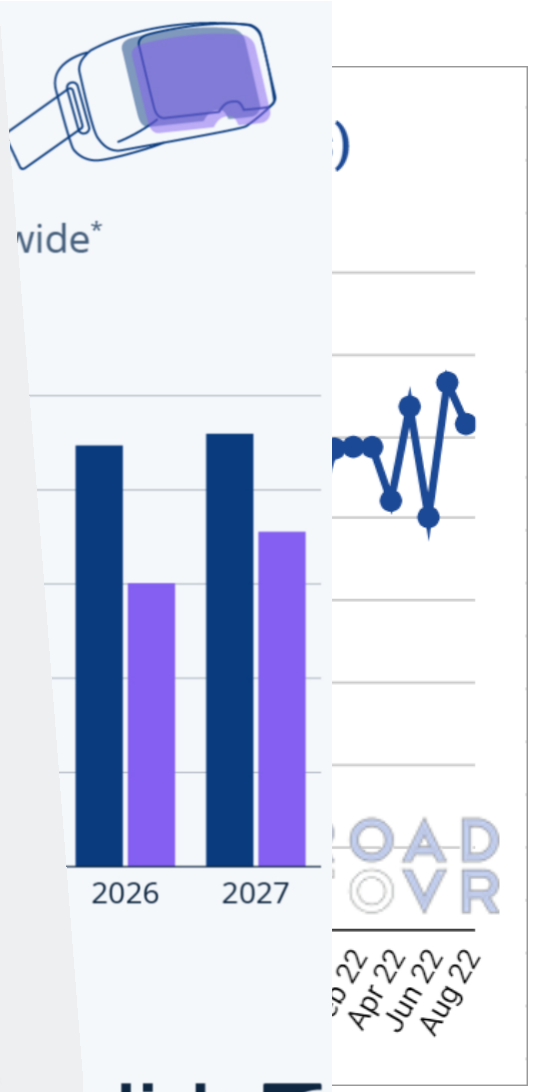
(for most people, as well as this lecture)

- VR „exploded“ in 2014 when Facebook (Meta) bought Oculus

Really exploded?

Virtual Reality Today – Market

- Various data
  actual users
  is questiona
- Right plot: es
  active users
  Steam



Virtua

Source: VR.Space

Virtual Reality Today – Components

Audiovisuals

Interactions

Position tracking

Computations

Virtual Reality Today – Components

Audiovisuals	Interactions	Position tracking	Computations

Display(s) – count, type, resolution, refresh rate

Lenses

Virtual Reality Today – Components

Audiovisuals

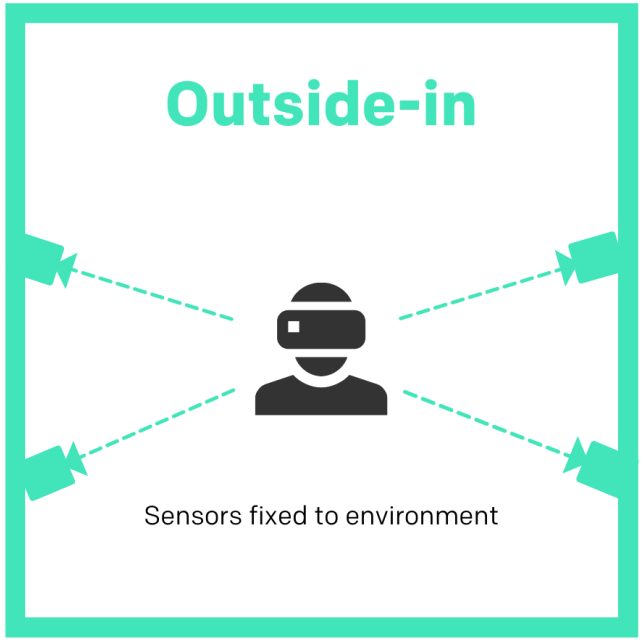
Interactions

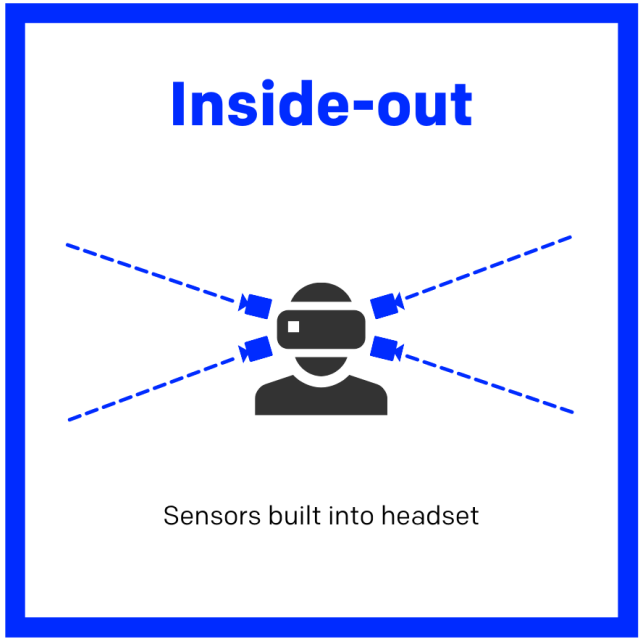
Worth remembering: if you develop a VR application for users with different HMDs, you need to take into account their different interaction possibilities.

Types of controll(er)s

Virtual Reality Today – Components

Audiovisuals | Interactions | **Position tracking** | Computations





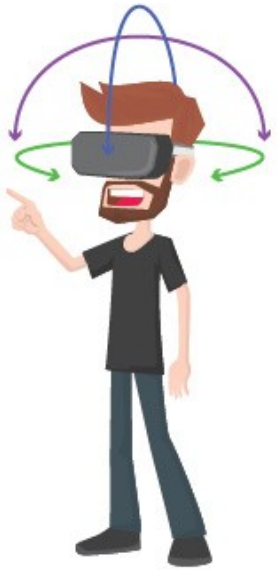
Virtual Reality Today – Components

Audiovisuals

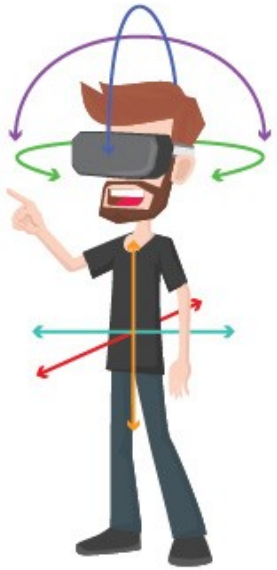
Interactions

Position tracking

Computations



3DoF



6DoF

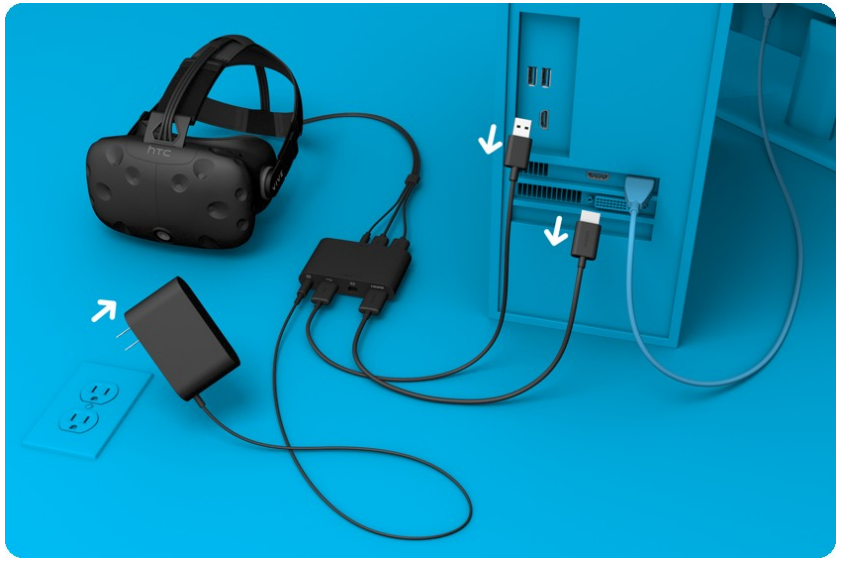
Virtual Reality Today – Components

Audiovisuals

Interactions

Position tracking

Computations



Outline

Topic Introduction → History of VR → VR nowadays → VR in the future




Images generated with craiyon.com

Joke Time


VIRTUAL REALITY
ROLLER COASTER SIMULATOR
I KNOW I HAVEN'T ALWAYS BEEN THE BEST DAD, BUT I LOVE YOU, AND I'M PROUD OF YOU
EMOTIONAL ROLLER COASTER SIMULATOR
@SKELETON_CLAW
SKELETONCLAW.COM

VR … what is it even good for?

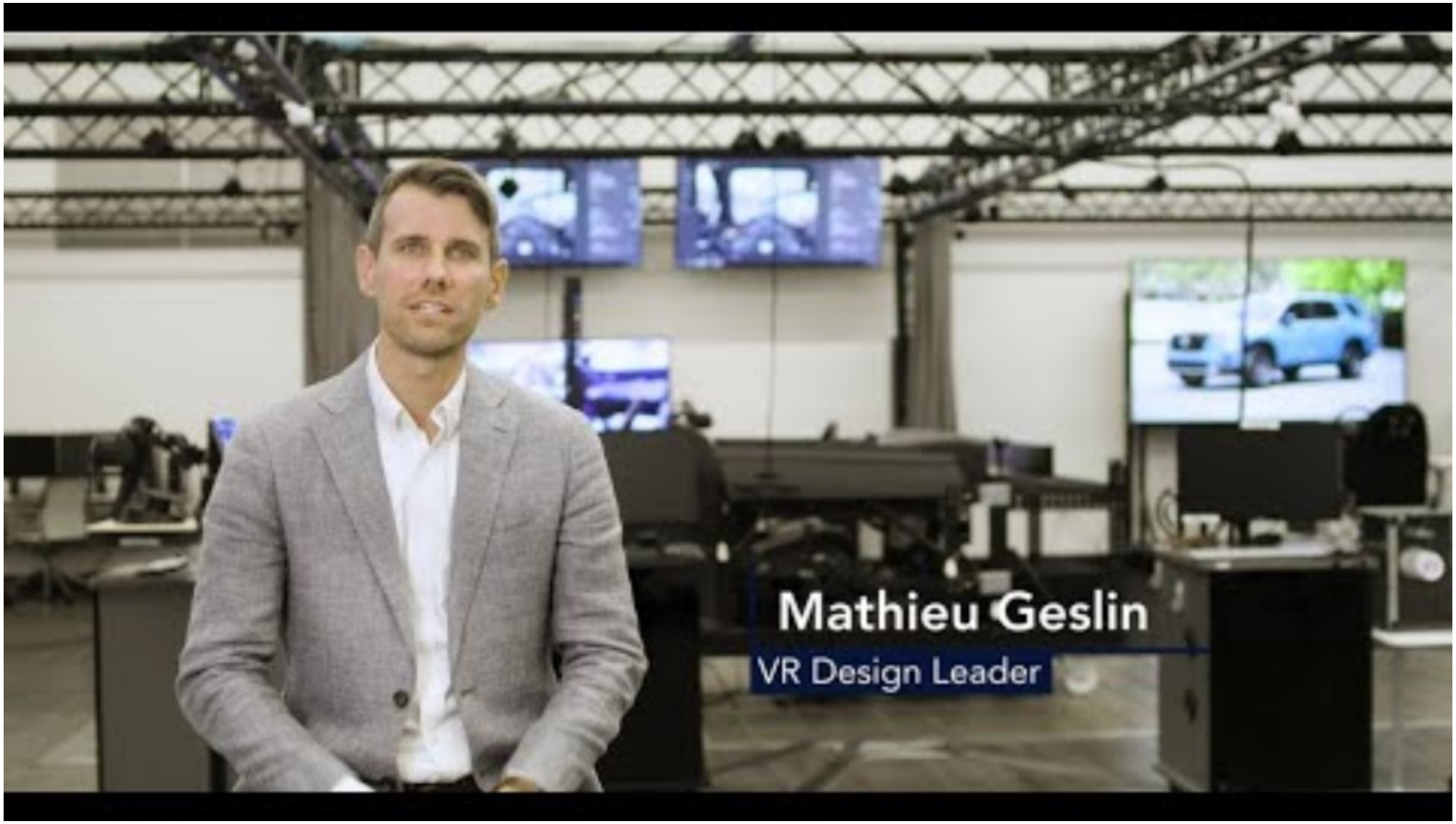
VR in automotive industry

BMW use case

- VR since 1990s
- HTC Vive since 2015
- Combined with physical model of car‘s interior
- Faster iterations than with real cars
- Easy to simulate real driving experience

VR in automotive industry

Honda



Virtual Reality Exposure Therapy (VRET)

- Treatment of mental health issues
  - Phobias
  - Posttraumatic stress disorder (PTSD)
  - Social anxiety
  - Brain injuries
  - Etc.

