Source

Interaction in Virtual Reality

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Questions

How can we move through infinite worlds in finite spaces?

How to minimize the feeling of vertigo?

How do we measure the quality of a VR simulation?

How real should the VR interaction feel?

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CHAPTER 1

Measuring VR Quality

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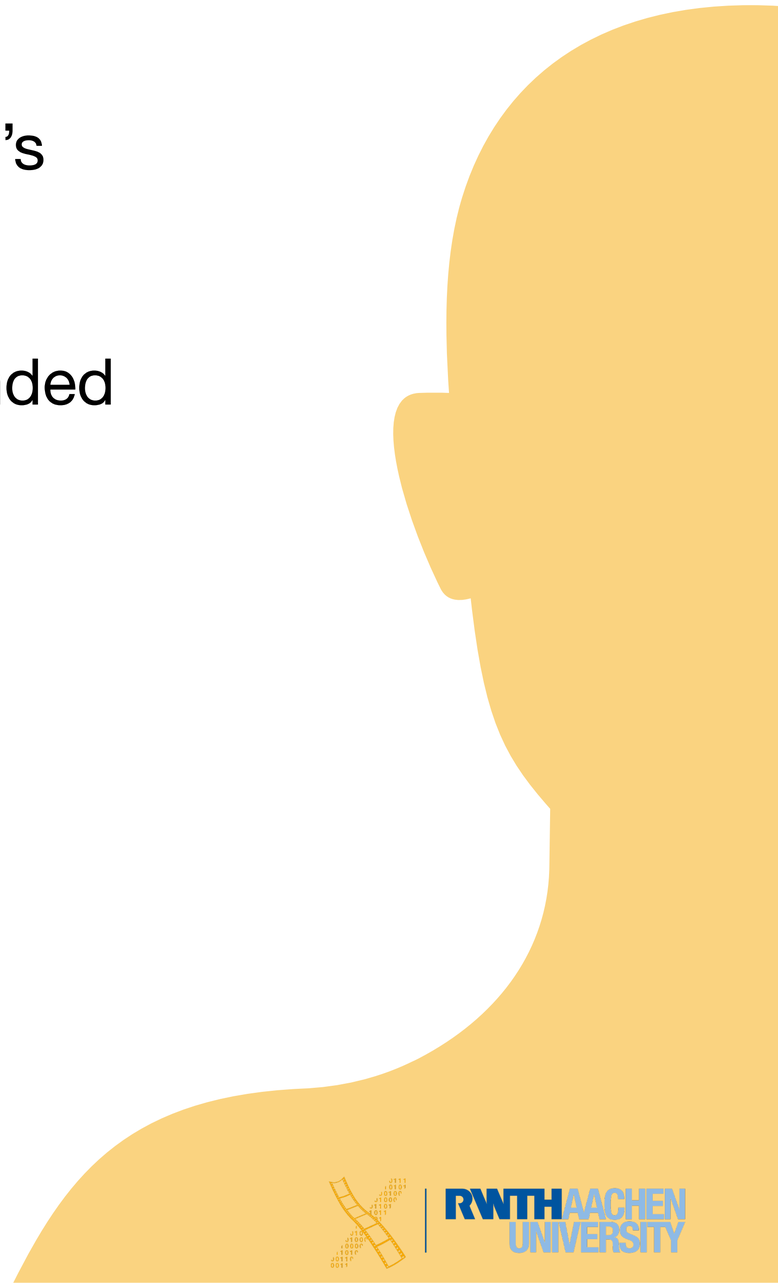
Orientation

Orientation (or **spatial understanding**) describes a person's **awareness** of time, place and person.

Teleporting creates cracks in the usually continuously extended image that we create of our environment.



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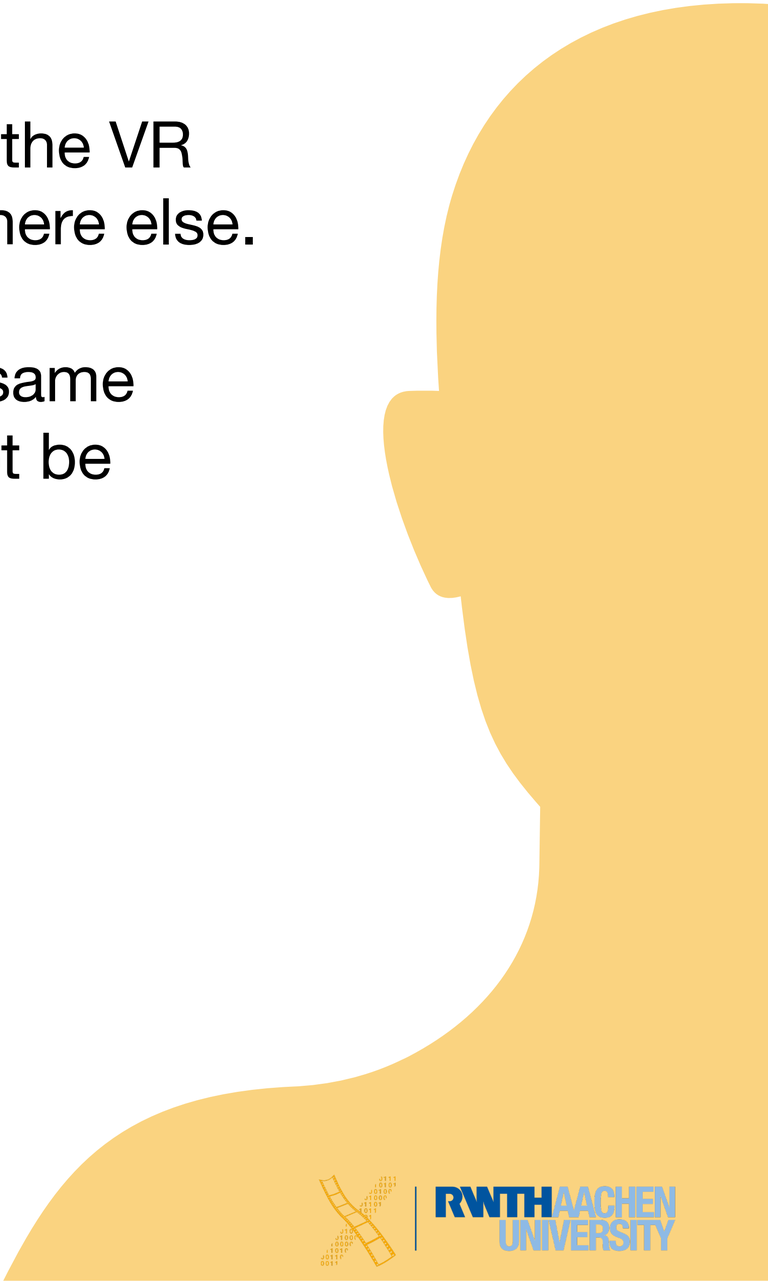
Immersion

Immersion describes the **technical** multimodal **abilities** of the VR system in tricking the user that he/she/* feels being somewhere else.

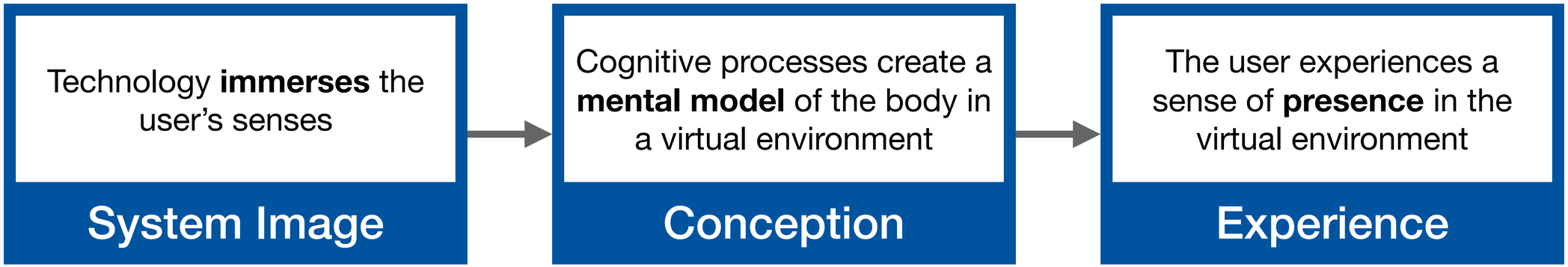
A system providing a perfect immersion would provide the same **sensorial information** as the real world and could, thus, not be identified as an illusion by our brain.



