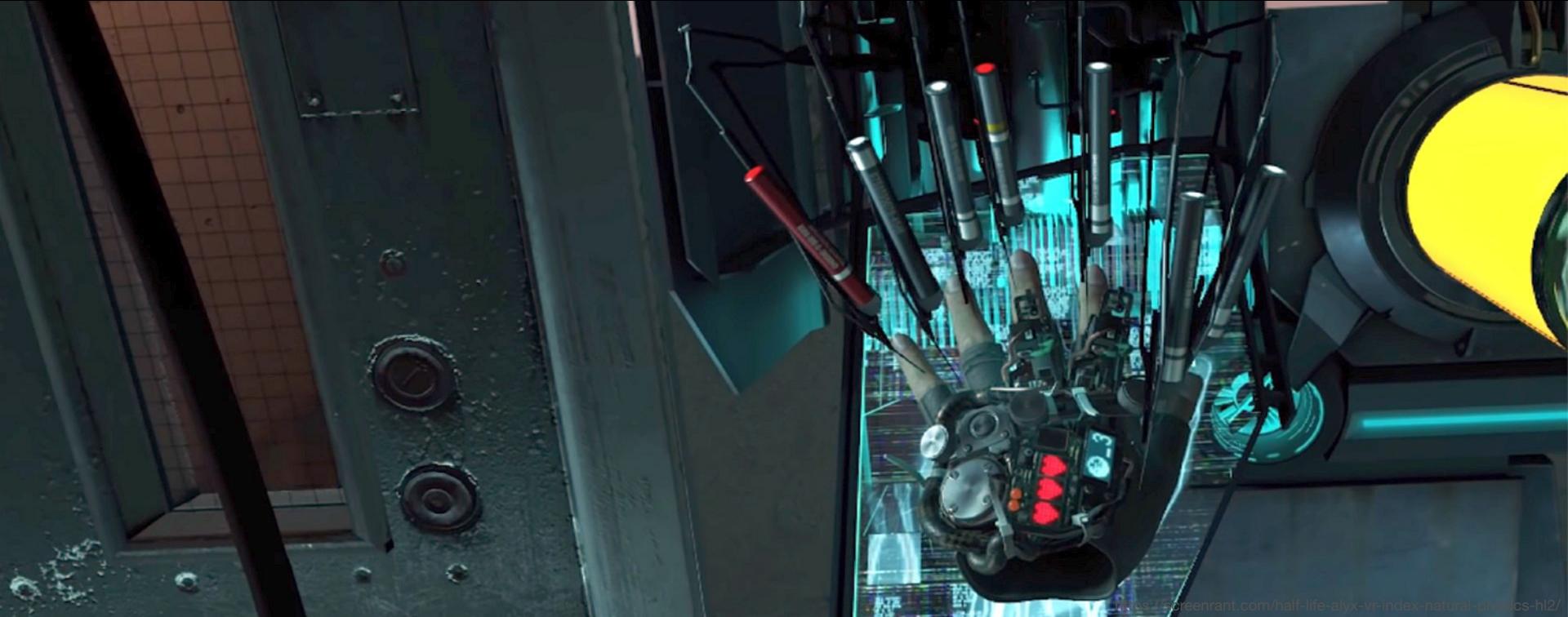


# *Virtual & Augmented Reality*

WS 2025



<https://screenrant.com/half-life-alix-vr-index-natural-physics-hl2/>

VR Immersion

BHT

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# VR IMMERSION, PRESENCE, MOTION SICKNESS

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# IMMERSION

- we are psychological in one place (VR) and physically in another (Real World)
  - Location can be a replica of the real world or imaginary
  - Immerse – “eintauchen”
  - Immersion describes the effect how far we can block out the real world and believe the virtual world
  - Immersion is not VR exclusive
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# IMMERSION FACTORS

- Extensiveness: amount of modalities presented to the user
  - Matching: matching sensory input
  - Surroundness: panoramic effects (field of view, 360°, spatialized audio, tracking)
  - Vividness: quality of simulation
  - Intractability: capability of interactions, influence on the world
  - Plot: story, consistent portrayal of experience
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# PRESENCE

