VRDC

Cognitive Psychology of Virtual Reality: Basics, Problems and Tips

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Atari 800XL

Image: https://www.flickr.com/photos/zigazou76/16968557412

Human
Psychology

Machine
Engineering

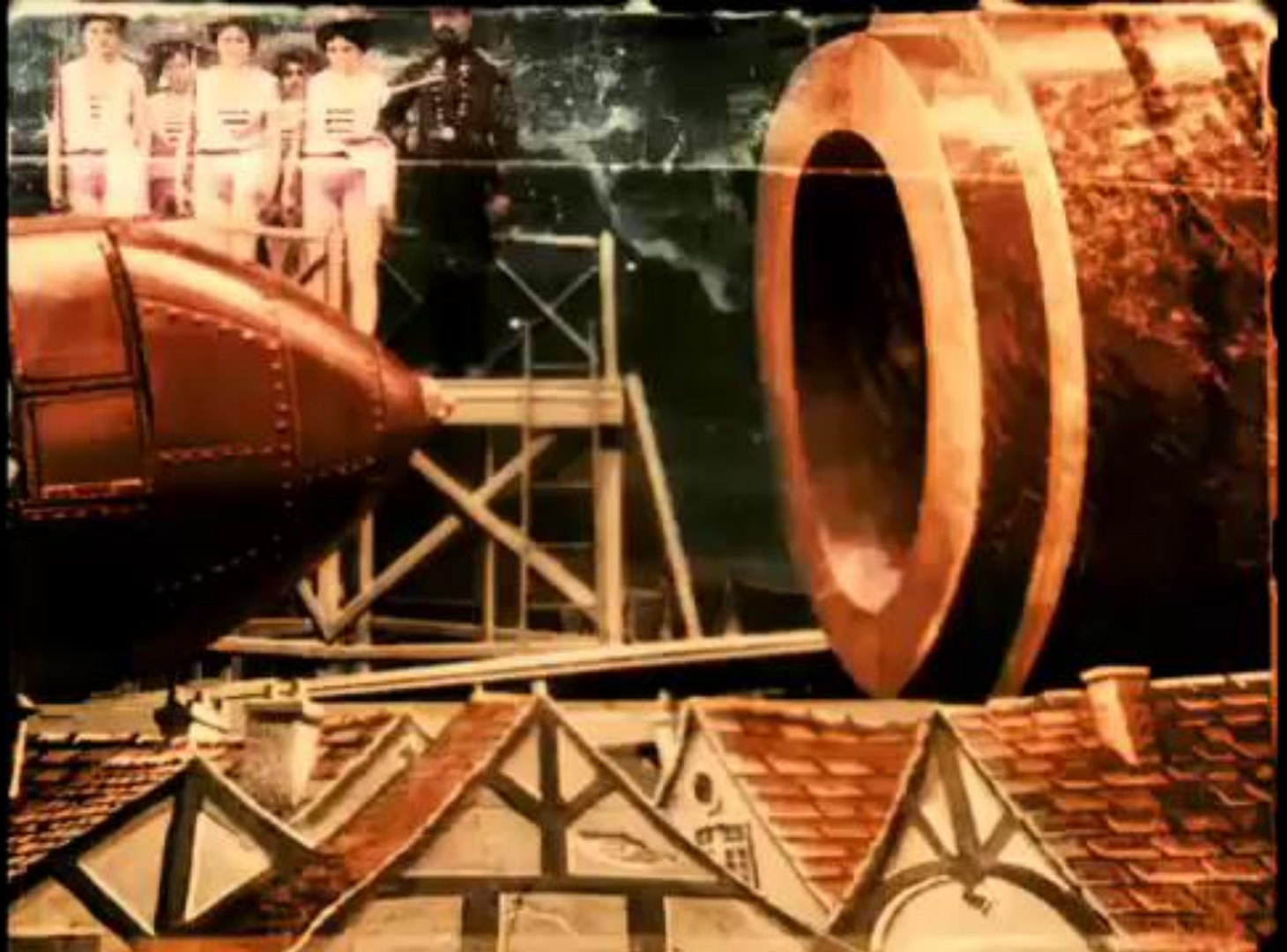
Image: https://www.flickr.com/photos/healthblog/