Presence

Presence describes to which extent the user of a VR system develops a **sense of being in the virtual environment**.

This is also influenced by our brain building a verdict on whether the world around us and the **social interactions** with it appear “natural”.



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Measuring Presence

- Igroup Presence Questionnaire (**IPQ**)
- Examples for some of the 14 items, ranked with likert scale
  - In the computer generated world I had a sense of "being there”
  - I still paid attention to the real environment.
  - The virtual world seemed more realistic than the real world.

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CHAPTER 2

Locomotion Techniques

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How to move through VR?

- **Walking**
  in limited rooms (not larger than tracked area)

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Weser et al., SAP ‘16

Can’t We Just Make People Walk Faster?

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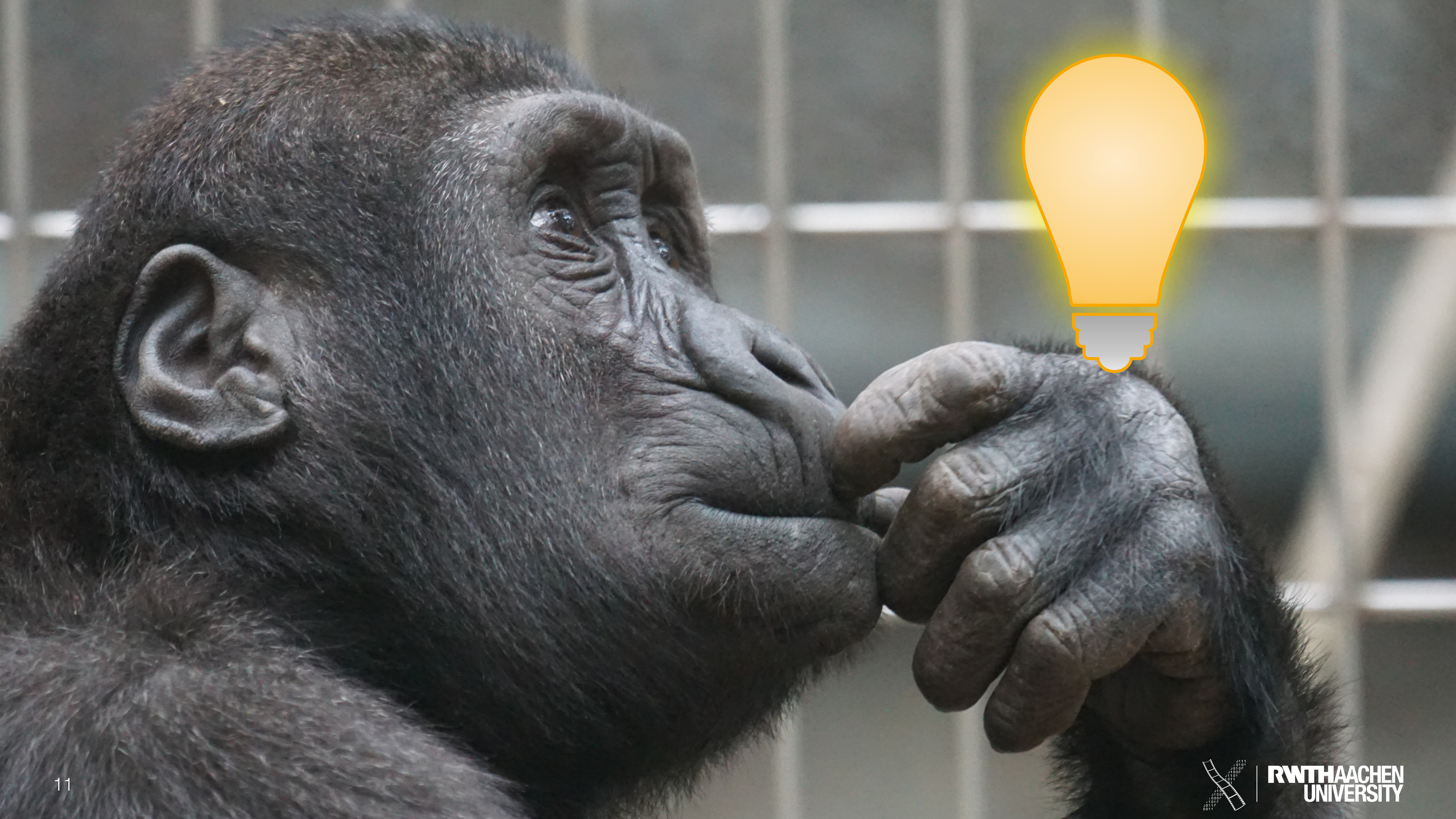

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VirtuSphere

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How to move through VR?

- **Walking**
  in limited rooms (not larger than tracked area)

- **Walking-in-place**
  in open interaction spaces

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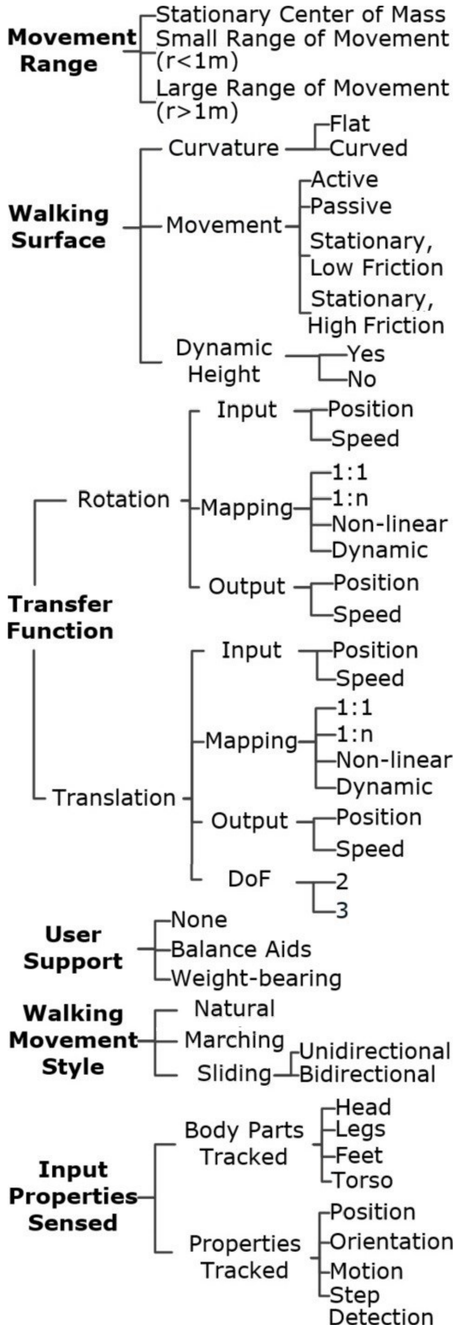
Walking-in-Place (WIP)

- While real walking creates the highest spatial understanding of our actions and enhances orientation, WIP offers an interesting alternative
- 1995: Slater et al. shows that WIP offers spatial understanding
- Large number of concrete implementations:
  - How is the velocity controlled?
  - Hos is the steering controlled?