- Landstuhl Regional Medical Center
  - VRET treatment of soldiers with PTSD
  - „(…) extremely effective treatment because it is a patient's personalized reality that they learn to process, control and regulate.“

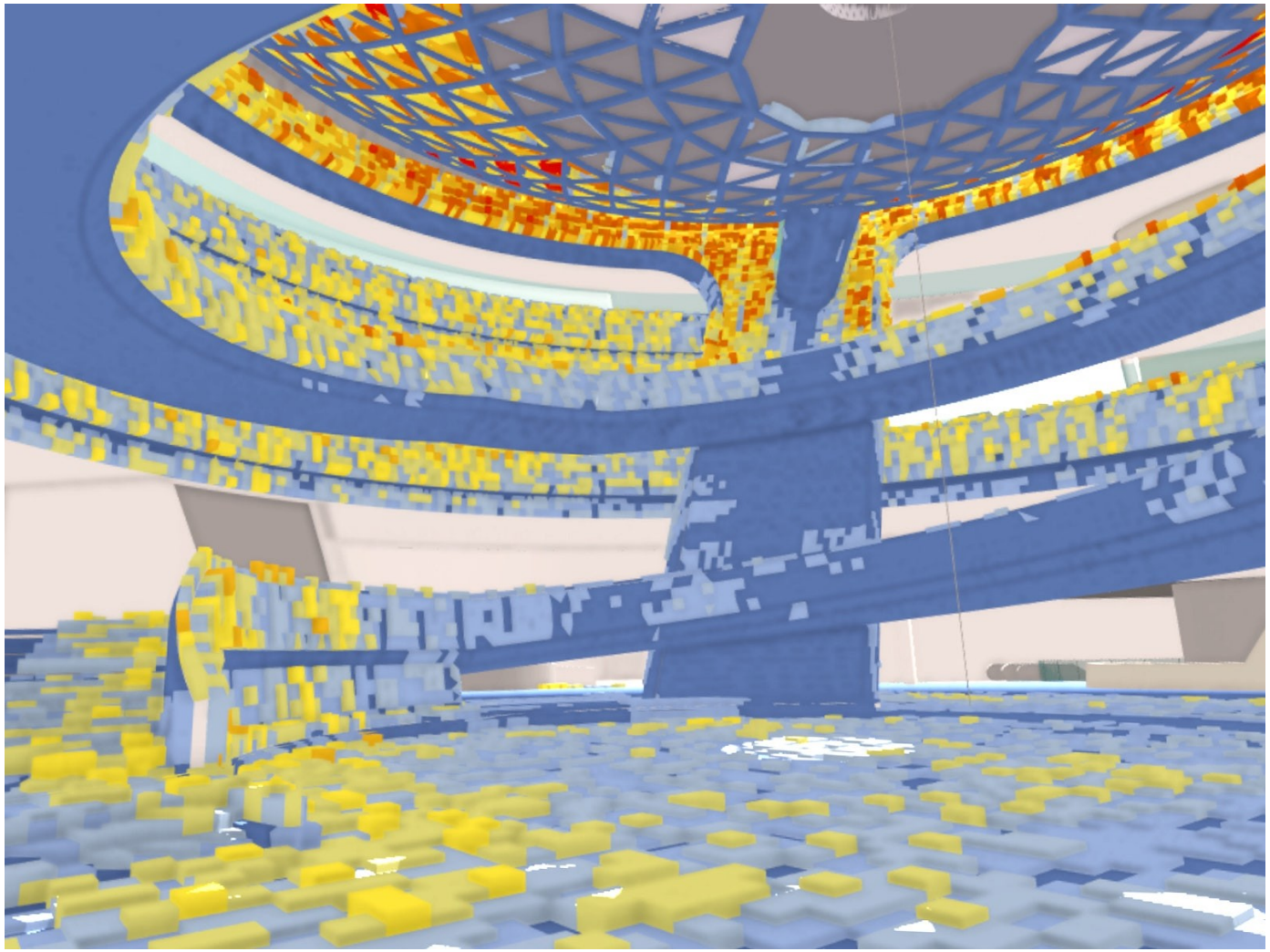
Virtual Reality Exposure Therapy (VRET)

Targeting arachnophobia

VR in architecture

- VR is popular in this area for visualization of buildings and their designs

- Ennead Architects company
  - Shanghai Planetarium visualization
  - Not just space itself but also most-lit locations

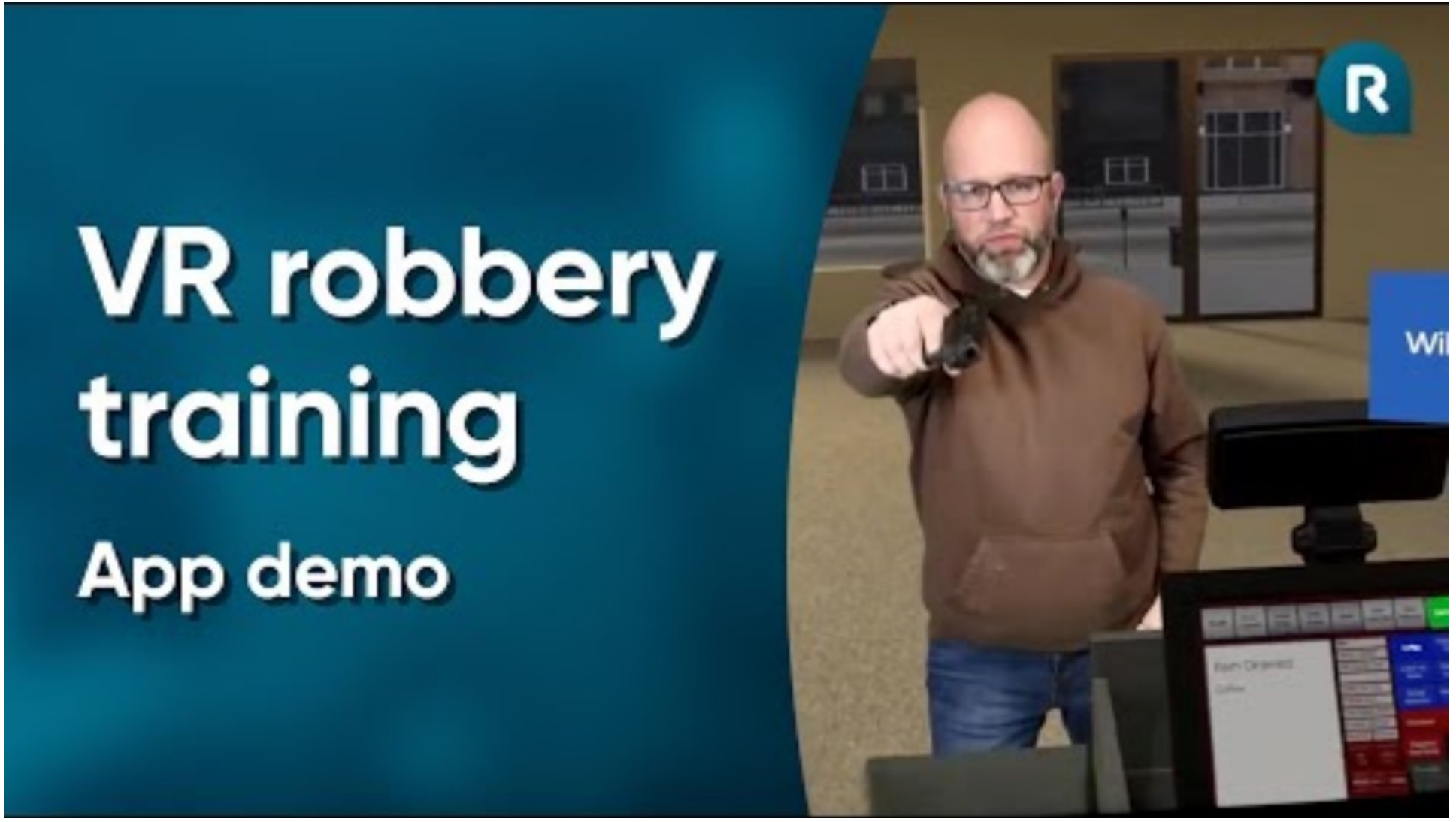


VR in training

- Used by multiple companies to train their employees

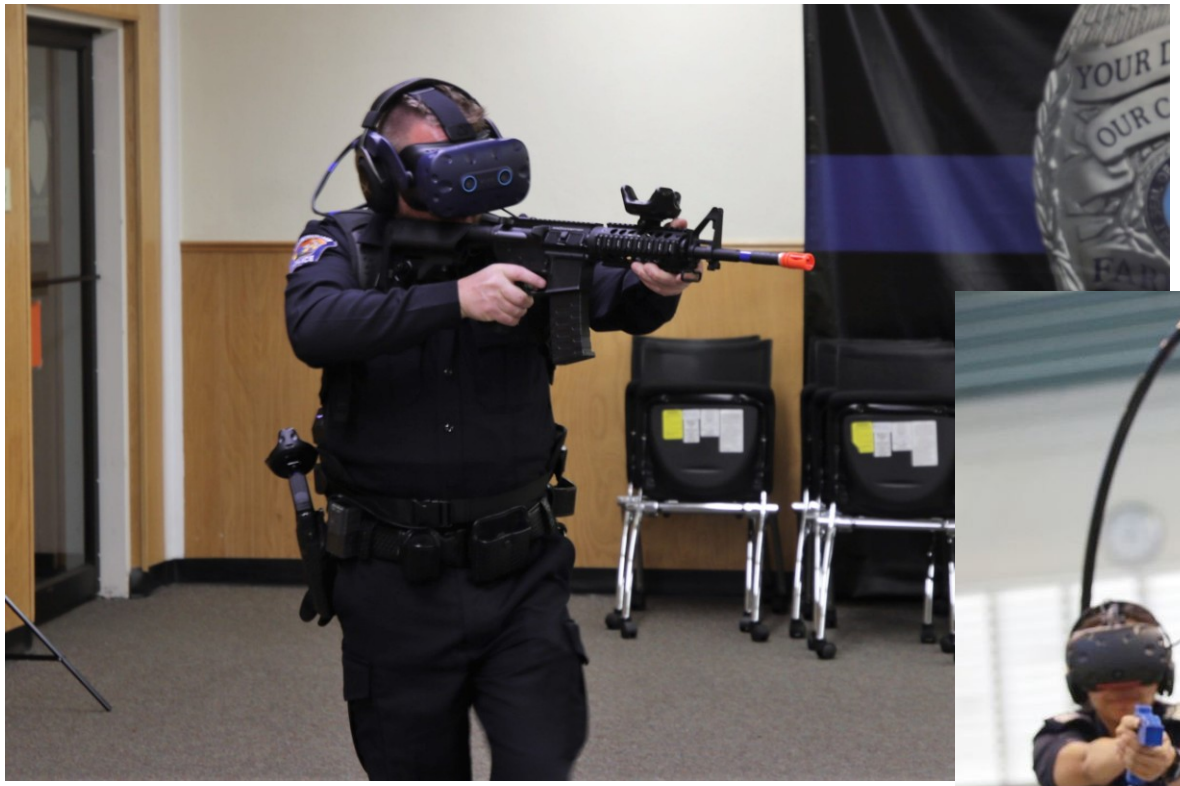
- Bank of America
  - VR training for 50,000 employees
  - Five different VR simulations
    - Relationships with clients
    - Navigating difficult conversations
    - Responding with empathy