ZEIT 2
BRIGHTSIDE games
XBOX LIVE arcade
STEAM
UBISOFT


exozet
Agency For Digital Transformation

Outline

- **VR as a new medium**
- **Psychology of VR**
  - Perception
  - Body & Movement
  - Attention
  - Interaction
  - Emotional / Social
- **Conclusion**




MARIO 360°
https://vrodo.de/super-mario-trifft-virtual-reality-im-360-video/

Shift of successful content

GAMEFORGE Select country: United Kingdom More games

Player: Zerohours Buddies Notes Highscore (901) Search Options Support Chat Log out 15.04.2013 23:58:02

OGame

12.034 18.903 7.132 0 139

Patch notes

Own Missions: 2 Friendly Missions: 0 Hostile Missions: 0
53m 53s ACS Attack

3/3 Planets

Overview
Resources
Facilities
Merchant
Research
Shipyard
Defense
Fleet
Galaxy
Alliance
Recruit Officers
Shop

Events

53m 53s	00:51:55 Clock	Union user	1 / 5	2	Homeworld	[1:445:4]
1h 47m 50s	01:45:52 Clock	Zeros Lair	[1:445:8]	1	Homeworld	[1:445:4]
1h 47m 58s	01:46:00 Clock	Colony	[1:445:9]	1	Homeworld	[1:445:4]

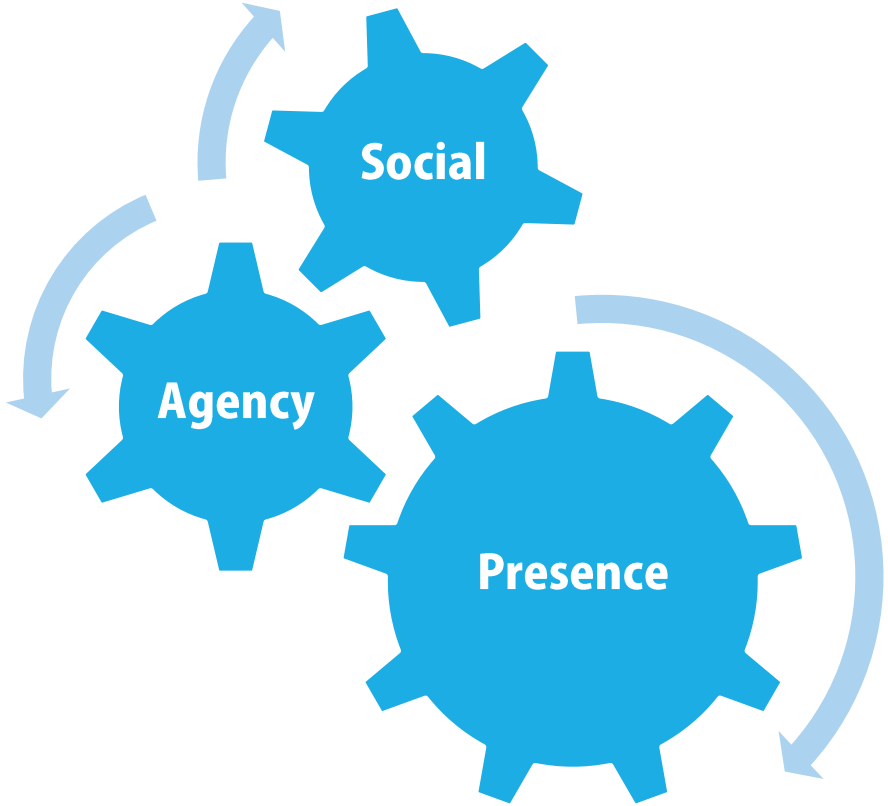
Fleet movement - Colony

Zeros Lair [1:445:8]
Colony [1:445:9]
Colony [1:445:7]

Reload fleets: 2 / 6 Expeditions: 0 / 1

53m 53s 00:51:55 Clock ACS Attack	[1:445:9] Colony	Homeworld	[1:445:4]	1h 47m 58s 01:46:00 Clock Return
53m 53s 00:51:55 Clock Attack	[1:445:8] Zeros Lair	Homeworld	[1:445:4]	1h 47m 50s 01:45:52 Clock Return

VR AS A NEW MEDIUM




FANTASTIC
CONTRAPTION

New Medium

will have disruptive impact!