Nabiyouni & Bowman, ISS '16

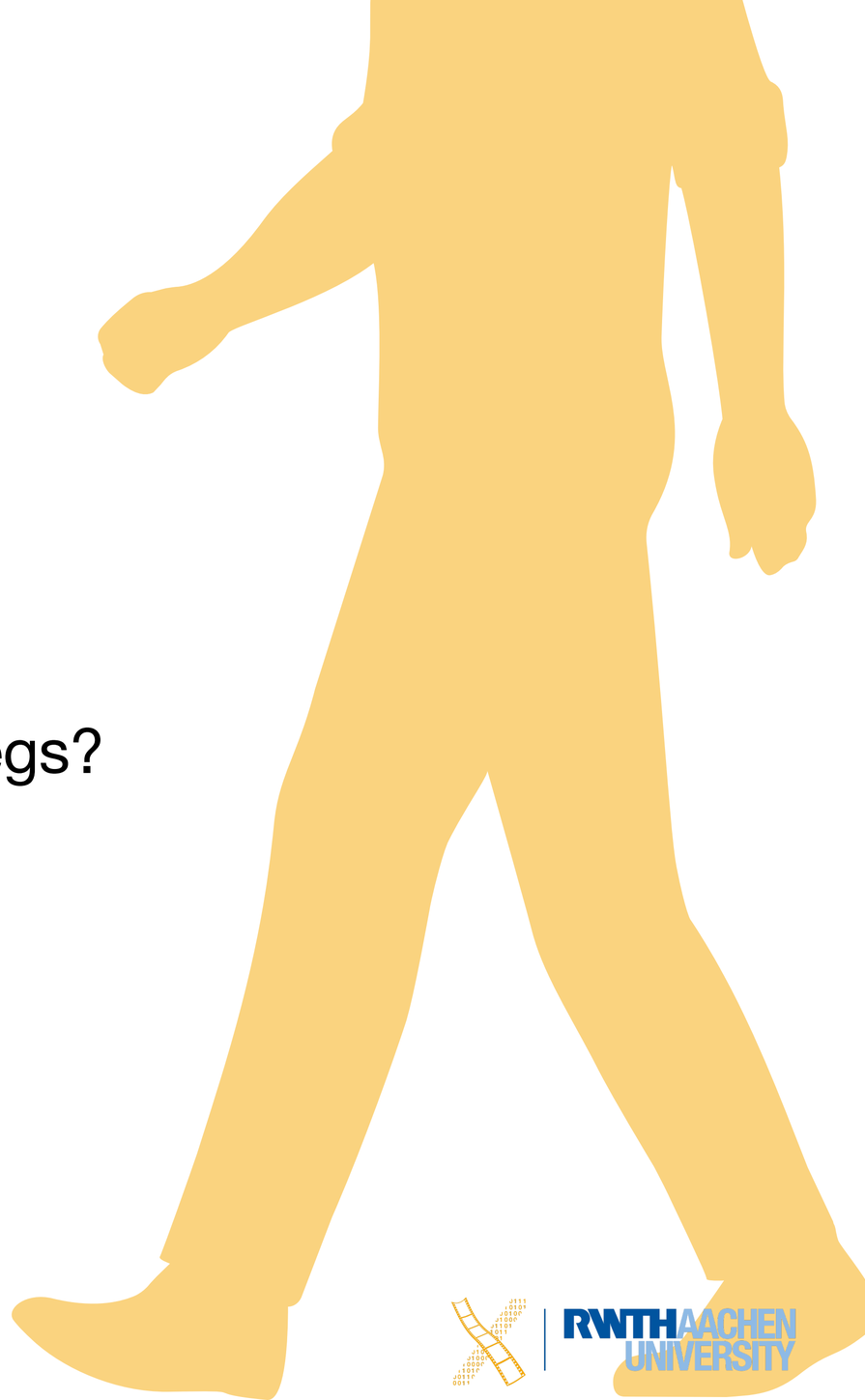


How to move through VR?

- **Walking**
  in limited rooms (not larger than tracked area)

- **Walking-in-place**
  in open interaction spaces

- But what can you do if it is **not possible** to use the legs?



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Locomotion Techniques

Arm-Cycling

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Locomotion Techniques

Arm-Cycling

Point-Tugging

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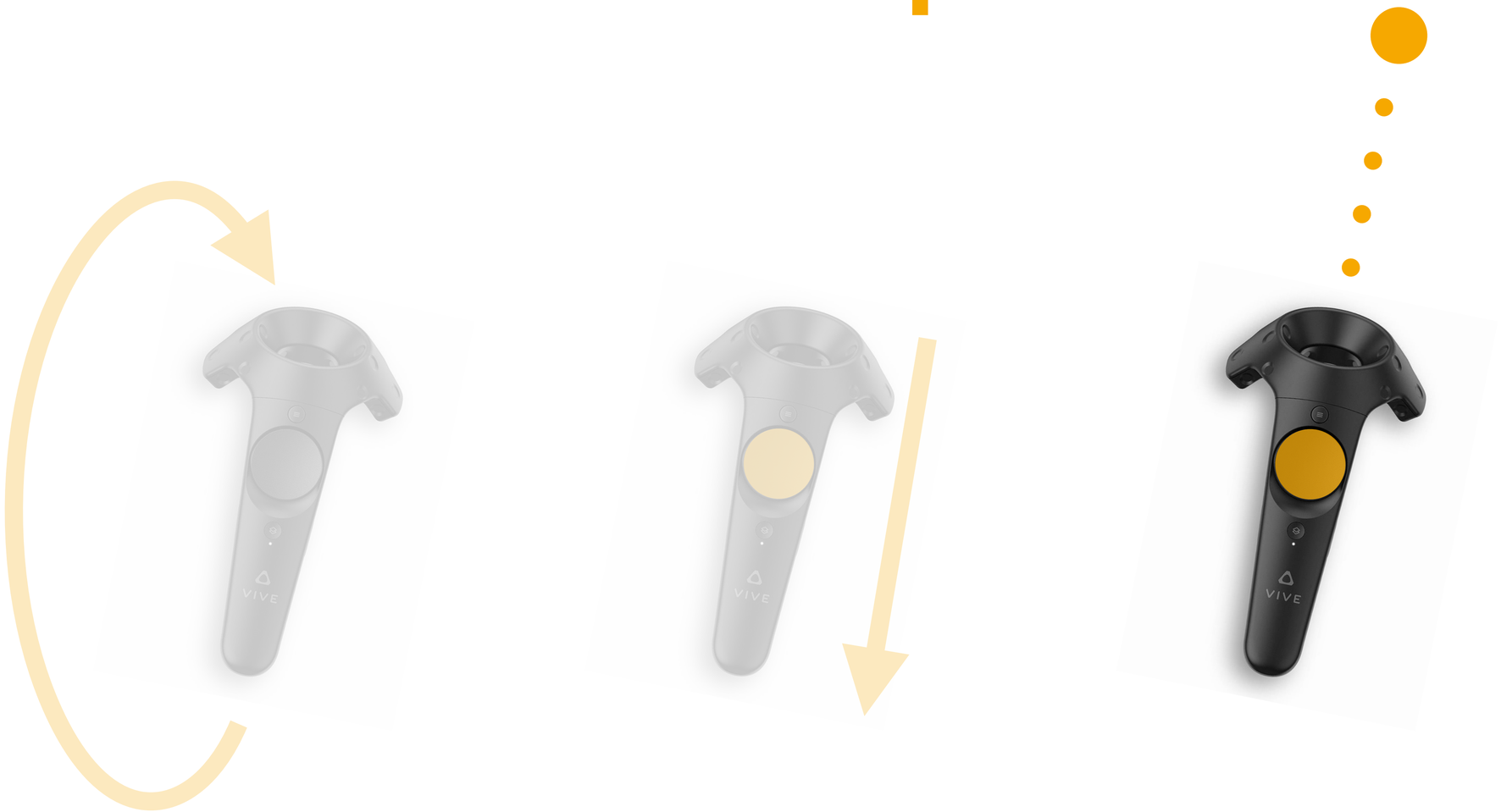
Locomotion Techniques