- Sense of “being there”
  - The goal of most VR applications is to increase the feeling of presence in the virtual world
  - By Definition: Immersion is often more used to describe the characteristics of technology
  - Where presence is a psychological and physiological state of the user
  - Immersion can produce presence (but doesn’t have to)
  - Presence is limited by immersion
  - We can feel immersed in a story without the feeling of presence, but presence can’t be achieved without immersion
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# PRESENCE AND VR

- The increased presence is a unique experience of VR
- Interactive experiences with a high feeling of presence creates high expectations
  - users will expect to be able to touch and/or interact with objects – physics are expected to work
- Suspension of disbelief – in favor of immersion users are willing to suspend their doubt about believability
  - we are willing to believe magic in movies or games, because we want to
- Suspension of disbelief often depends on the expectations users have

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# BREAK-IN-PRESENCE

- Everything that disrupts the generated illusion breaks the presence
    - Loss of tracking
    - Frame drops
    - Lag
    - Sound / Voices from the real world
    - Lack of interactability / disappointed expectations about the virtual world
    - Collision with real world objects
  - Because of that, in VR disruption feel more uncomfortable than in traditional applications
  - Should be avoided as much as possible
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ARE THERE SITUATIONS  
WHERE YOU WANT TO  
BREAK-IN-PRESENCE?

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# INTERACTION BOUNDARIES

- Coming to close to real world objects
- Vive: Boundaries will be shown at a defined distance
- Meta Quest: Showing the real world (camera image)



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# SELF-EMBODIMENT

embodiment = Verkörperung, Verkörperlichung, Ausführungsform

- Example Game: Don't let go (Image to the right)
  - Plays with fears created by the self embodiment
- Self embodiment studies have shown to increase empathy towards people
  - Decrease of sexism/racism
- can help injured people to regain functionality (also used in learning to use prosthetics)



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- embodiment = presence + connection/syncronisation to virtual body/hands ...



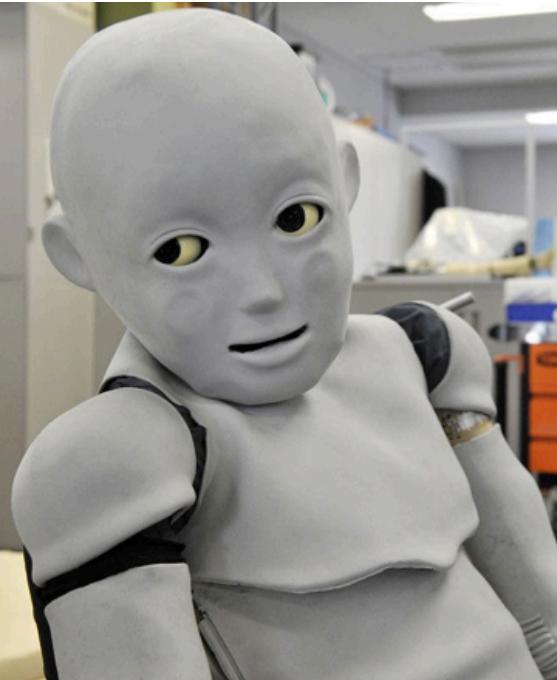
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# VISUAL REALISM