Hype and Backlash

Embrace Limitations

Gamer Expectations

Comfort

Ease of Use

Memory

Knowledge

Language

Intelligence

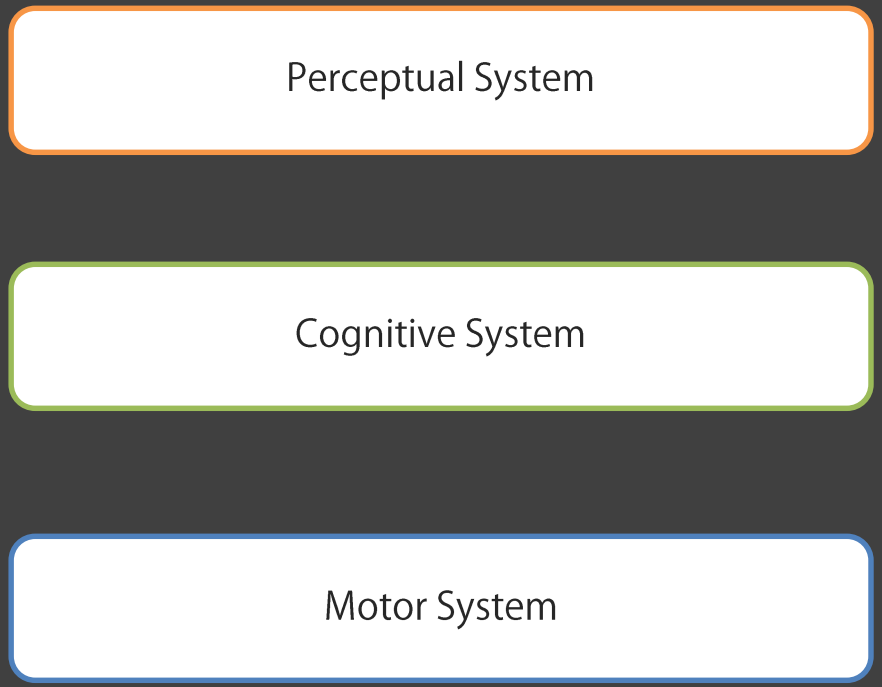
Cognitive Psychology

Perception

Attention

Thinking

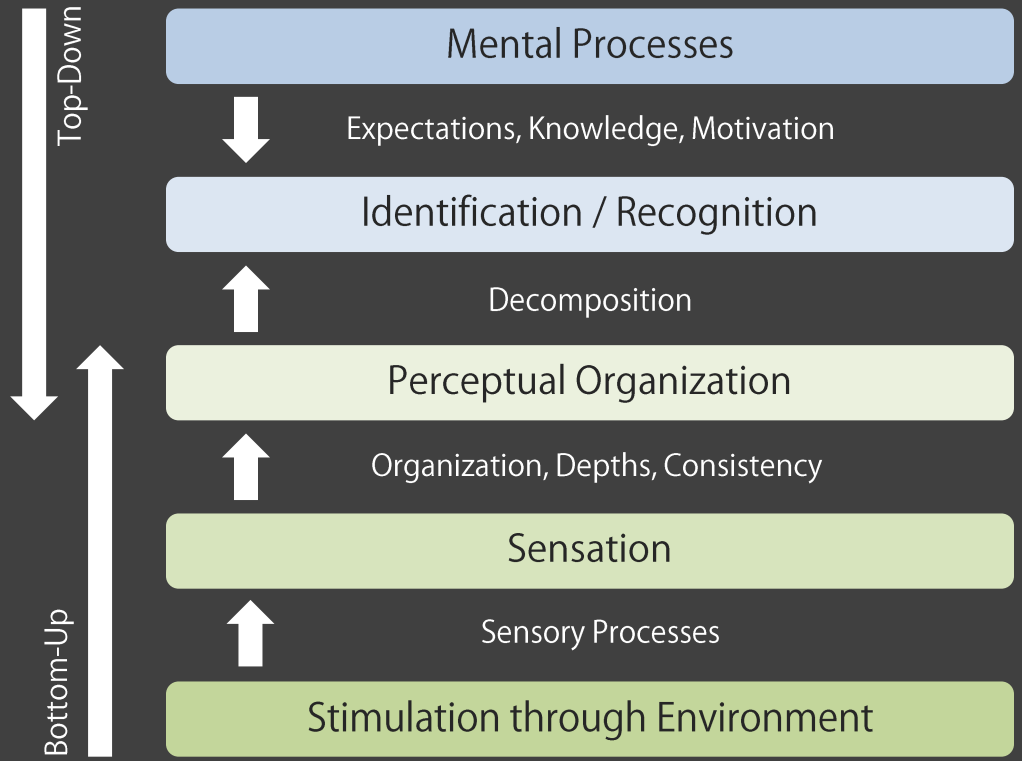