Arm-Cycling

Point-Tugging

Teleporting

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Locomotion Techniques

Arm-Cycling

Point-Tugging

Teleporting

Joystick

Results: Coomer et al. , SAP ‘18

Evaluation

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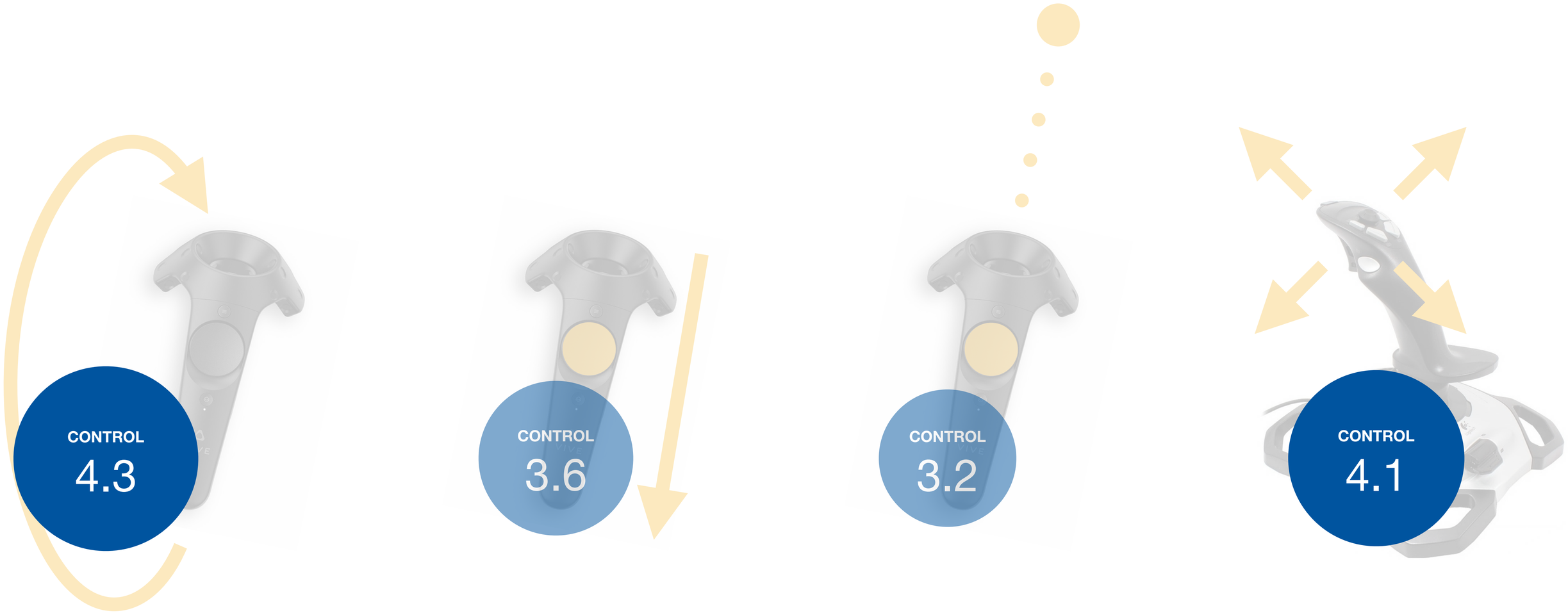
Results: Coomer et al. , SAP ‘18

Perceived Control



Arm-Cycling **Point-Tugging** **Teleporting** **Joystick**

sig. differences are denoted by change in opacity

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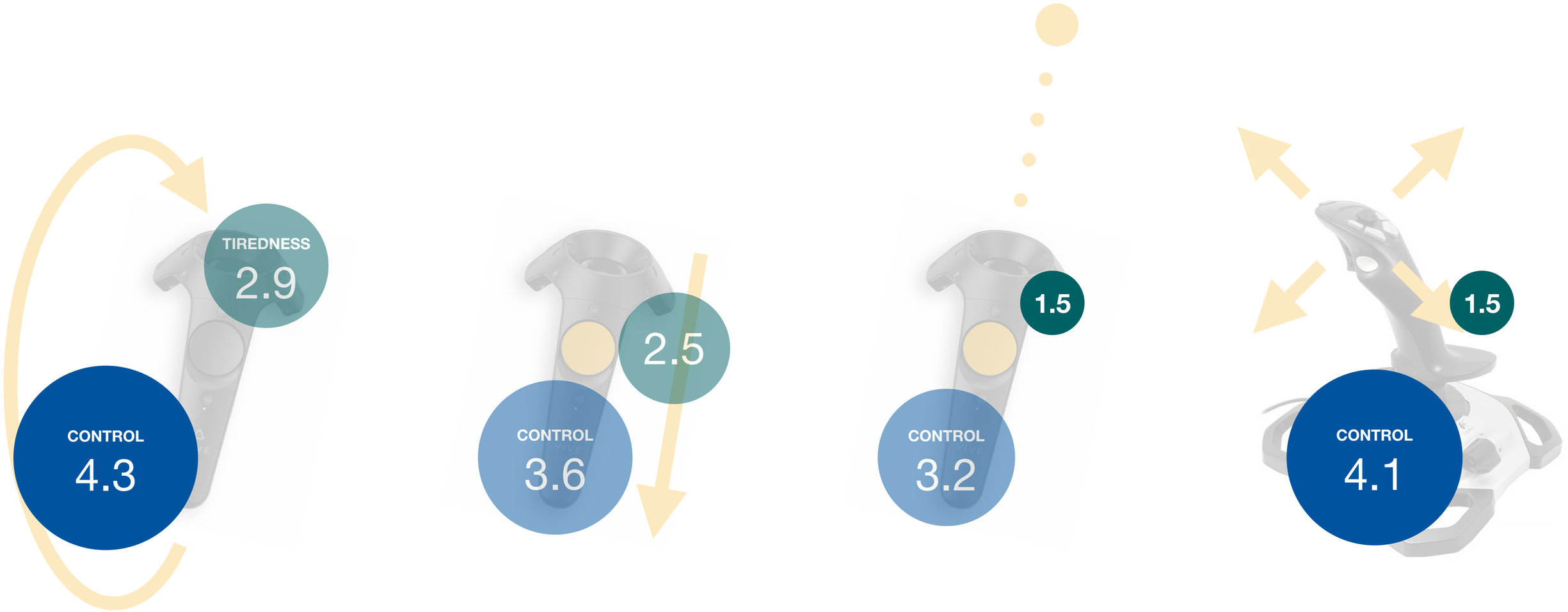
Results: Coomer et al. , SAP ‘18

Perceived Tiredness



Arm-Cycling **Point-Tugging** **Teleporting** **Joystick**

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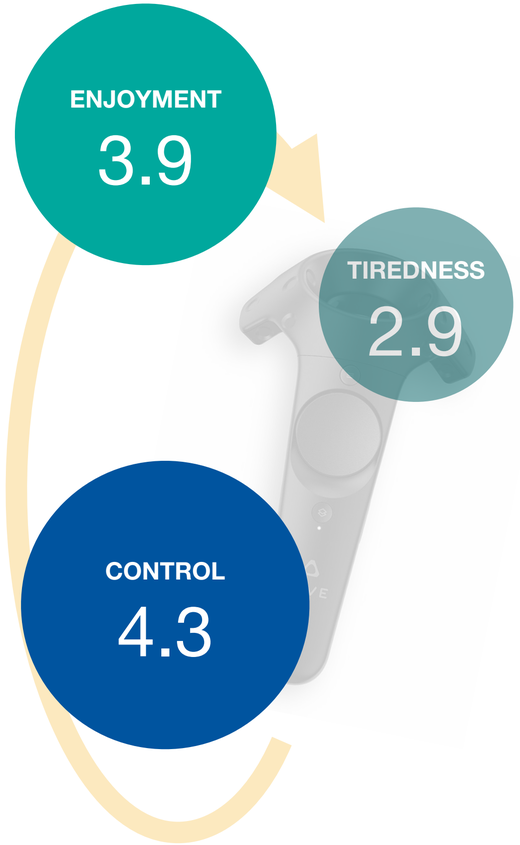
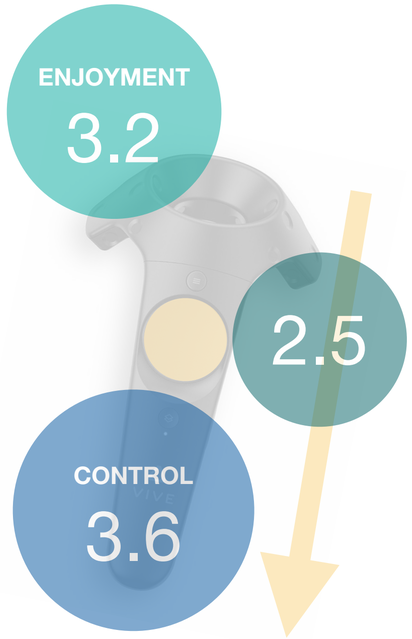
Results: Coomer et al. , SAP ‘18