VR in training



VR in training

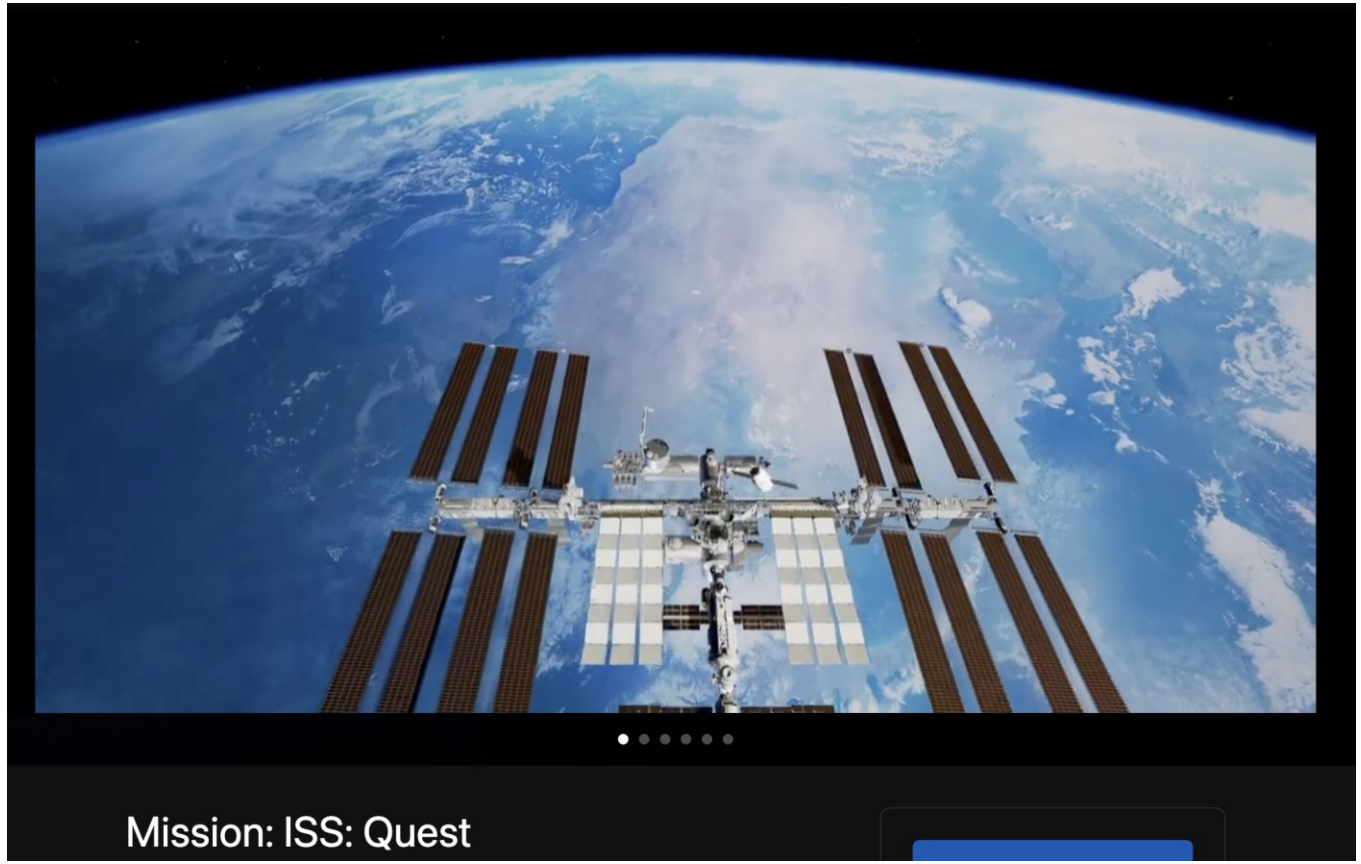
- Military or law enforcement training

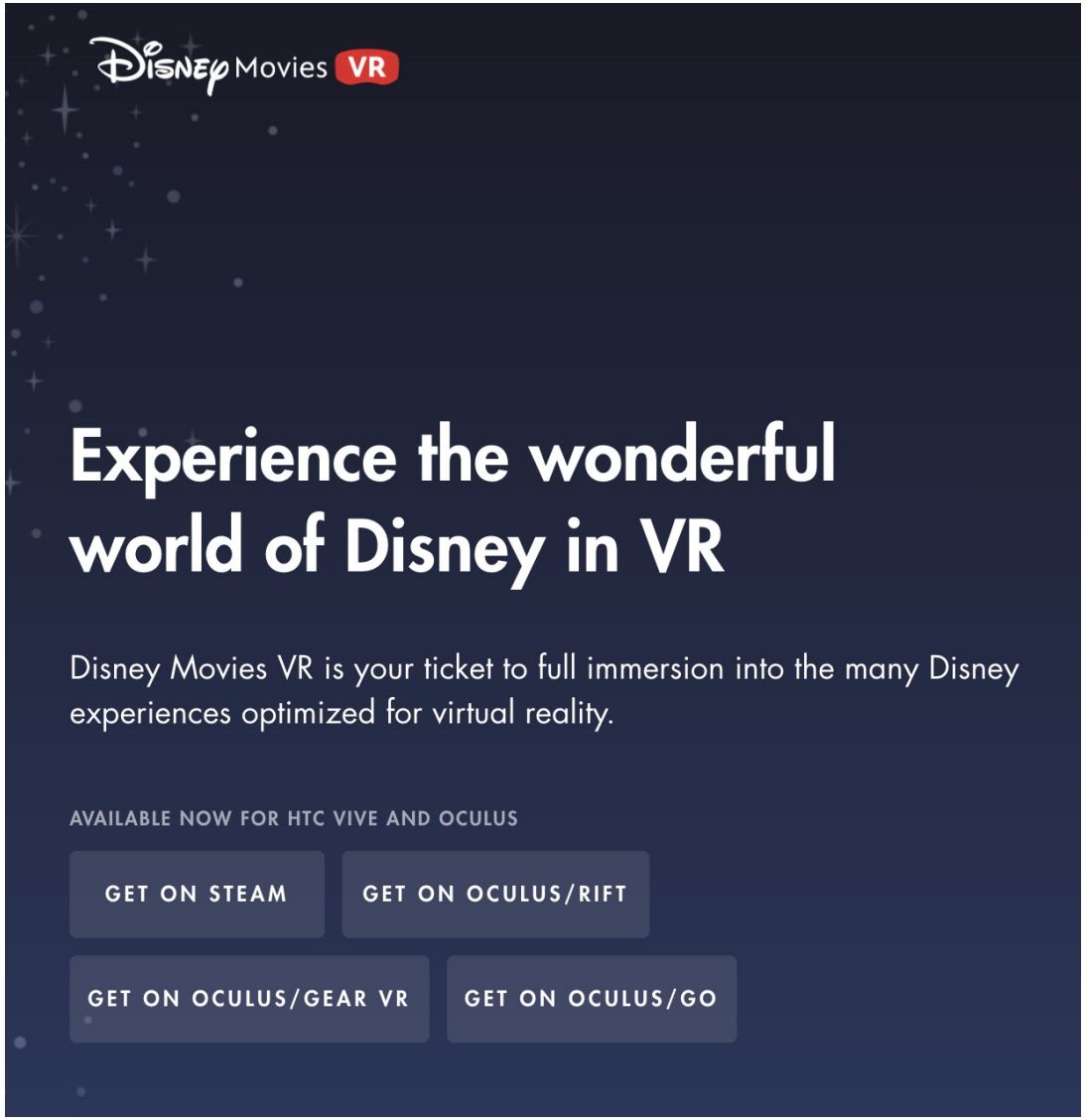


VR in entertainment

360° Movies

- YouTube, Disney, …





VR in entertainment

Games

The New York Times

Virtual Reality Is a Disappointment? Not in the World of Video Gamers

VR in entertainment

Games

- Large VR

VR in entertainment

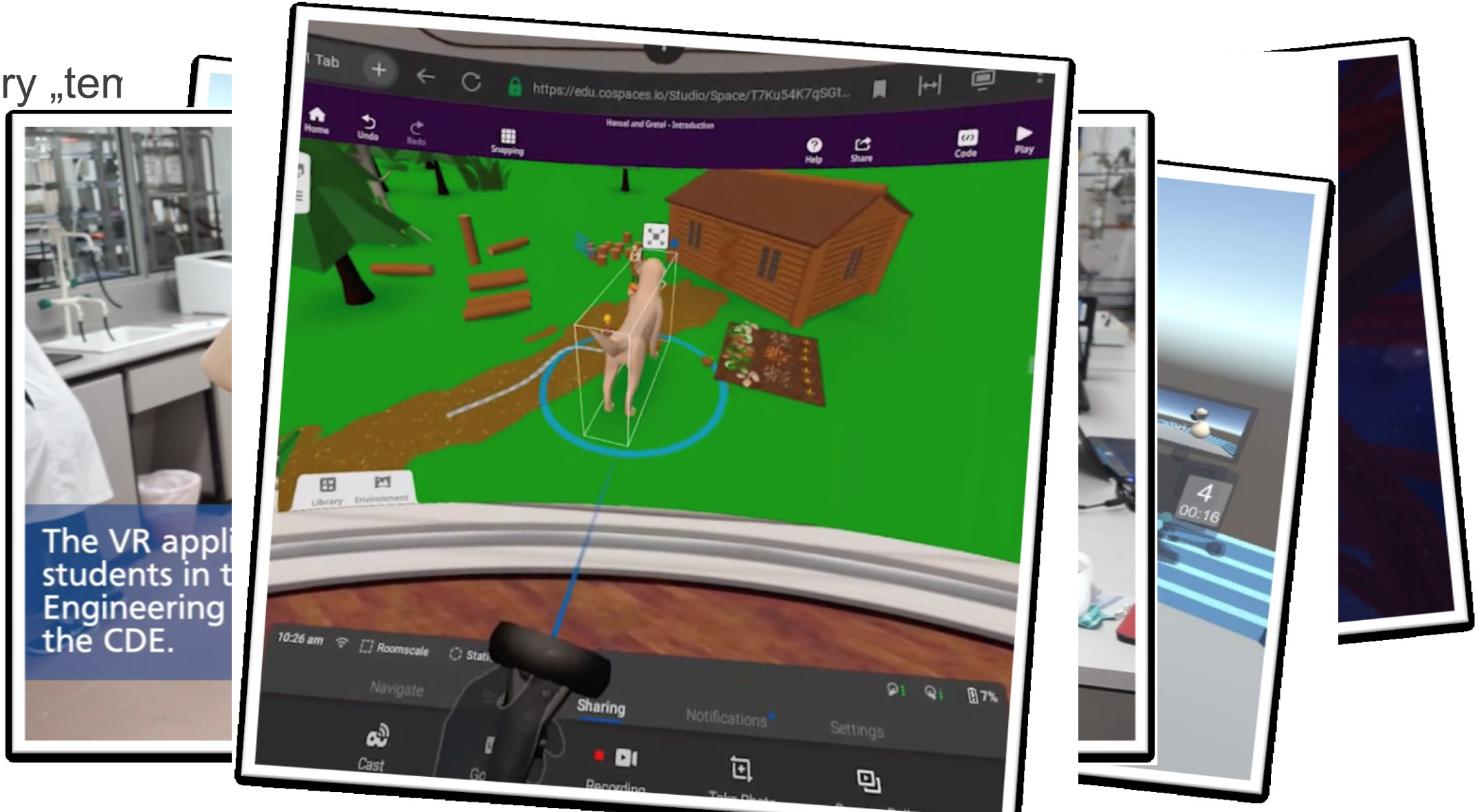
Games

VR in entertainment

Games

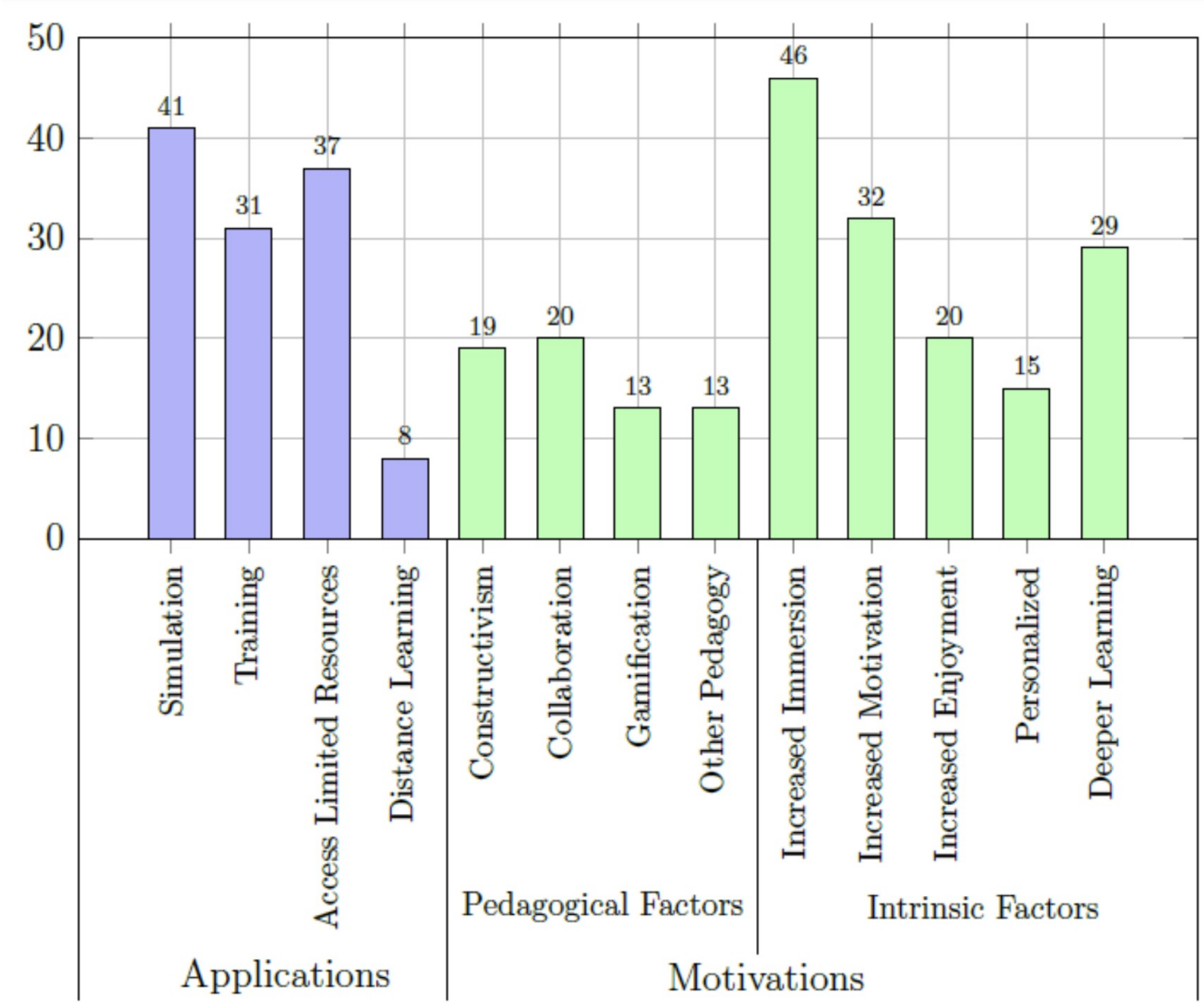
VR in education

- Very „ten



VR in education

- Reported applications and motivations of papers applying VR to education
  - Increased immersion
  - Increased motivation
  - Deeper learning
  - Increased enjoyment
  - Collaboration