Decision Making


Perceptual System
Cognitive System
Motor System

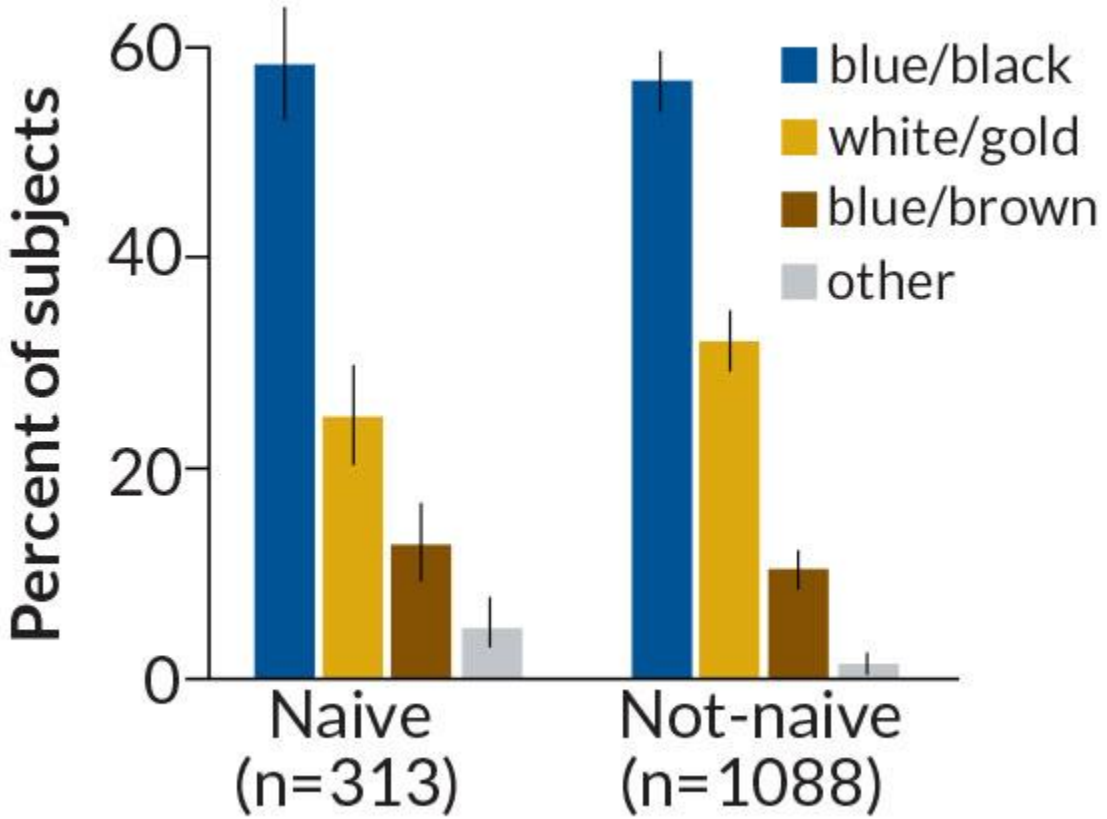
Adaptivity

http://www.awz.uni-wuerzburg.de/archiv/film_foto_tonarchiv/filmdokumente/th_erismann_ikohler/die_umkehrbrille_und_das_aufrechte_sehen/