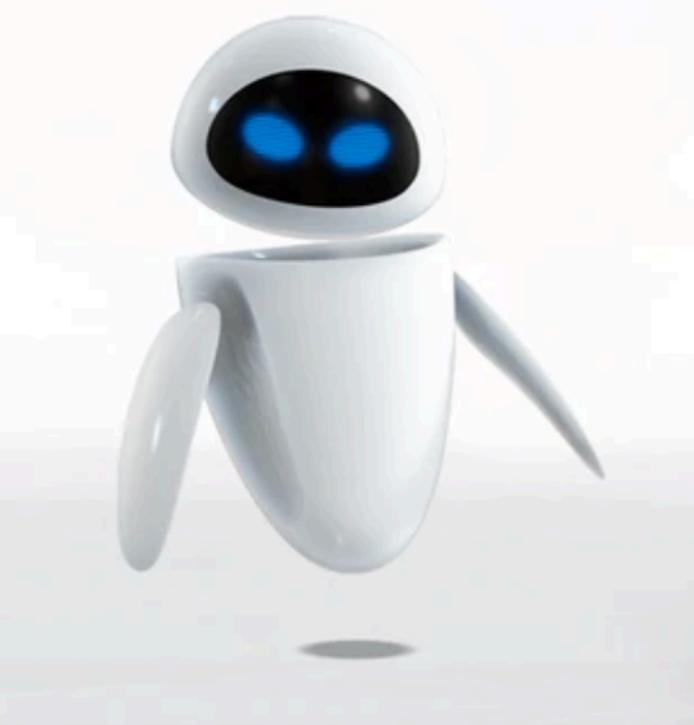
- Grade of visual realism of an application is often a personal reference and based on expectations
- Often stylized art is easier to create (lower polygon count, animations are more forgiving, texture size)
- “Realism” of the current state-of-the-art doesn't age very good
- Realism can fall into the uncanny valley

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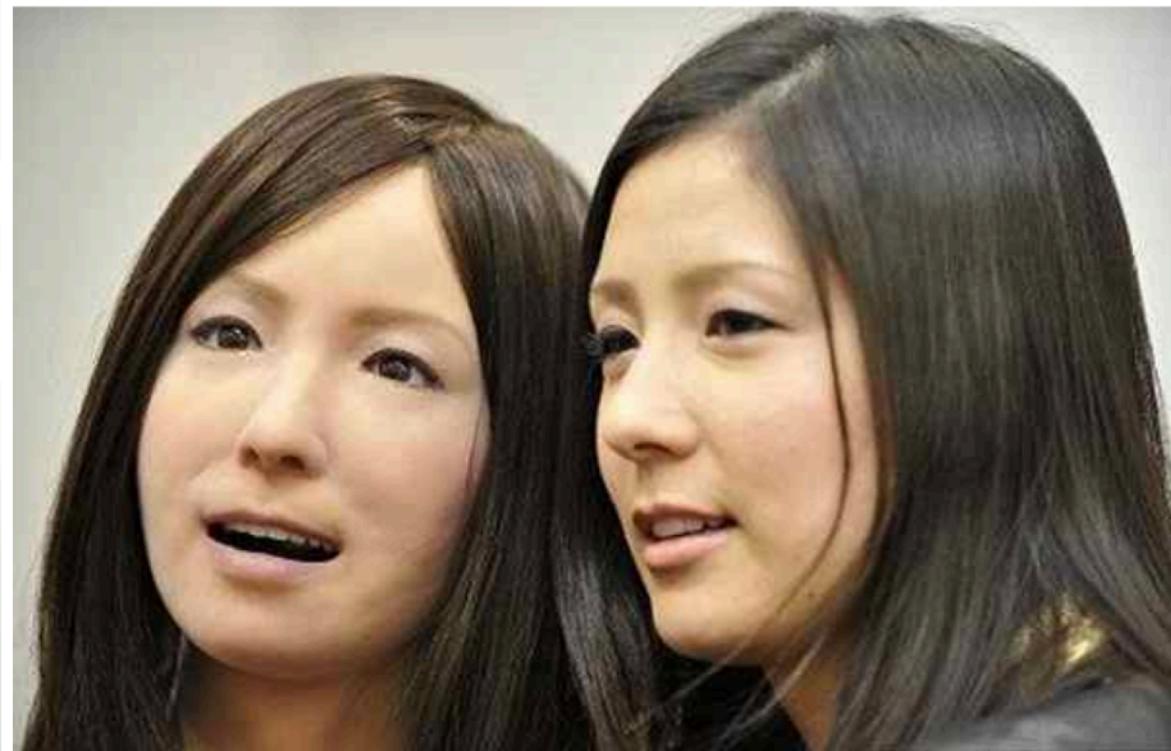
# UNCANNY VALLEY