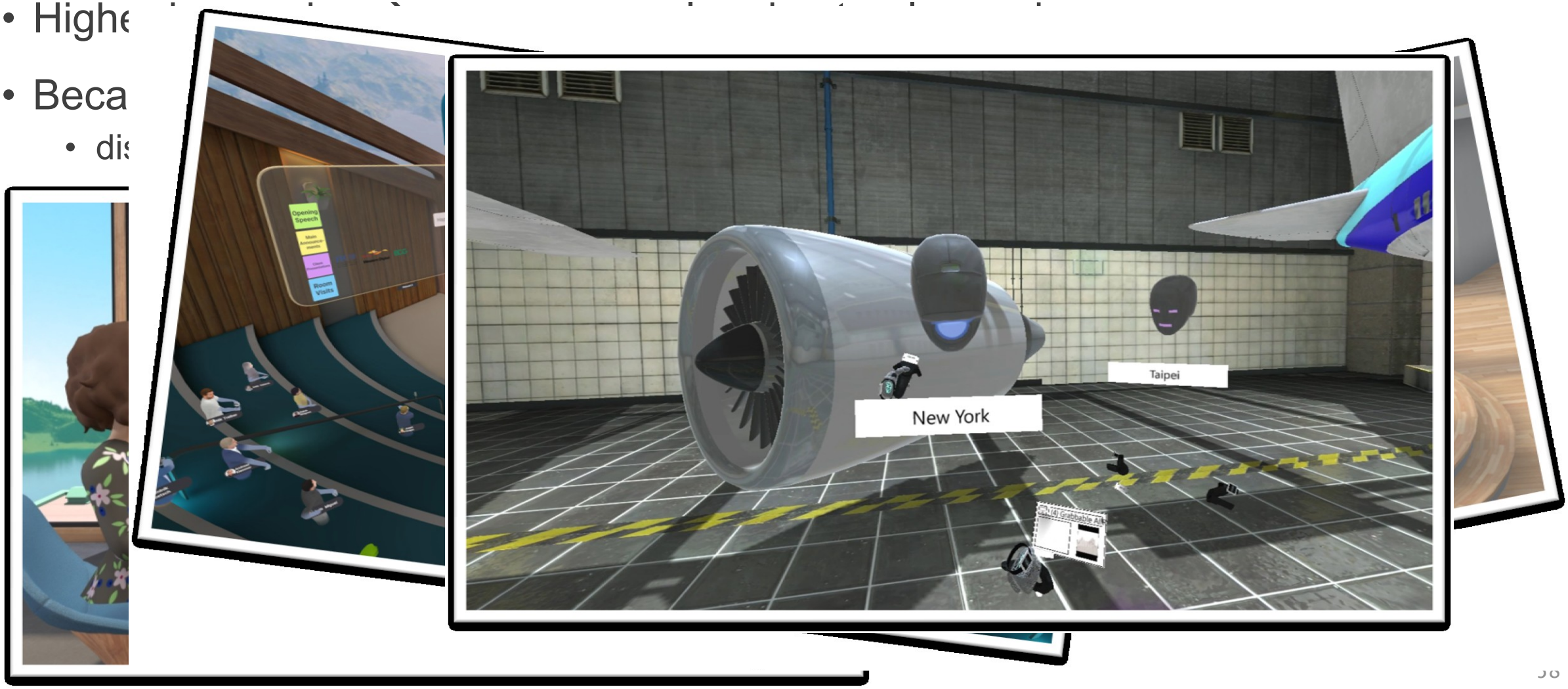


Kavanagah et al. (2017)

VR for collaboration

Events, meetings, and conferences

- Highe
- Beca
  - dis



VR for animals aka „true creativity“

Because … why not

- Turkish farmer use(s|d) VR with his cows as it seemed (call it a „preliminary data“) to increase the amount of milk produced

Bio(Vis) and Med(Vis) examples

Molecular Visualization in VR

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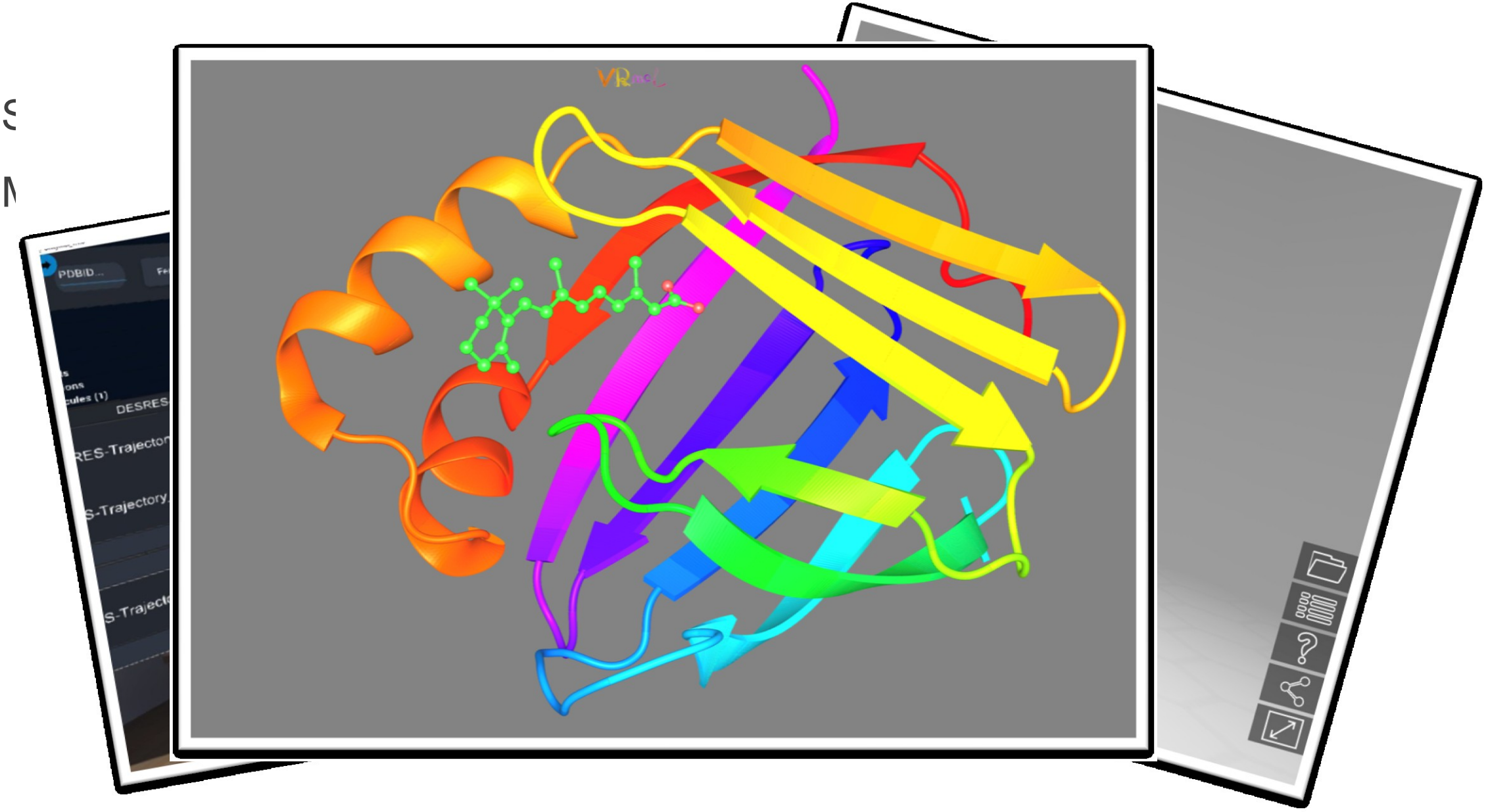
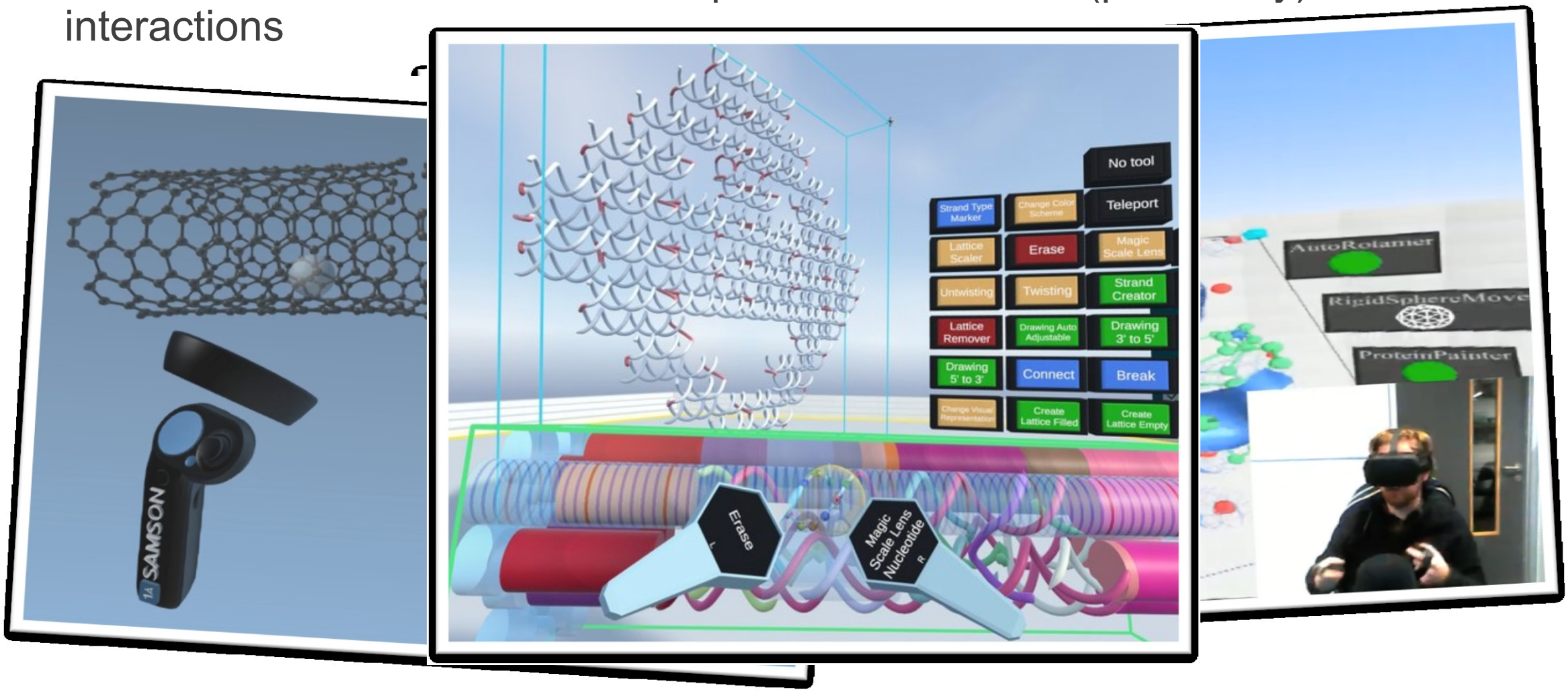
- M