Layers of Visual Perception




TAE CAT

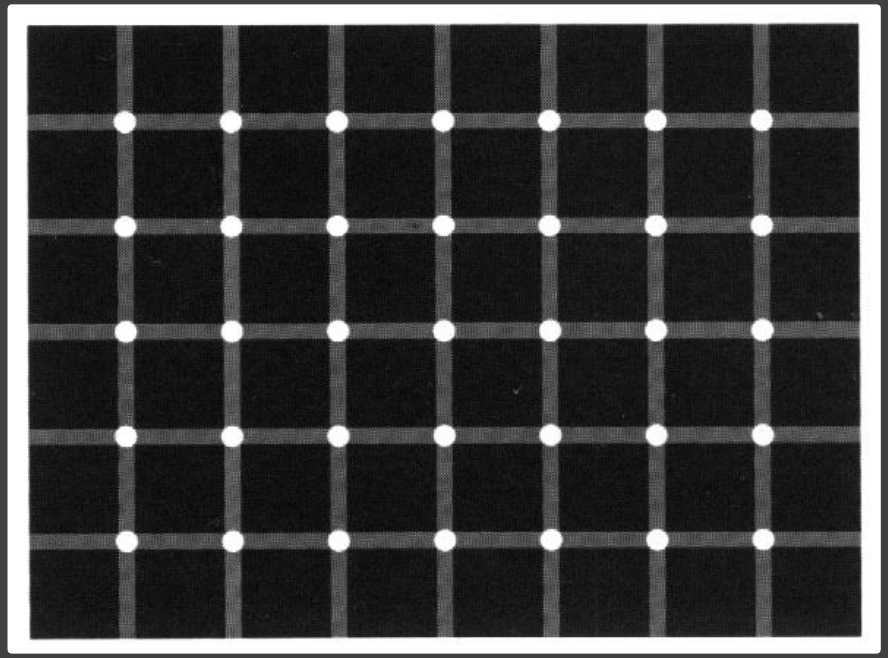


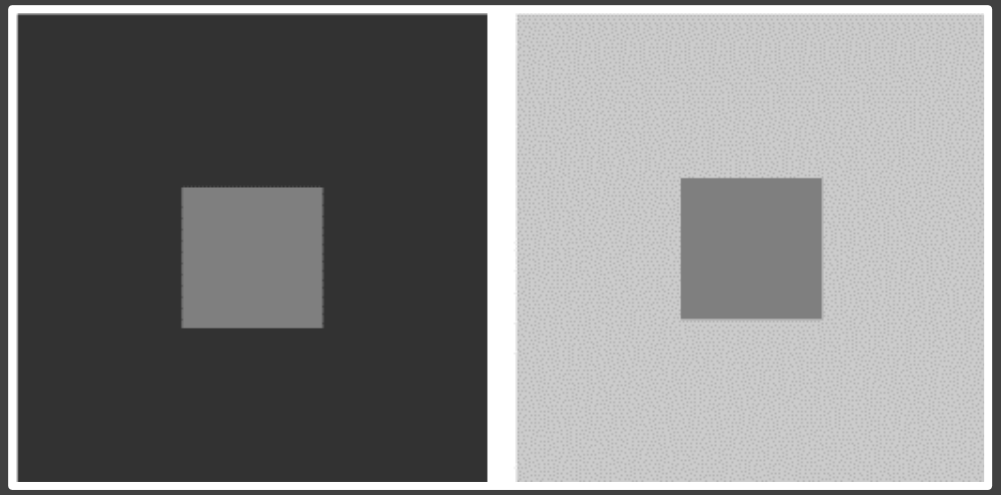
https://www.sciencenews.org/blog/culture-beaker/dress-divided-internet-it%E2%80%99s-really-about-subtraction/