# UNCANNY VALLEY

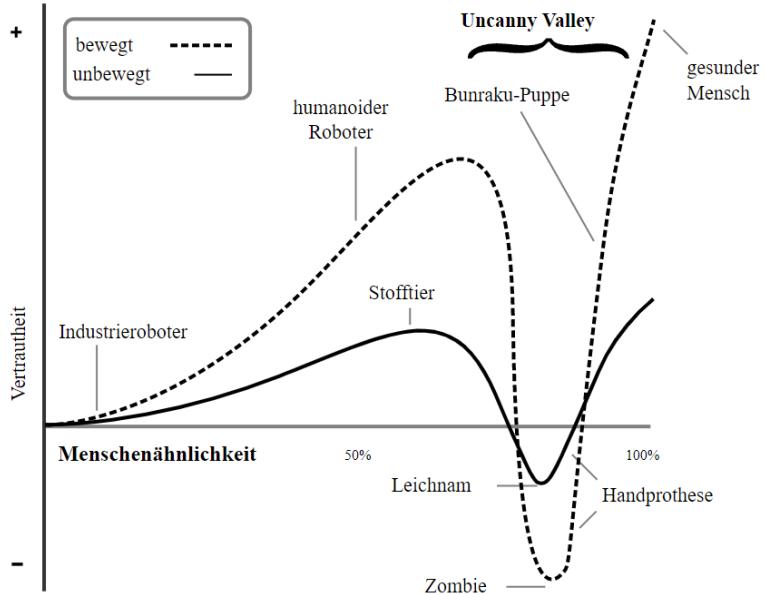


Quelle: <https://robots.fandom.com/wiki/EVE>



Quelle: <https://japanese-online.com/whatsnew/view/323334/humanoids/>

# UNCANNY VALLEY



- Hypothesis in robotics and computer animations, that human replicas (robots, 3D visualizations) looking and acting almost, but not perfectly, like humans, cause a response of revulsion in observers
- Multiple theories where the revulsion comes from (for example feeling the missing liveliness)
- geprägt von Masahiro Mori, jap. Professor für Robotik

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# COMFORT ZONE

- Because of high immersion of VR applications → the personal comfort zone comes into play
  - physical comfort zone and emotional / mind space
  - People will react more intuitively to invasions of the comfort zone
    - Upholding physical distance towards other people during conversations
    - Protect or avoid objects flying towards you
    - Avoid uncomfortable interactions with other people (multiplayer)
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# COMFORT ZONE

- Walking around in the same space with other players → users will hold up personal distance
- The same with non-player character and objects
- In an immersive world you want to interact and react in the same way

Sports Bar VR →



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# COMFORT ZONE - SECURITY

- VR can simulate dangerous situations and can trigger fears
- Used in therapy and training simulations
- Tip: Easy designed level border in games



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## **Harassment in Social Virtual Reality: Challenges for Platform Governance**

LINDSAY BLACKWELL, Oculus VR, USA

NICOLE ELLISON, Oculus VR, USA

NATASHA ELLIOTT-DEFLO, Oculus VR, USA

RAZ SCHWARTZ, Oculus VR, USA

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In immersive virtual reality (VR) environments, experiences of harassment can be exacerbated by features such as synchronous voice chat, heightened feelings of presence and embodiment, and avatar movements that can feel like violations of personal space (such as simulated touching or grabbing). Simultaneously, efforts to govern these developing spaces are made more complex by the distributed landscape of virtual reality applications and the dynamic nature of local community norms. To better understand this nascent social and psychological environment, we interviewed VR users ( $n=25$ ) about their experiences with harassment, abuse, and discomfort in social VR. We find that users' definitions of what constitutes online harassment are subjective and highly personal, which poses significant challenges for the enforcement of platform- or application-level policies. We also find that embodiment and presence in VR spaces make harassment feel more intense, while ephemerality and non-standardized application controls make it difficult to escape or report unwanted behavior. Finally, we find that shared norms for appropriate behavior in social VR are still emergent, and that users distinguish between newcomers who unknowingly violate expectations for appropriate behavior and those users who aim to cause intentional harm. We draw from social norms theory to help explain why norm formation is particularly challenging in virtual reality environments, and we discuss the implications of our findings for the top-down governance of online communities by platforms. We conclude by recommending alternative strategies for community governance.