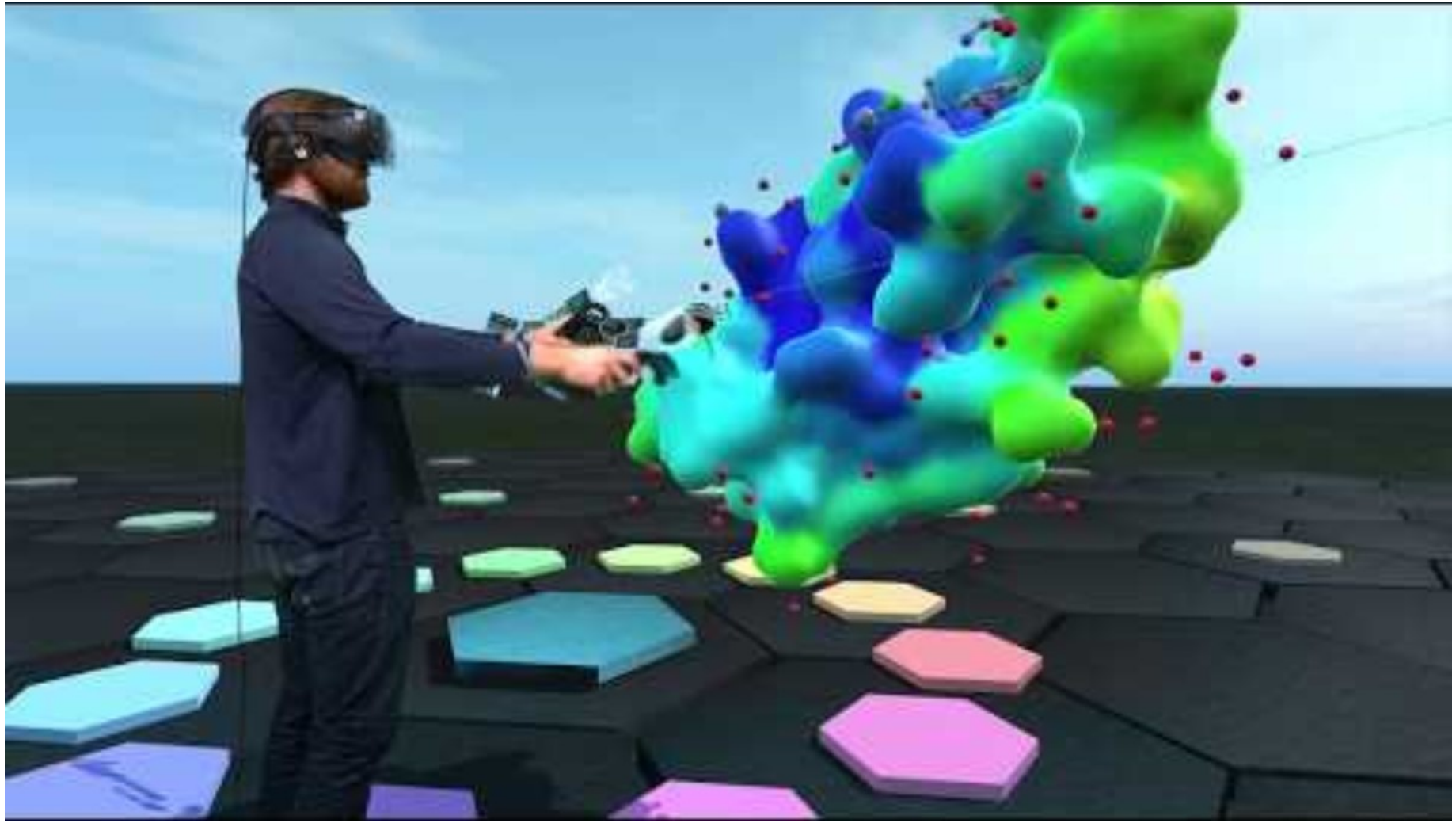


Molecular Modeling in VR

- Tries to combine VR visualization possibilities with its (potentially) more natural interactions

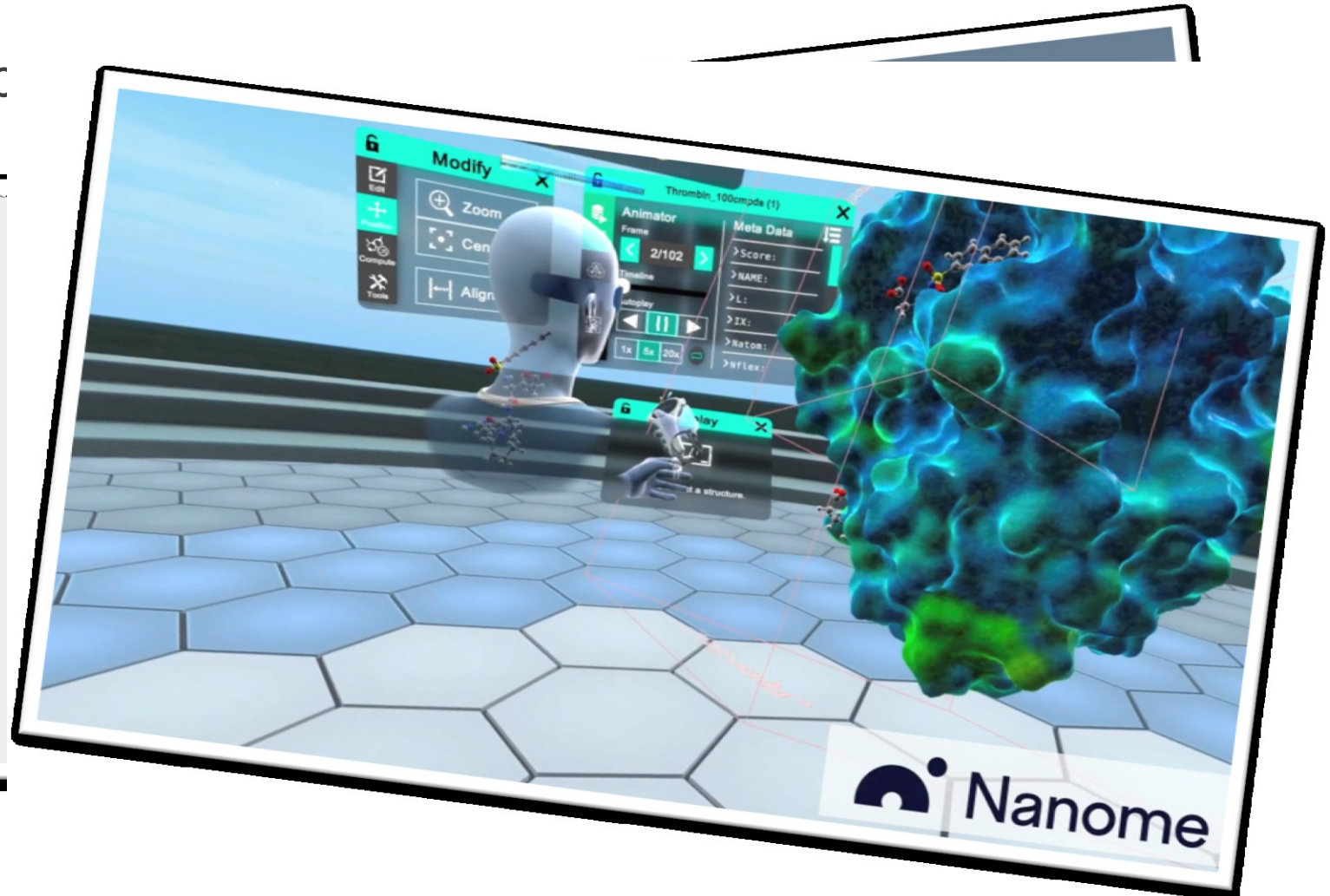


Molecular Visualization & Modeling in VR



Molecular Dynamics in VR

- Seeing how molecules behave
- Possibly also modeling sup

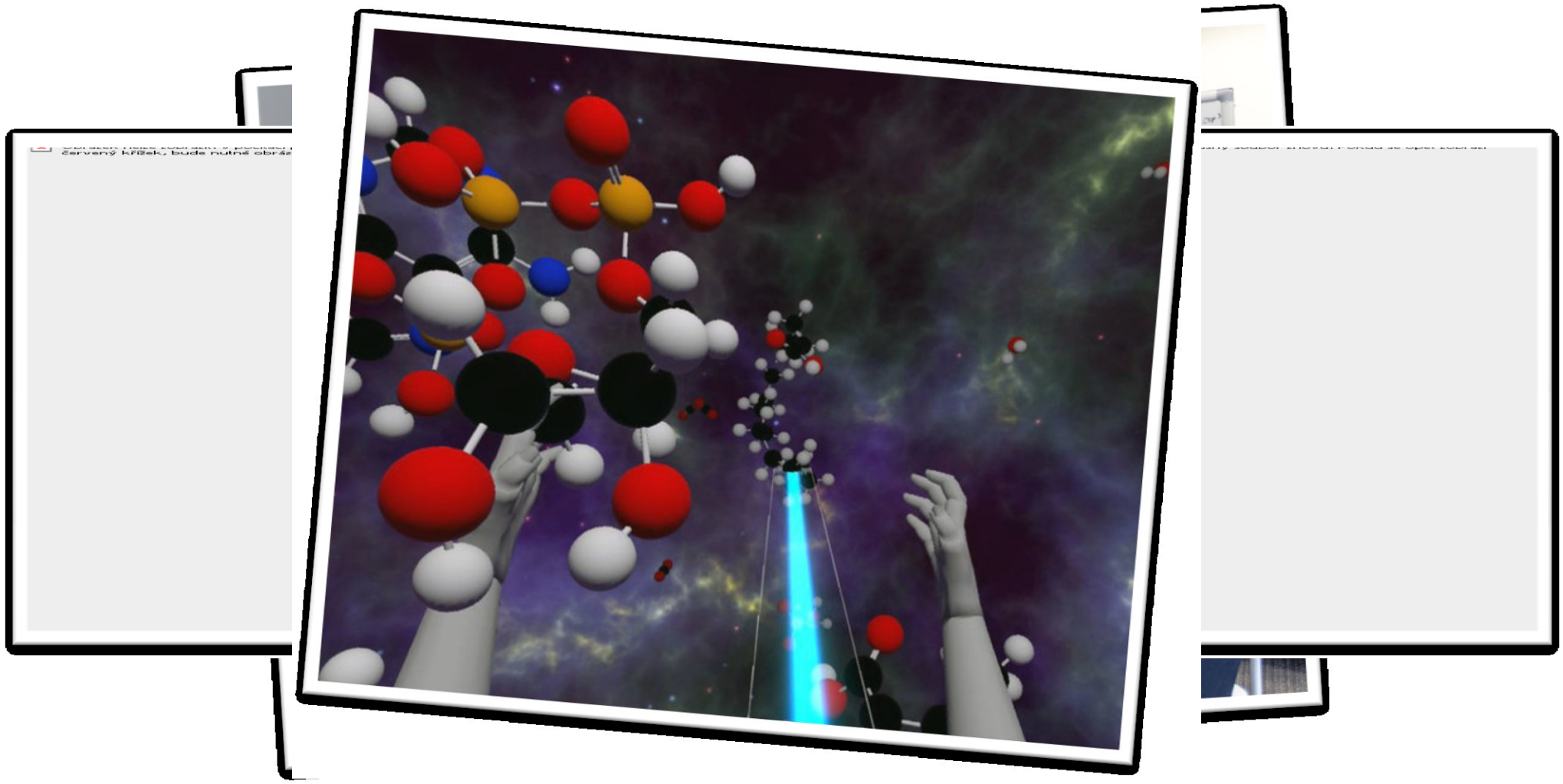


Molecular Dynamics in VR

Interacting with MD & docking (in Narupa)