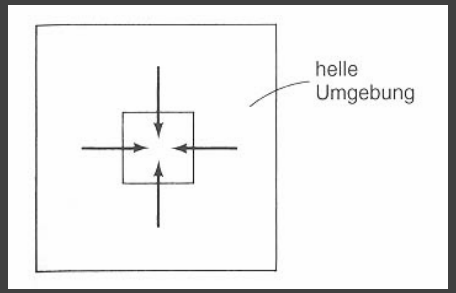
- Priming (top-down)
- Optical illusion (bottom-up)
- Context matters
- Great adaptivity


50
60
40
70
FPS
30
80
20
10
0


SMI



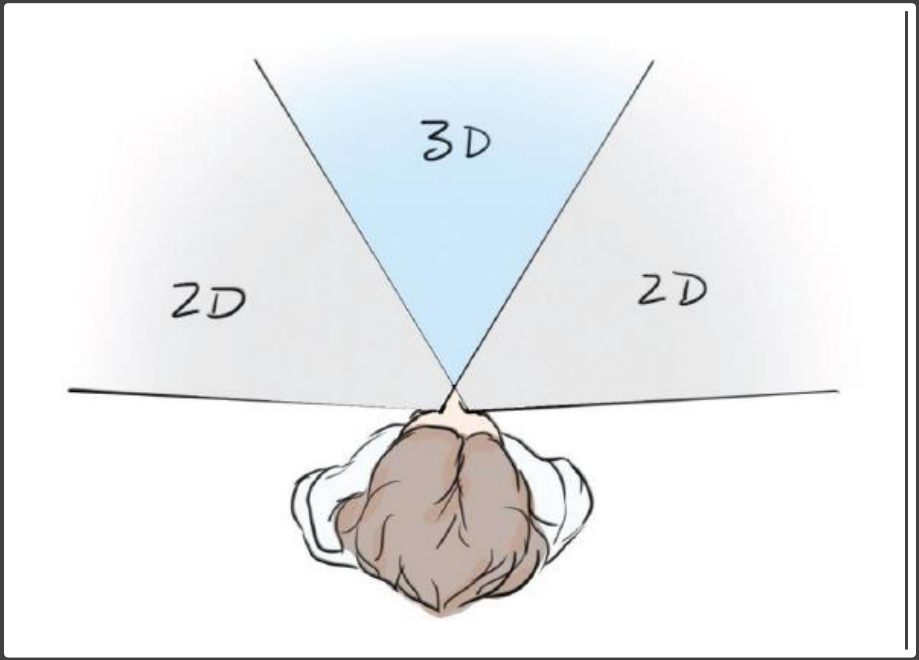



helle
Umgebung

- No “pixel-resolution” inside the eye
- Foveal / peripheral vision are very different

Spatial Perception

„3D“ Vision



Monocular Depth Cues

Familiar Size
Motion Parallax
Texture Gradient

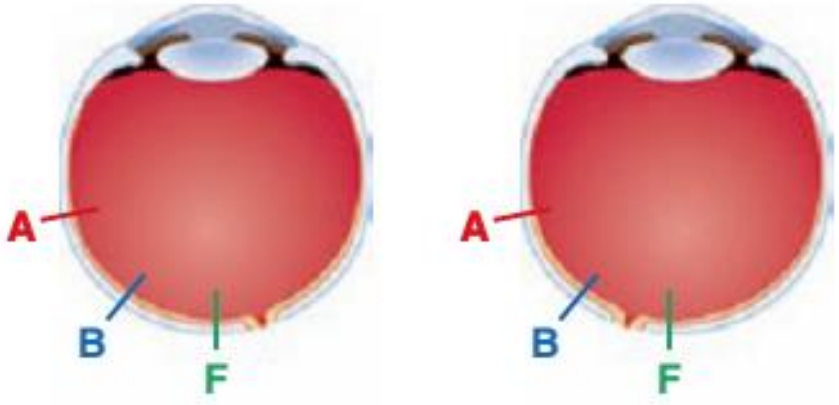
Goldstein (2010, pp. 231–235)