CCS Concepts: • **Human-centered computing** → Human computer interaction (HCI); **Human-centered computing** → Collaborative and social computing; **Human-centered computing** → Virtual reality

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# **SEXUAL HARASSMENT IN SOCIAL VIRTUAL REALITY**

- Feeling of presence creates new challenges
- Multiple reported cases of sexual harassment
- Quickly became a topic for research
- Multiple VR games added features to try to avoid specific people
  - But that doesn't tackle the problem

# MOTION SICKNESS



- Also called virtual reality sickness in context of VR
- Can be huge discomfort
- Mismatch of sensory input
  - the visual input does not match the sense of balance (sensory conflict theory)
  - Body “thinks” we have been intoxicated, tries to get rid of toxins or discourages to do the same again (evolutionary theory)
- Motion sickness is an important factor in almost all VR research
- The goal is to reduce motion sickness as much as possible
- Motion sickness reduces Immersion

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# MOTION SICKNESS

- *Motion Sickness*
  - caused by real-world movement (car, boat, plane)
  - mismatch between vestibular (inner ear) signals and visual/other senses triggers nausea, dizziness, sweating, vomiting, ...
- *Cyber Sickness*
  - caused by exposure to virtual or simulated motion (VR, video games, moving visual scenes)
  - stems from similar sensory conflicts -visual system signals motion while vestibular system does not-
  - can also involve factors like display latency, low frame rate, field of view, stereoscopic mismatch, user–device ergonomics, ...

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# SYMPTOMS OF MOTION SICKNESS

- Dizziness
  - Generel feeling of being unwell
  - Excessive production of saliva
  - Headache
  - Nausea → Vomiting
  - Burping
  - Sweating
-

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# SYMPTOMS OF MOTION SICKNESS

- Dizziness
- General feeling of being unwell
- Excessive production of saliva
- Headache
- Nausea → Vomiting
- Burping
- Sweating



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# RISK FACTORS FOR MOTION SICKNESS

- People with normal motion sickness (cars, bus, etc. ) will most likely experience VR sickness
  - Women are generally more susceptible than men
  - Children (especially 2-12) more susceptible than adults
  - Hormonal factors
  - Balance disorders may be factors
  - People who are expecting to be motion sick, because of past experiences (there are studies that suggest that VR experience can reduce motion sickness)
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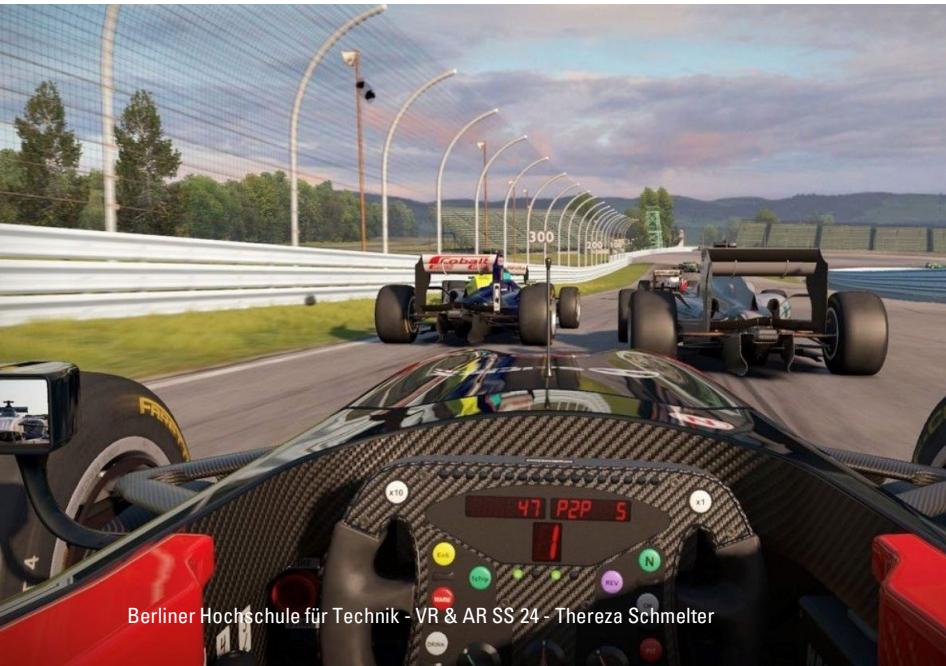
# MOTION SICKNESS REDUCTION