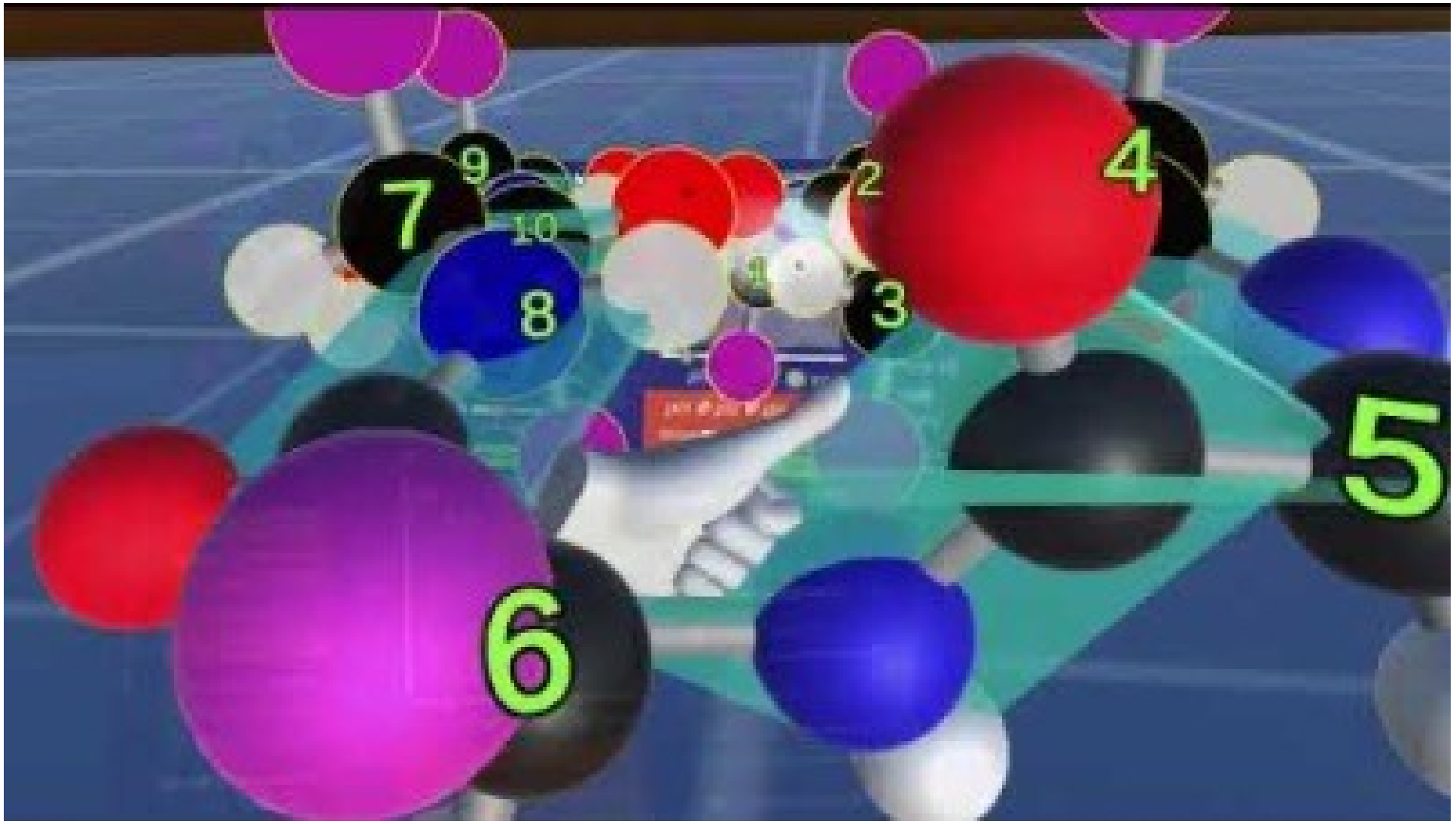
Learning about molecules in VR

- Biology education is a large area in VR MolVis



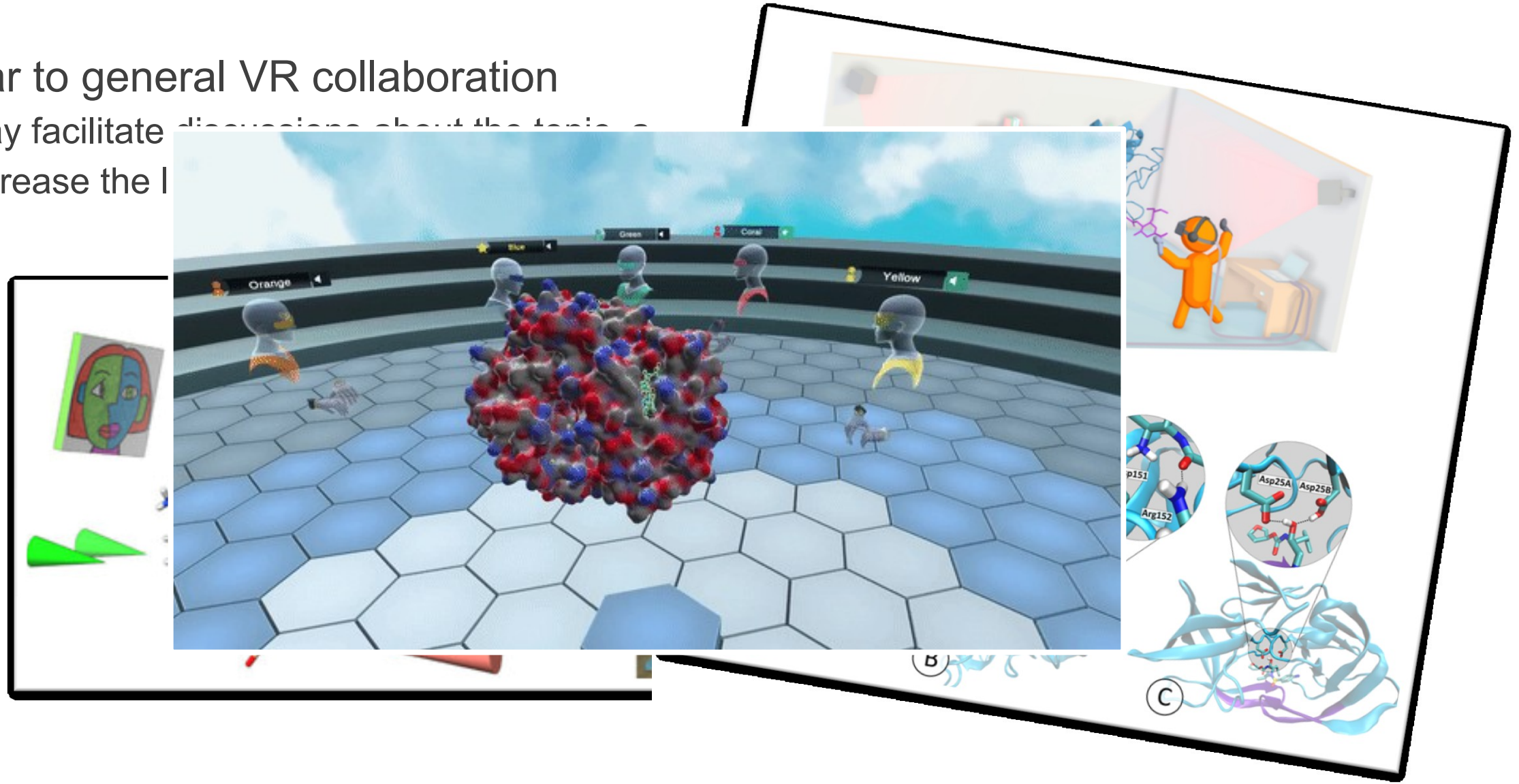
Learning about molecules in VR

Nice feature of Peppy: works both with and without VR



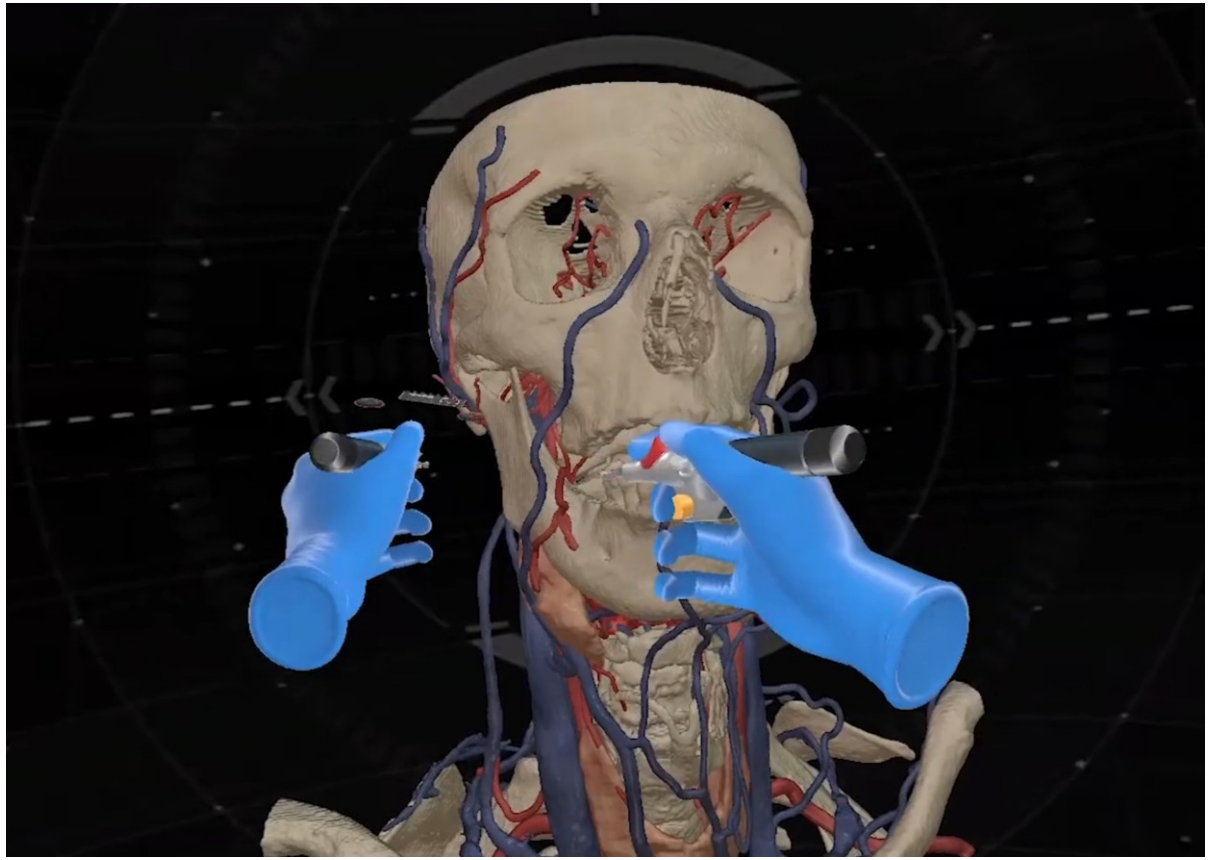
Collaboration, molecules, and VR

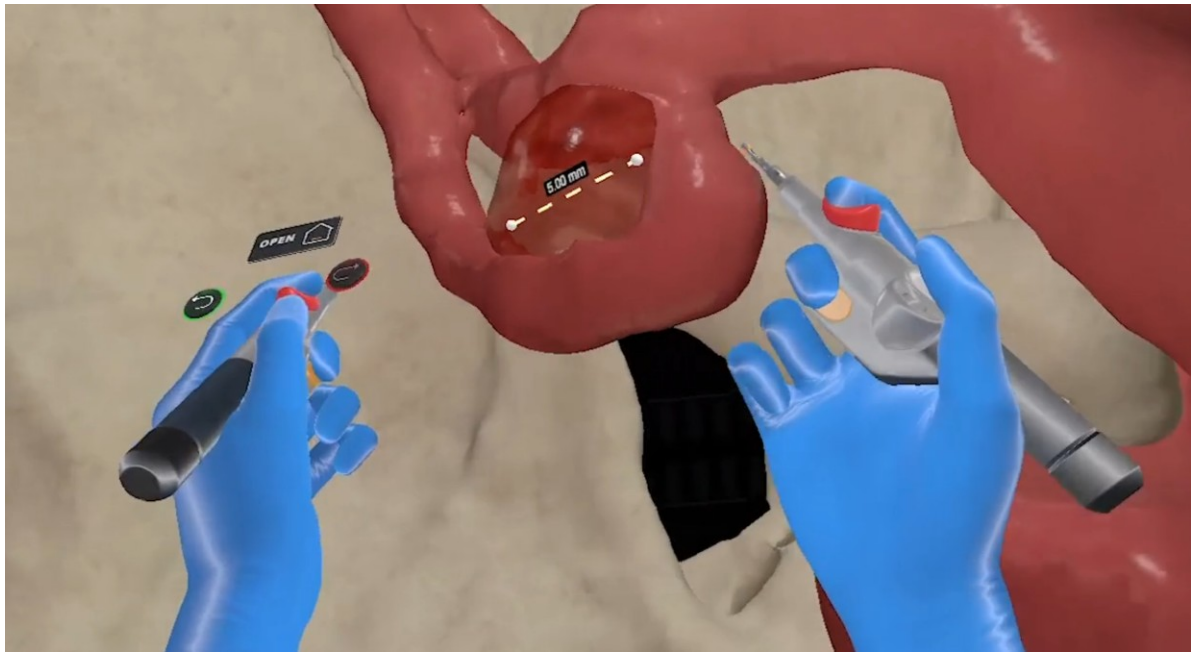
- Similar to general VR collaboration
  - may facilitate
  - increase the l



Surgical planning

CT, MRI, ... scans visualized in VR (by ImmersiveView)