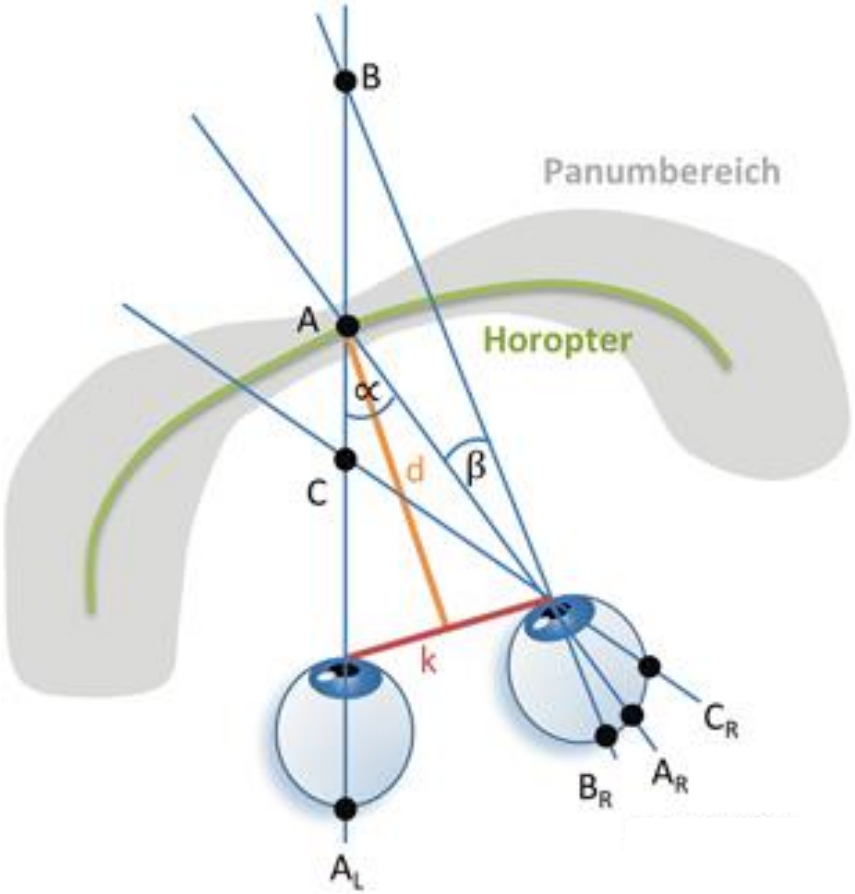
Effectivity of Depth Cues

(Cutting und Visthon, 1995)