- Minimum of 90 frames per second
  - High pixel density of display
  - Avoid forced motion (or rotations) – allow natural walking
  - Optimized rendering – no frame drops, smooth animations
  - Increased Tracking accuracy
  - Calibration of VR setup to the player (eye distance etc.)
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# MOTION SICKNESS REDUCTION

Provide static fix points or horizon

<https://www.welt.de/motor/news/article193747165/Ein-Brillen-Sondermodell-zum-Hundertsten-Citroen-feiert-Geburtstag.html>



Berliner Hochschule für Technik - VR & AR SS 24 - Thereza Schmelter

**S**P-X/Köln. Die im vergangenen Sommer von Citroen entwickelte Seetroen, eine Brille gegen Reisekrankheit, ist anlässlich des 100. Geburtstages des Unternehmens ab Juli in einer auf 1.919 Stück limitierten Sonderedition erhältlich. Die Seetroen S19 kostet 99 Euro und hat ein klassischeres Gestell als die erste Ausgabe.

Im jetzt blauen Brillengestell befindet sich eine ebenfalls blaue Flüssigkeit. Die bewegt sich in Ringen vor und seitlich der Augen und erzeugt so einen künstlichen Horizont. So soll Reiseübelkeit beim Lesen im Auto verhindert werden. Die Brille kann von Personen ab 10 Jahren getragen werden. Da die Seehilfe keine Gläser hat, ist sie auch für Brillenträger geeignet. Sobald die ersten Übelkeitssymptome auftreten, sollte die Brille für ca. 10 Minuten aufgesetzt werden.



# MOTION SICKNESS EVALUATION

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- Motion sickness is difficult to measure
- Large variance between individuals
- In current research men are overrepresented, because participants of studies often haven been (and are) students or research assistants in Computer Science
- Kennedy Simulator Sickness Questionnaire (SSQ) is a standard questionnaire for VR sickness
  - Questions include categories of oculomotor, disorientation and nausea
  - 4-point scale (none, slight, moderate, severe)

Original Paper(1993) [https://www.tandfonline.com/doi/abs/10.1207/s15327108ijap0303\\_3](https://www.tandfonline.com/doi/abs/10.1207/s15327108ijap0303_3)

S. Balk et al (2017) [https://www.researchgate.net/publication/321841849\\_Simulator\\_Sickness\\_Questionnaire\\_Twenty\\_Years\\_Later](https://www.researchgate.net/publication/321841849_Simulator_Sickness_Questionnaire_Twenty_Years_Later)

# EYE STRAIN, SEIZURES, AFTEREFFECTS

- People are generally getting strained from VR much quicker
  - Display close to the eyes is not natural >looking< - display distance
  - Flickering should be avoided as it can cause eye strain, nausea, dizziness
  - Flickering or flashing lights should be avoided, because they can cause seizures
  - Nausea and other side effects will most likely continue until after the VR experience based on the severity of symptoms and length of playing time
  - Subsequent activities should be restricted to avoid accidents
- man steht meistens
  - Gewicht auf dem Kopf
  - körperliche Bewegungen

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# WHAT SHOULD I DO WITH THIS INFORMATION?

Fragen, die man sich bei klassischen Apps evtl. nicht stellen würde/müsste

- When designing your VR experience, you should consider the factors:
  - Which immersion factors are relevant for this project?
  - How can I avoid a break-in-presence?
  - How much self embodiment is needed?
  - Should the level or interaction be designed to avoid comfort zone invasion?
  - How do I reduce motion sickness or other straining effects?