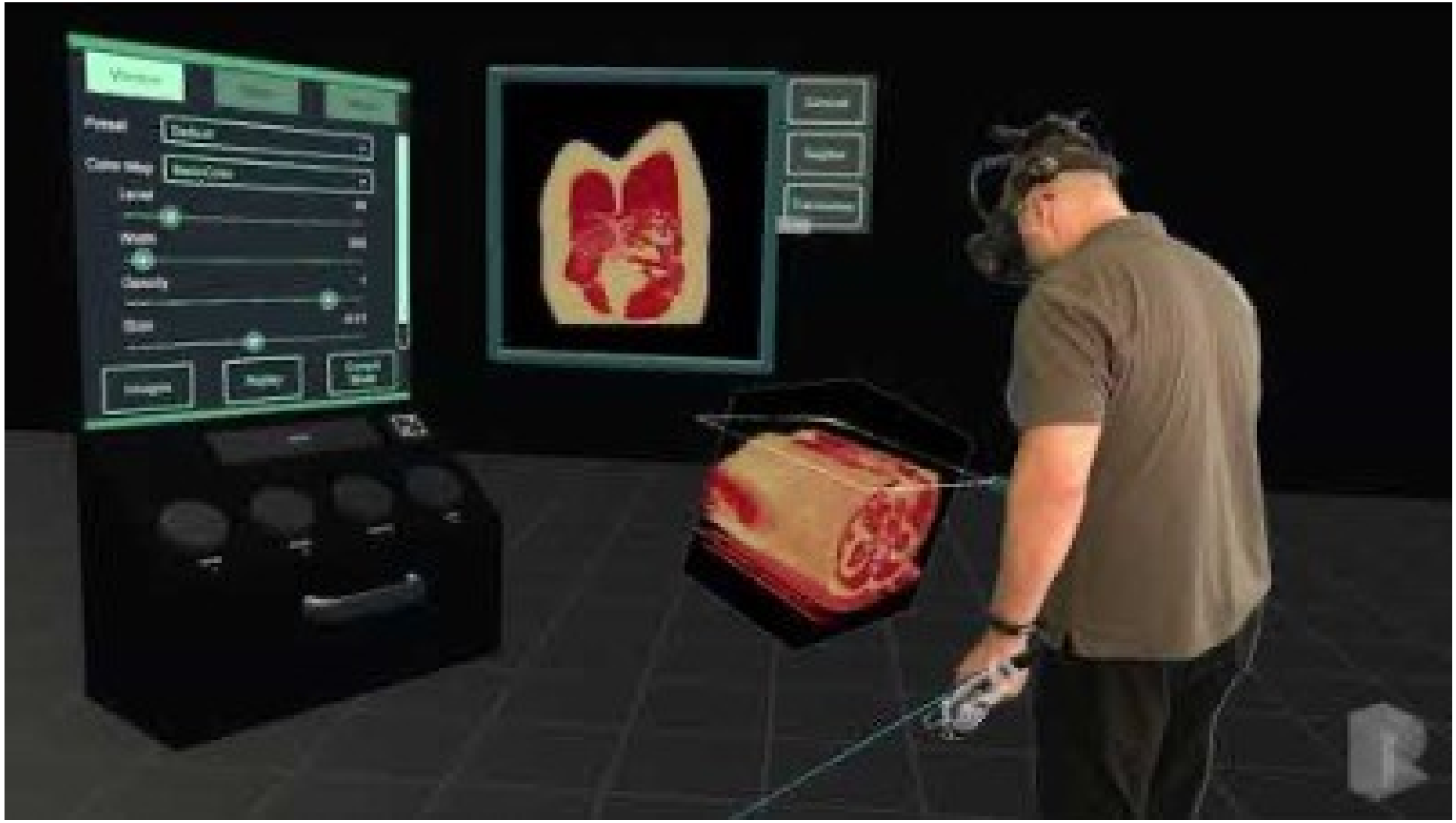




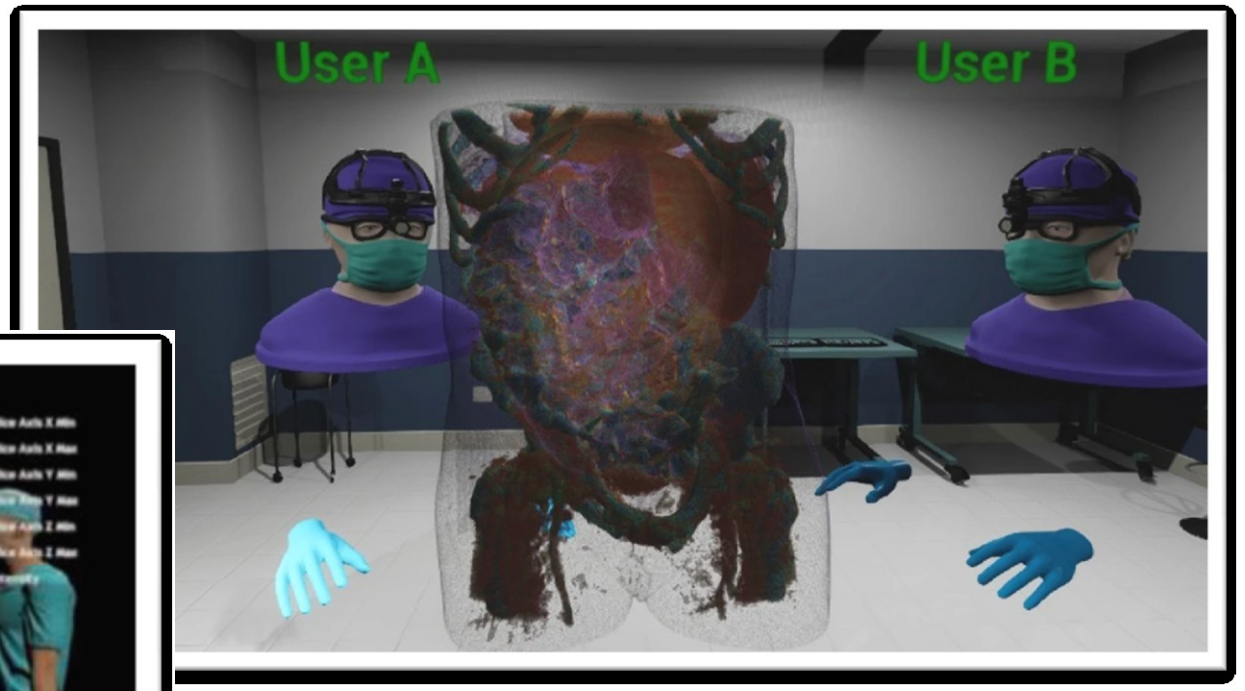
Anatomy education

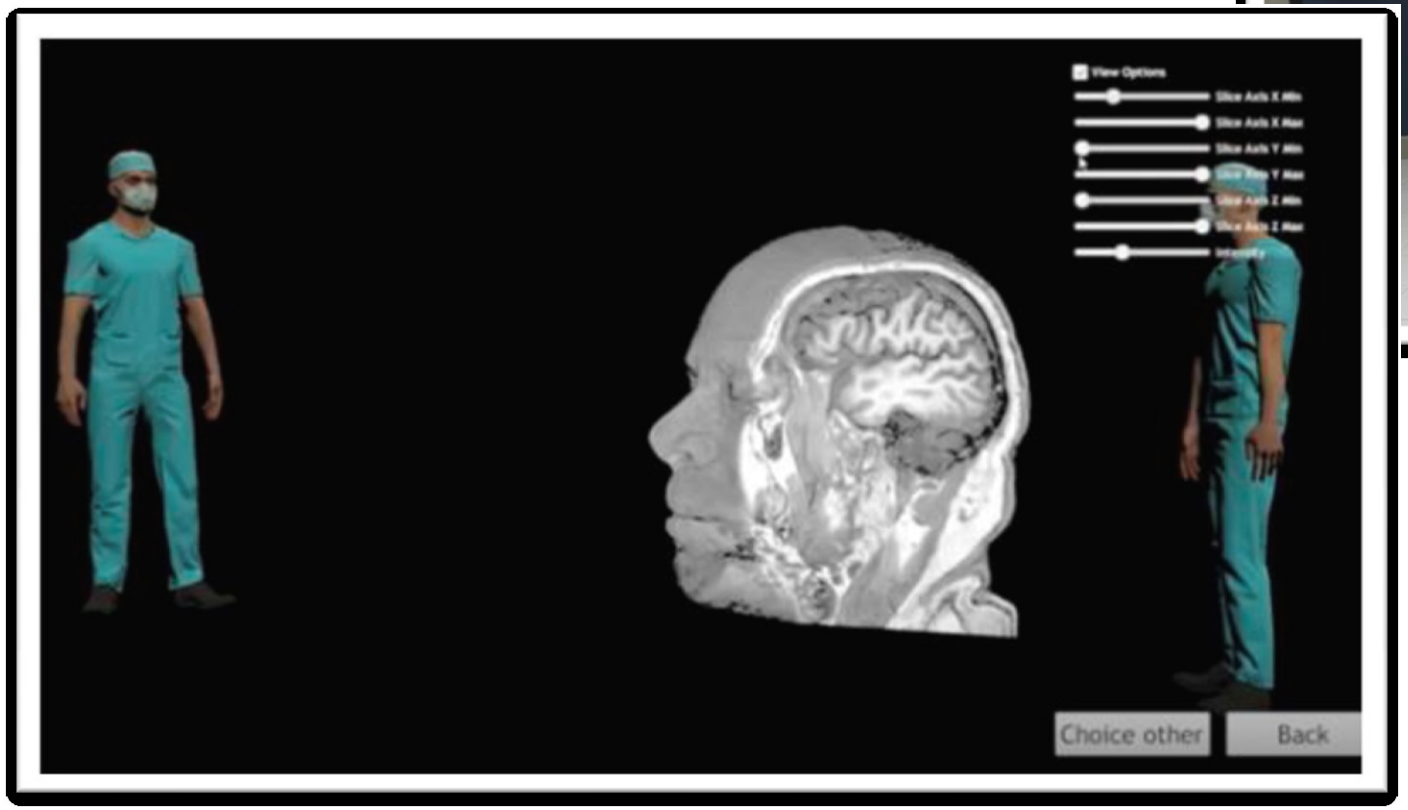
Generic (volumetric) medical data visualization

Imaging Reality



Collaborative medical data visualization





Benefits and drawbacks of (HMD) VR

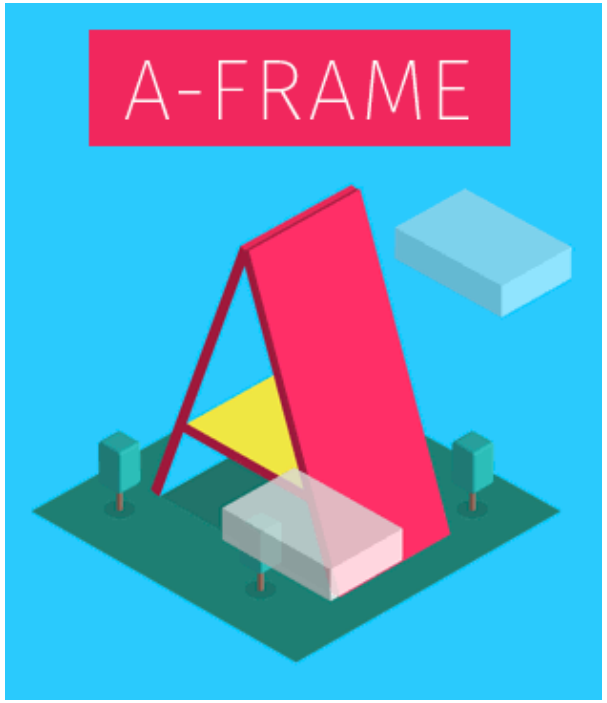
When compared to regular „desktop interface“

Higher immersion	Hardware limitations / overhead
Better spatial perception	Fatigue
More natural 3D interactions	Difficult to input text and numbers
Controlled environment	Some “classical” 2D interactions cumbersome
Less distractions	

Q&A: Can you come up with additional benefits or disadvantages?

How to develop for VR?

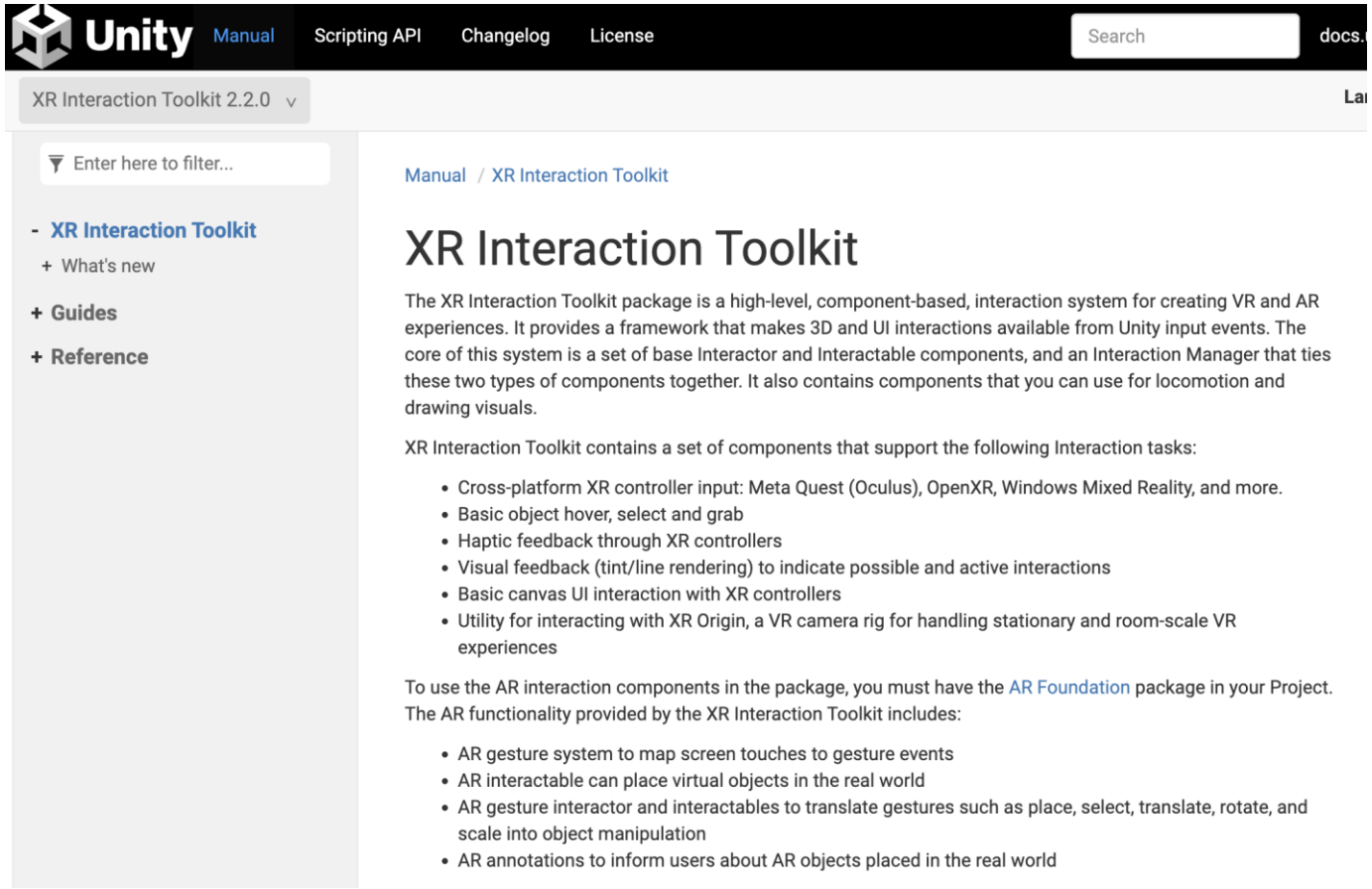
- I would suggest to consider any of these three ways:



How to develop for VR?