Perceived Enjoyment

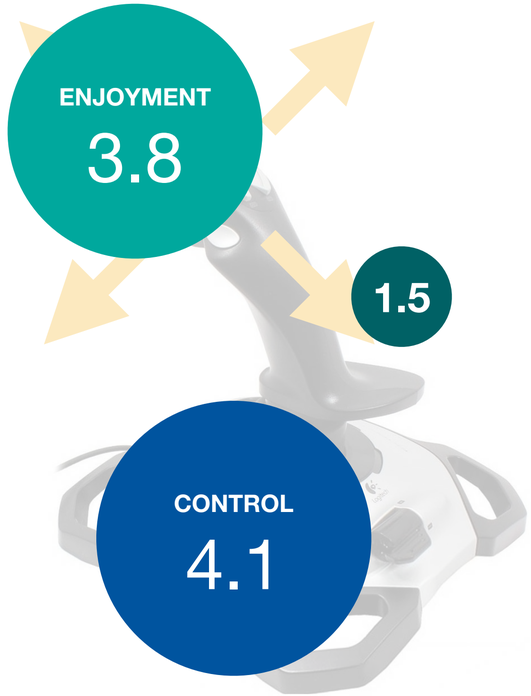


Arm-Cycling



Point-Tugging

Teleporting



Joystick

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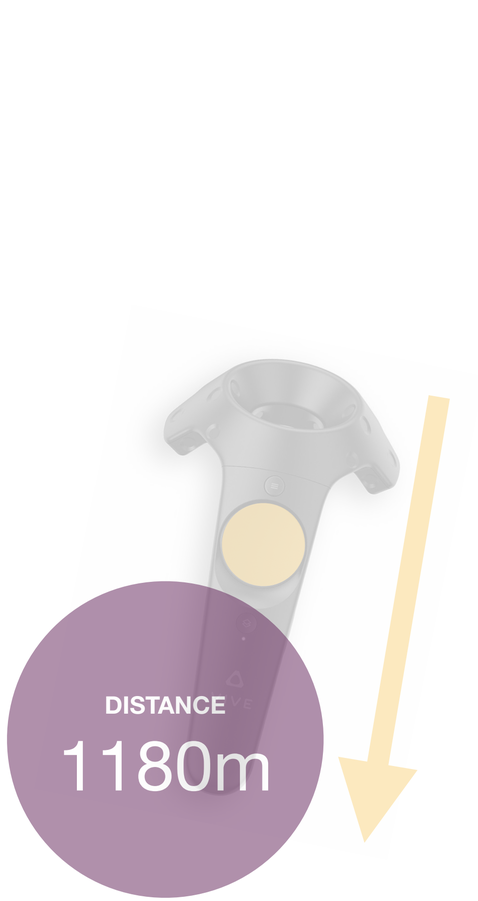
Results: Coomer et al. , SAP ‘18

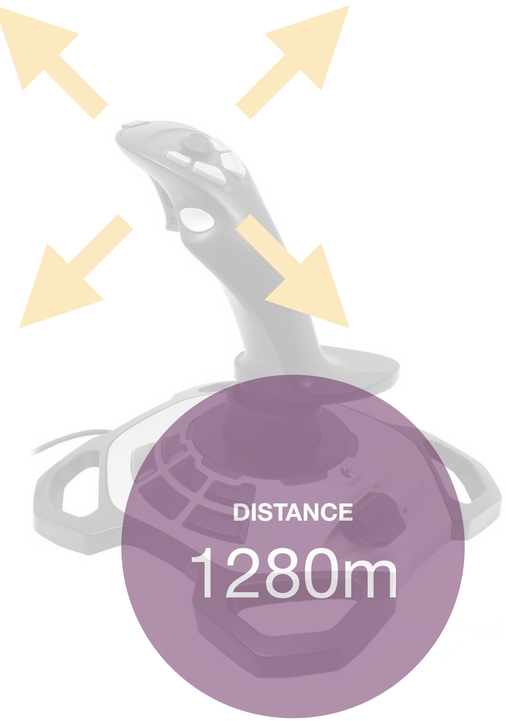
Travelled Distance

Arm-Cycling



Point-Tugging

Teleporting



Joystick

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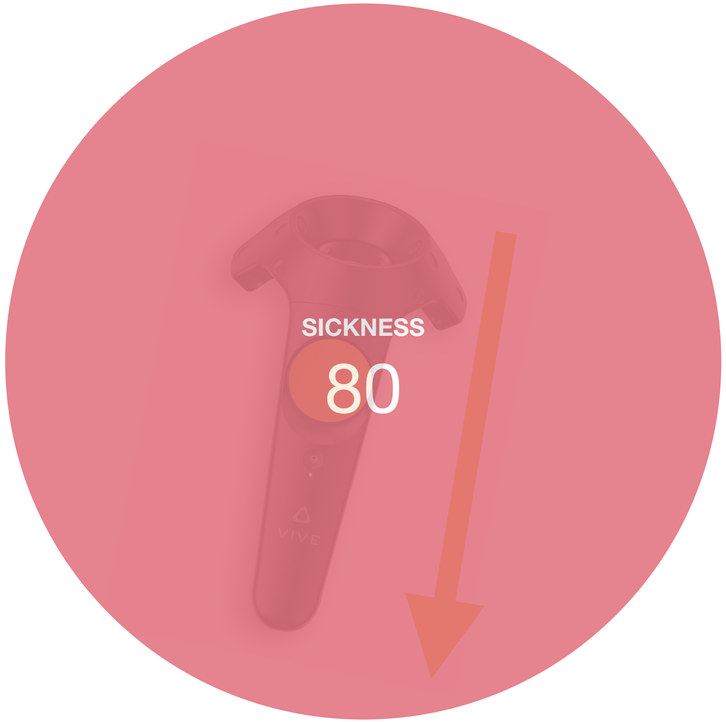
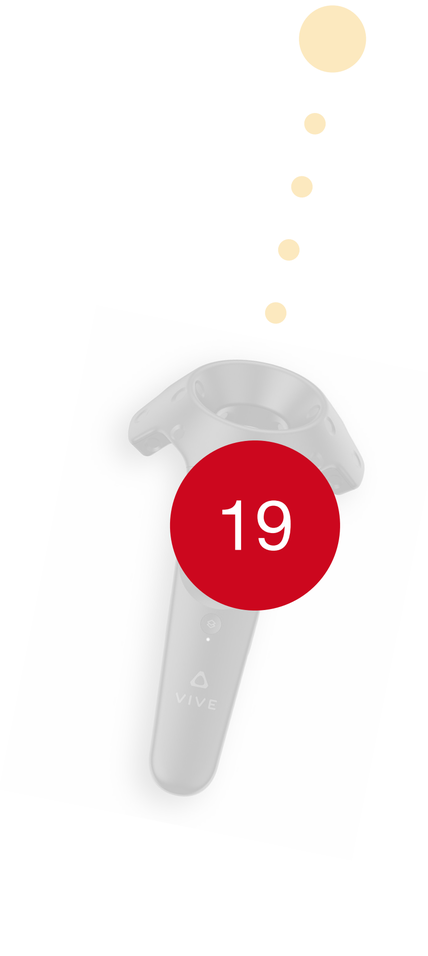
Results: Coomer et al. , SAP ‘18