Unity

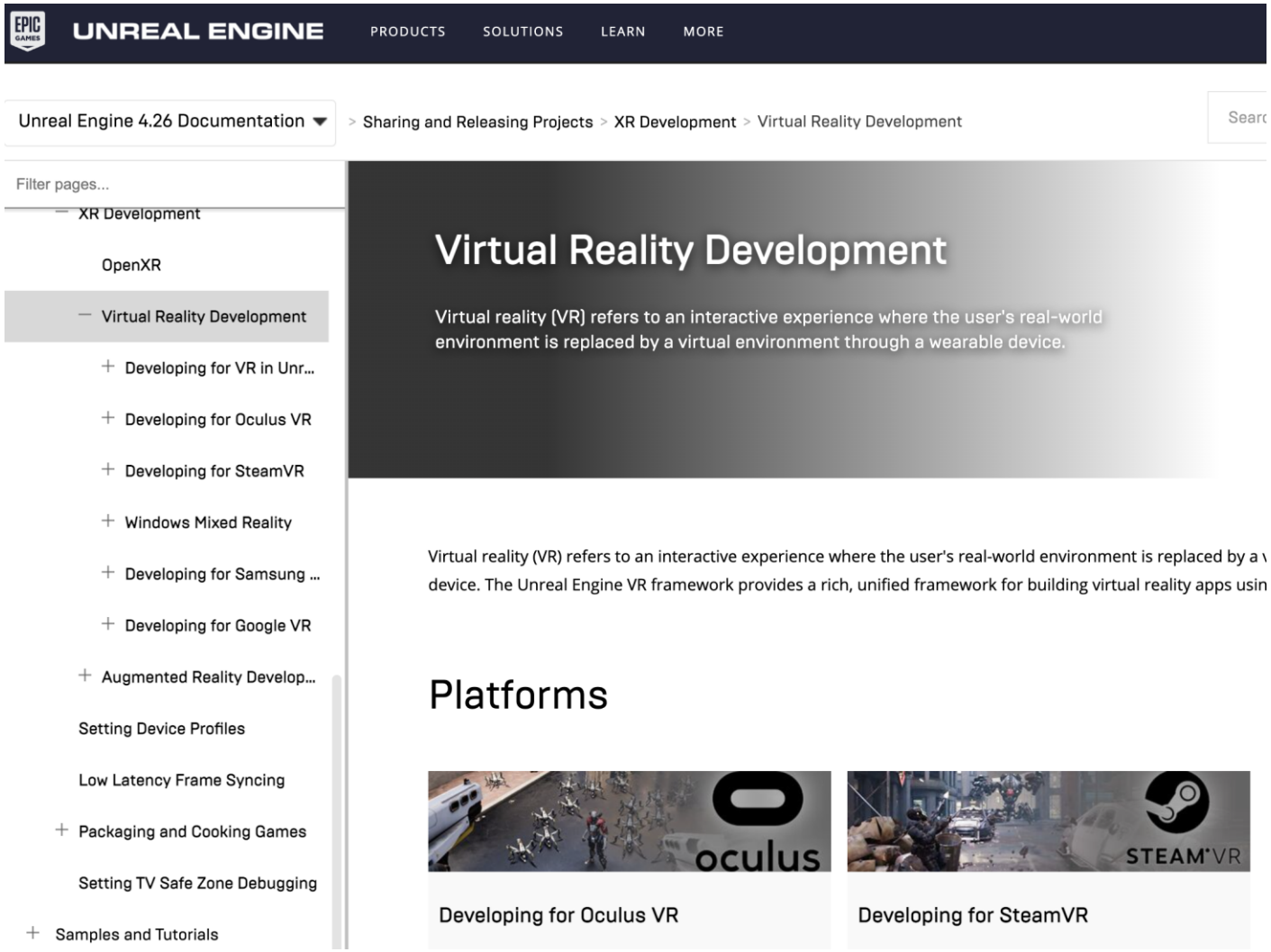
- Good support for majority of modern VR headsets
- Unity & C# are quite user friendly :)
- XR Interaction Toolkit
  - Developed by Unity
  - Good starting point



How to develop for VR?

Unreal

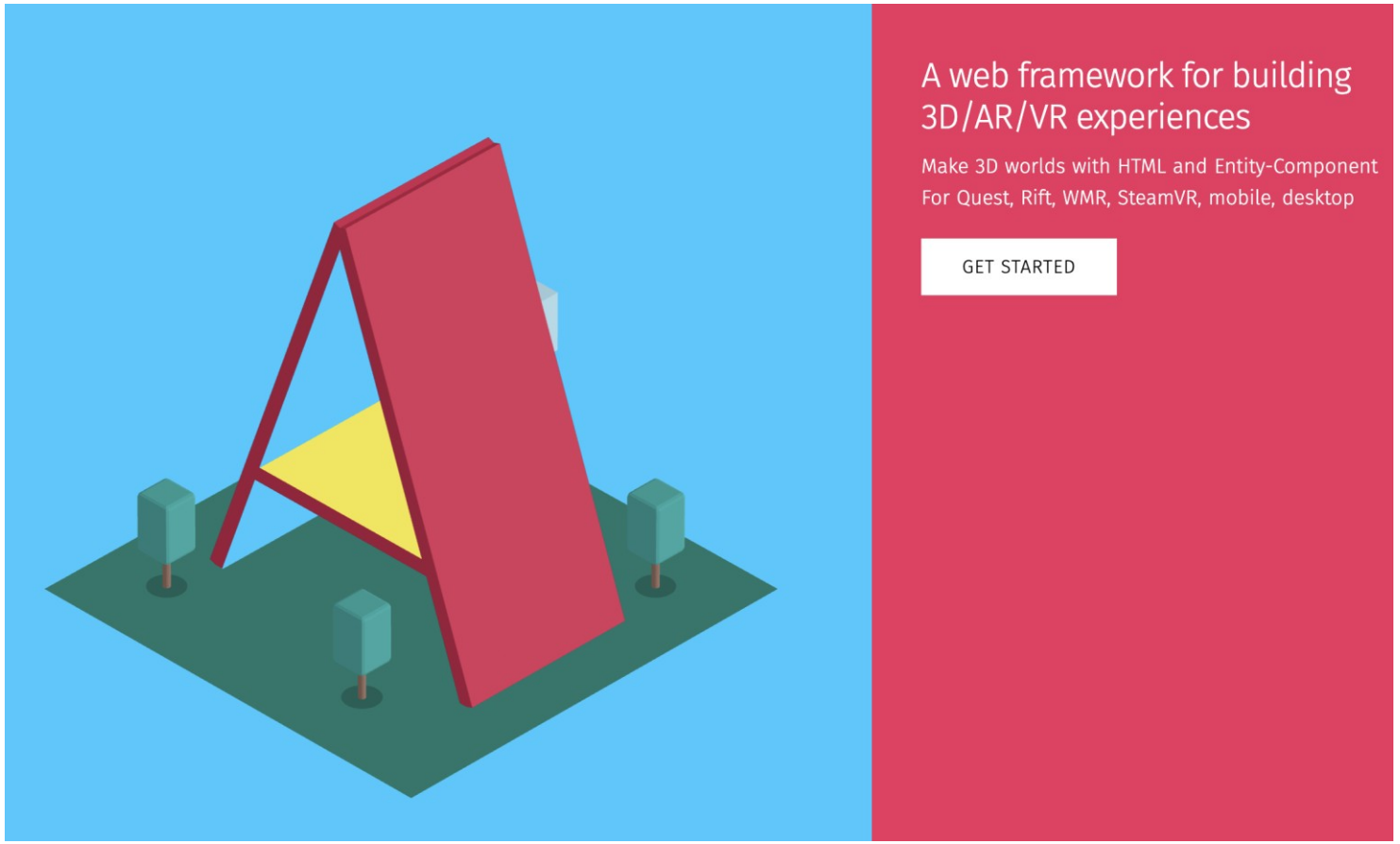
- Also good support for majority of modern VR headsets
- Not as user friendly as Unity
- Unreal licensing is more „clear“



How to develop for VR?

A-FRAME

- Web framework
- Built on WebXR and Three.js
- Web app → No installation of application nedded
  - However, WebXR support depends on the user‘s browser
- Performance and some features might be limited



VR in the

- Two key fa
  - Hardwar
  - **Availabi**
- Makes ser
- How to inte
- How to har
- Build large
  Or find a g
  - → Conve

A NEW KIND OF "KILLER APP" —

Oculus co-founder makes a VR headset that can literally kill you

Sword Art Online inspires Palmer Luckey to put explosive charges on a Quest Pro.

KYLE ORLAND - 11/7/2022, 10:28 PM

Palmer Luckey

Enlarge / Looks comfortable...

/R viewer“?

Concluding this section …

- VR has advantages
- VR has disadvantages
- You should try it :)
  - But please do not try the explosive headset

Core thing to remember: **pros >> cons** to convince people to actually use it

Thank you for your attention!

References

- The VR Book: Human-Centered Design for Virtual Reality (Jason Jerald)
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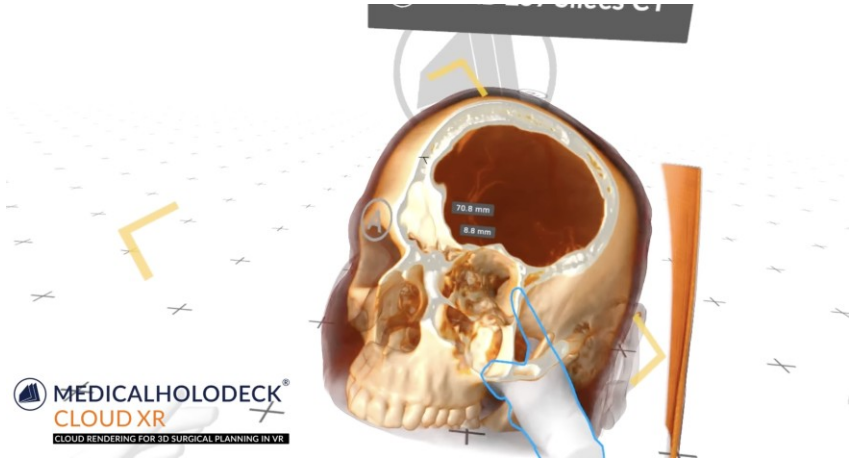
- https://ieeexplore.ieee.org/document/9288058

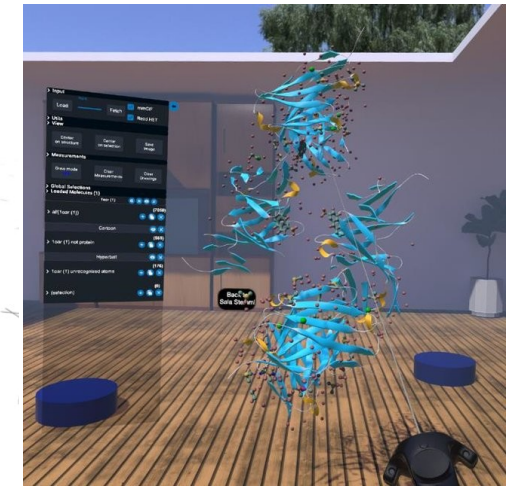
Applications you may try …

Nanome (molvis/molmod)



Medicalholodeck (medvis)

Alternatively: MedicalImagingVR



UnityMol (molvis)

CellPaint VR (drawing of cell env.)

Blocks (creativity)

GORN (brutal game)