Sickness

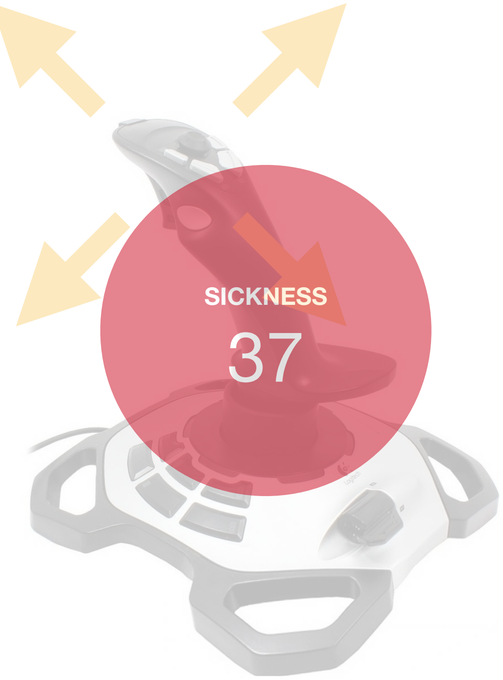
Arm-Cycling



Point-Tugging



Teleporting



Joystick

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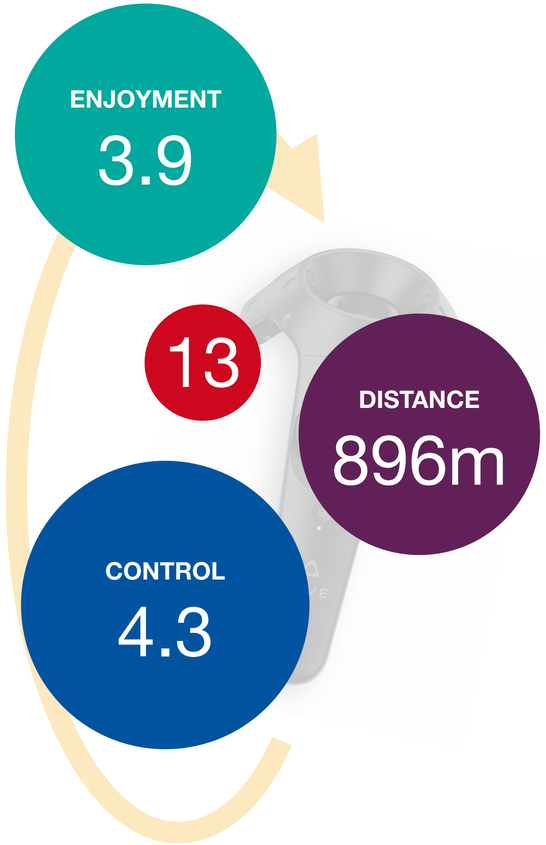
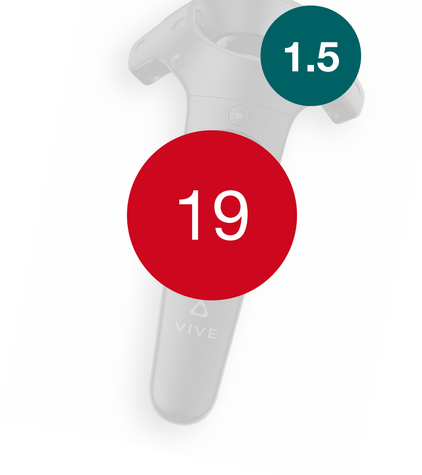
Results: Coomer et al. , SAP ‘18

Locomotion Techniques: Verdict

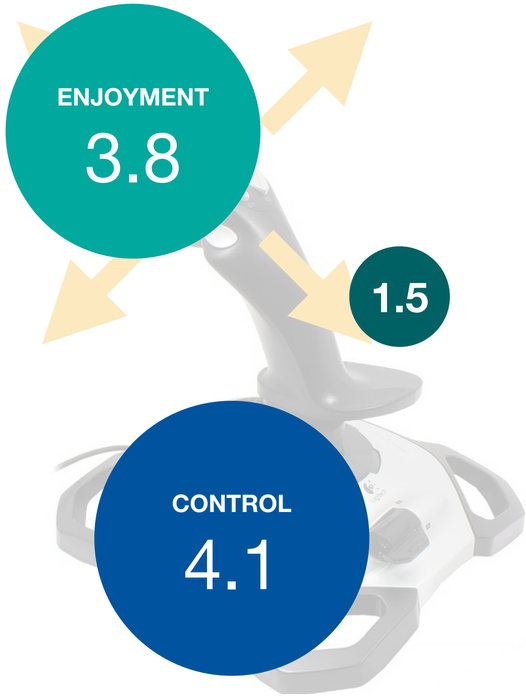


Arm-Cycling

Point-Tugging



Teleporting



Joystick

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CHAPTER 3

Vertigo

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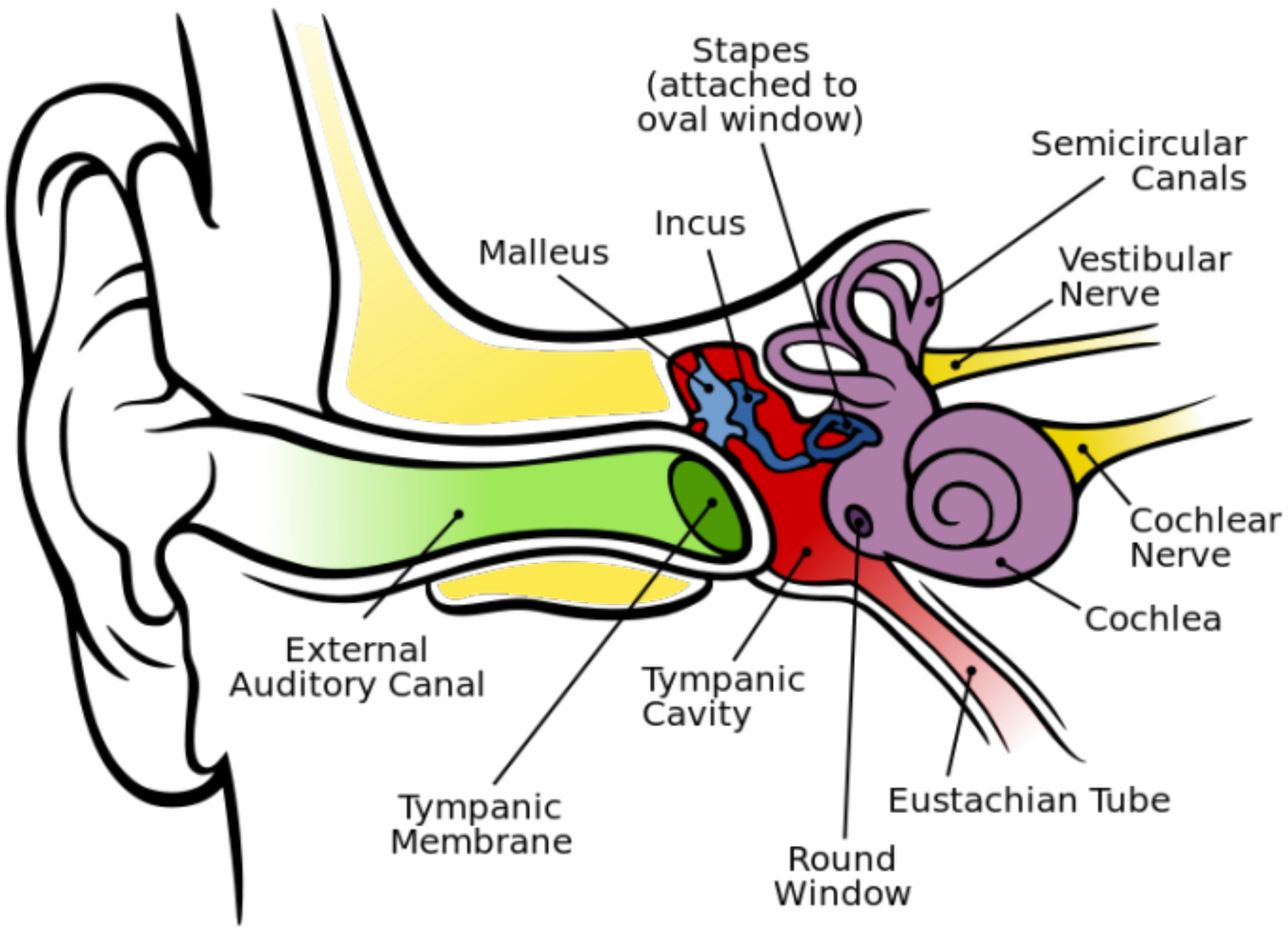
The Vestibular System

- The semicircular canals in our internal ear determine how our head is rotated in the world
- Contradicting information from other senses lead to vertigo



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Moving in a direction that you are not facing will cause sickness

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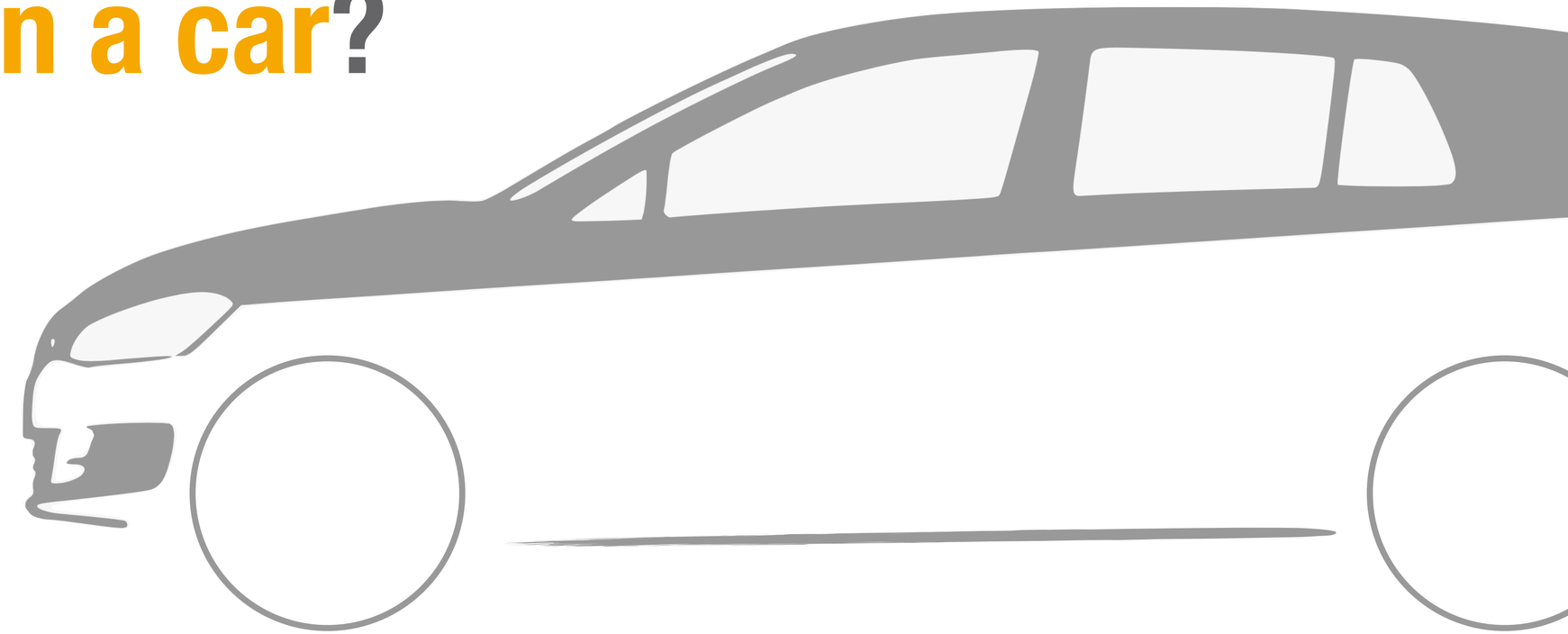
What happens if you try to use VR in a car?



Hock et al. , CHI ‘17

CarVR

- Prototype that measures vehicle dynamics and translates them into the virtual reality
- Parking condition vs driving condition

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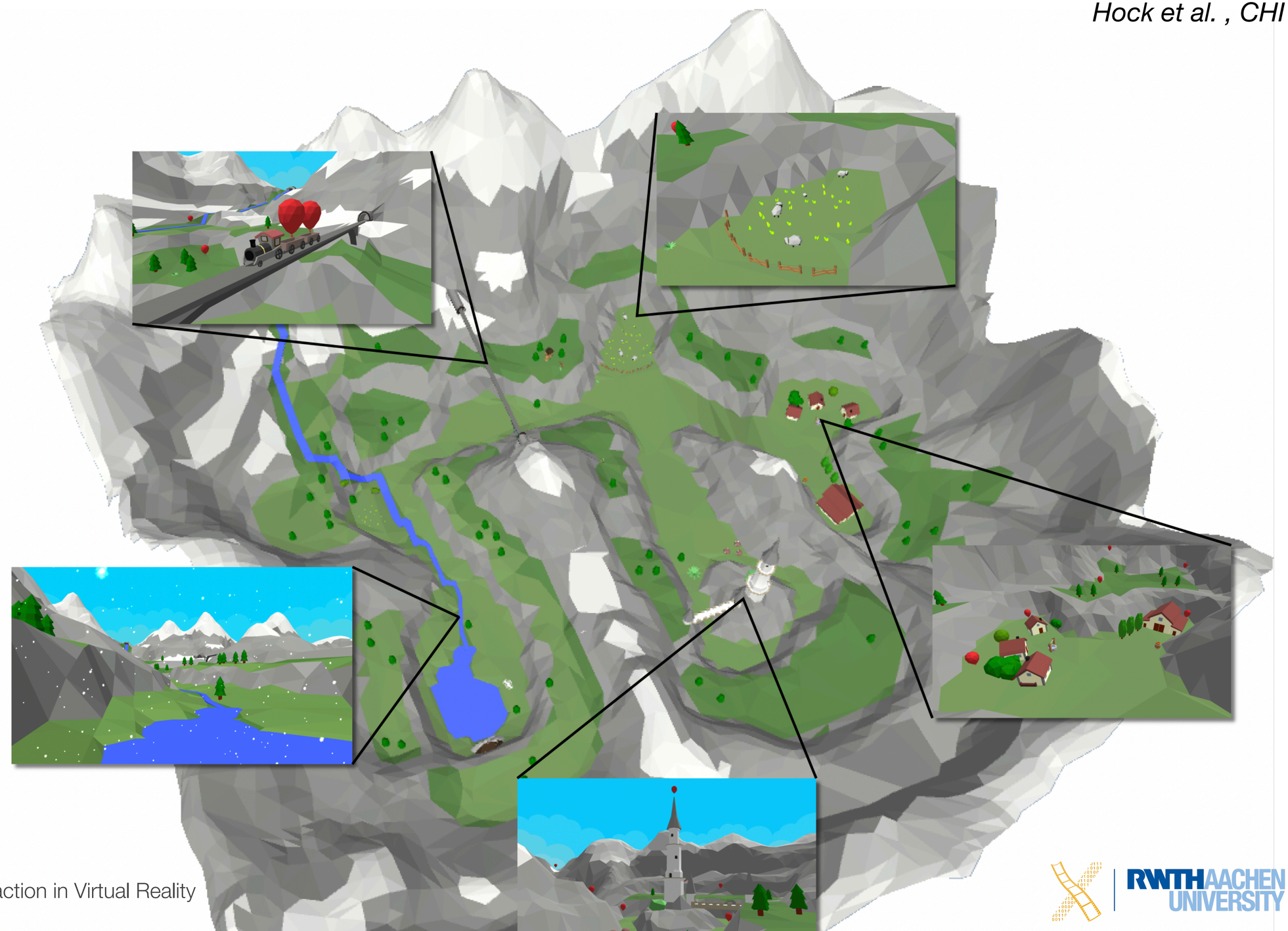
CarVR

Hock et al. , CHI ‘17



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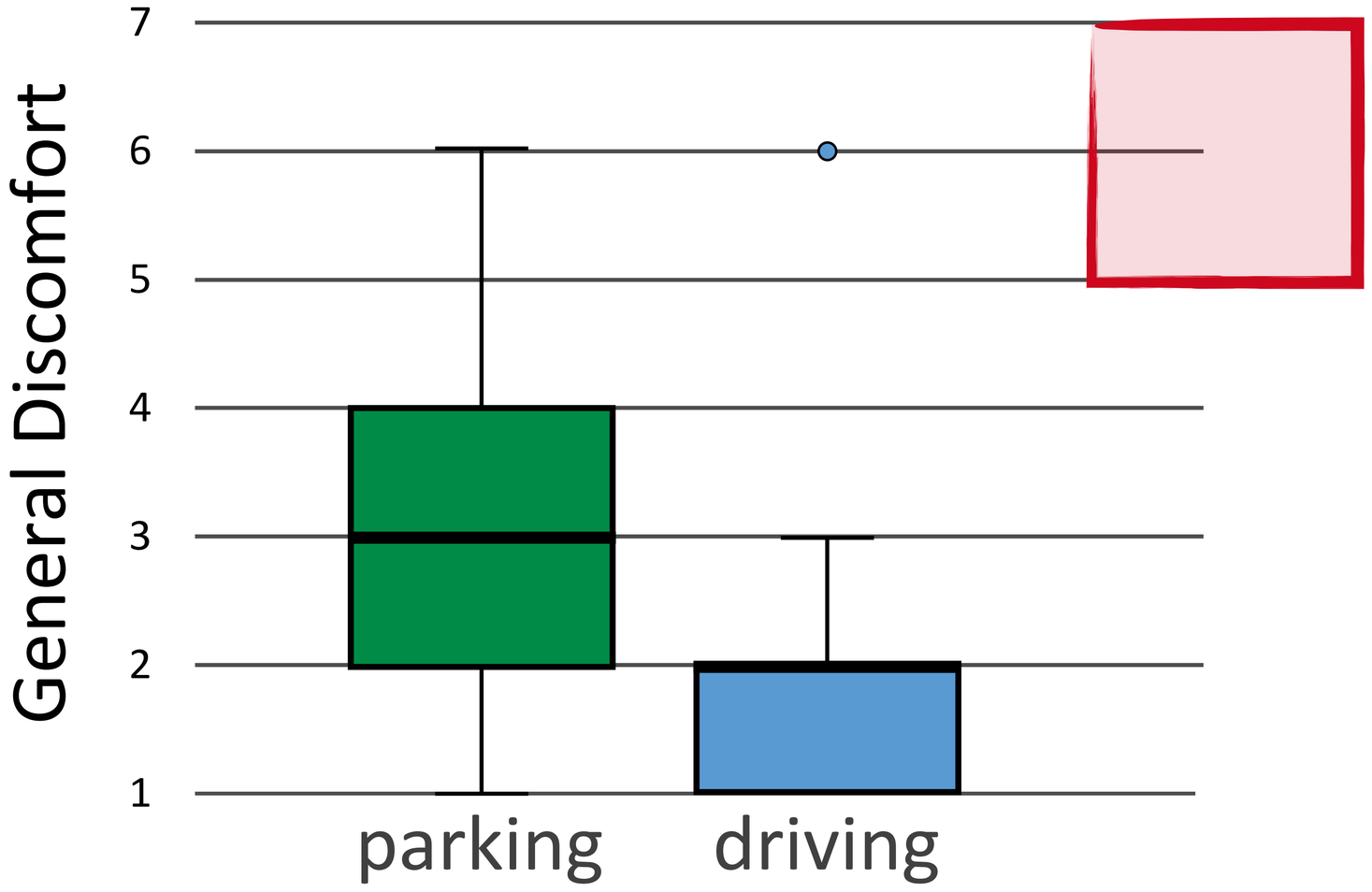
Hock et al. , CHI ‘17

CarVR



Assumption: Driving without sync?

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CHAPTER 4

Interaction Fidelity

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Is realism always favorable?

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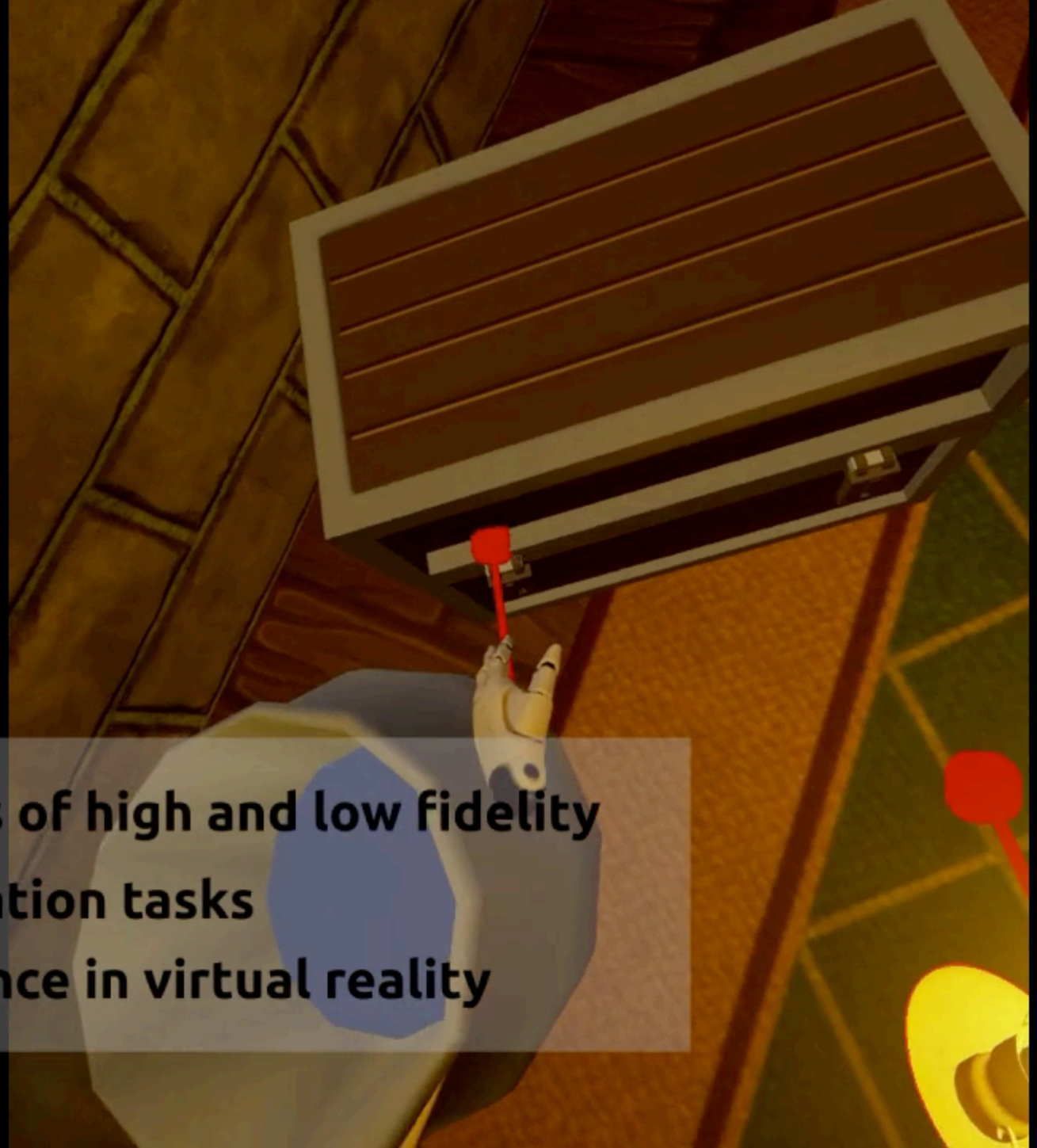

Comparing effects of high and low fidelity
in object manipulation tasks
on player experience in virtual reality

Rogers et al. , CHI ‘19

Realism vs Abstraction

- In order to get items out of a chest
- High Fidelity: Open the two buckles, push the lid and take items out, no inventory menu (a,b)
- Low Fidelity: Click on chest and move items between inventories (c)

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Implications on the Design of VR Games

- Prefer high interaction fidelity for object manipulation
- Strive for moderate interaction fidelity for whole-body movements
- Larger enjoyment of exploration in VR
- Consider onlooker effects

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