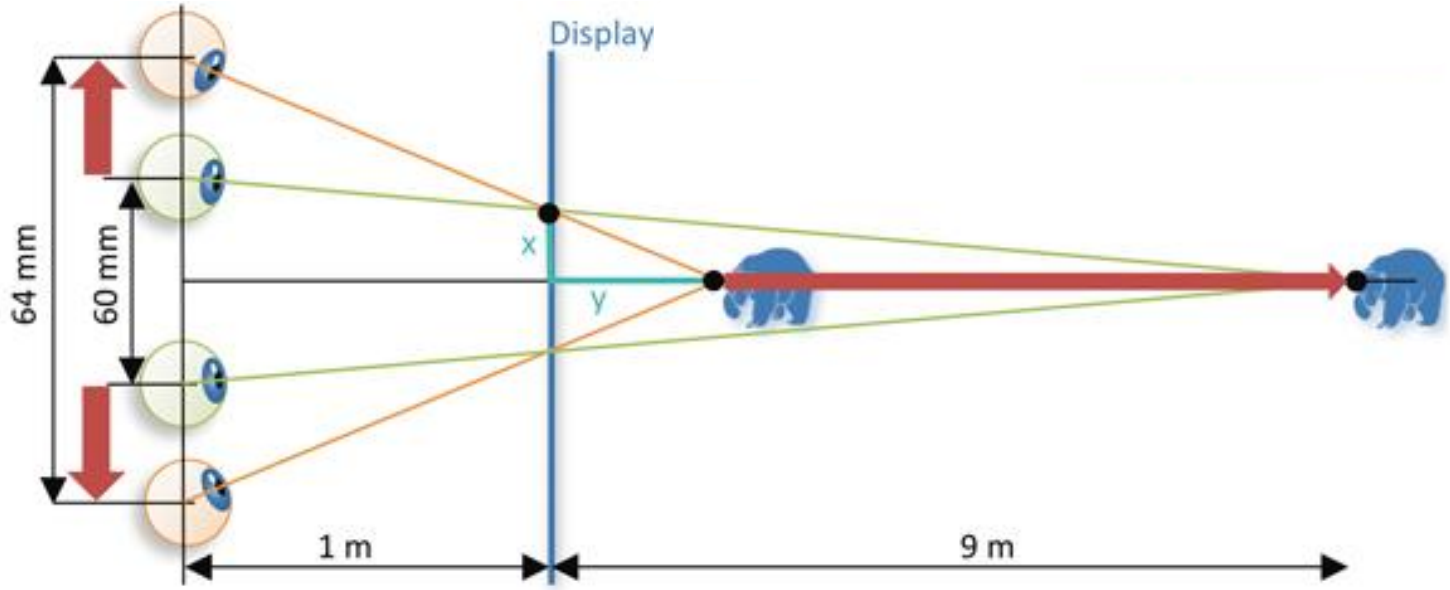
Depth Cue	0-2 m	2-30 m	> 30 m
Occlusion	✓	✓	✓
Relative Size	✓	✓	✓
Accommodation & Convergence	✓		
Motion Parallax	✓	✓	
Stereopsis	✓	✓	
Elevation		✓	✓
Aerial Perspective			✓

Binocular Disparity and Stereopsis





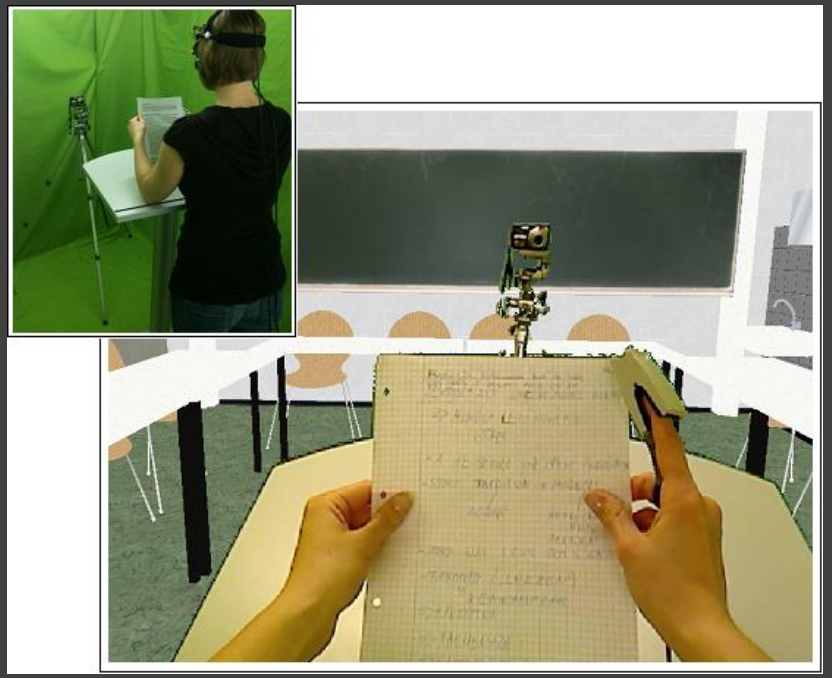
Dörner 2013, Virtual and Augmented Reality (VR/AR)



Dörner 2013, Virtual and Augmented Reality (VR/AR)

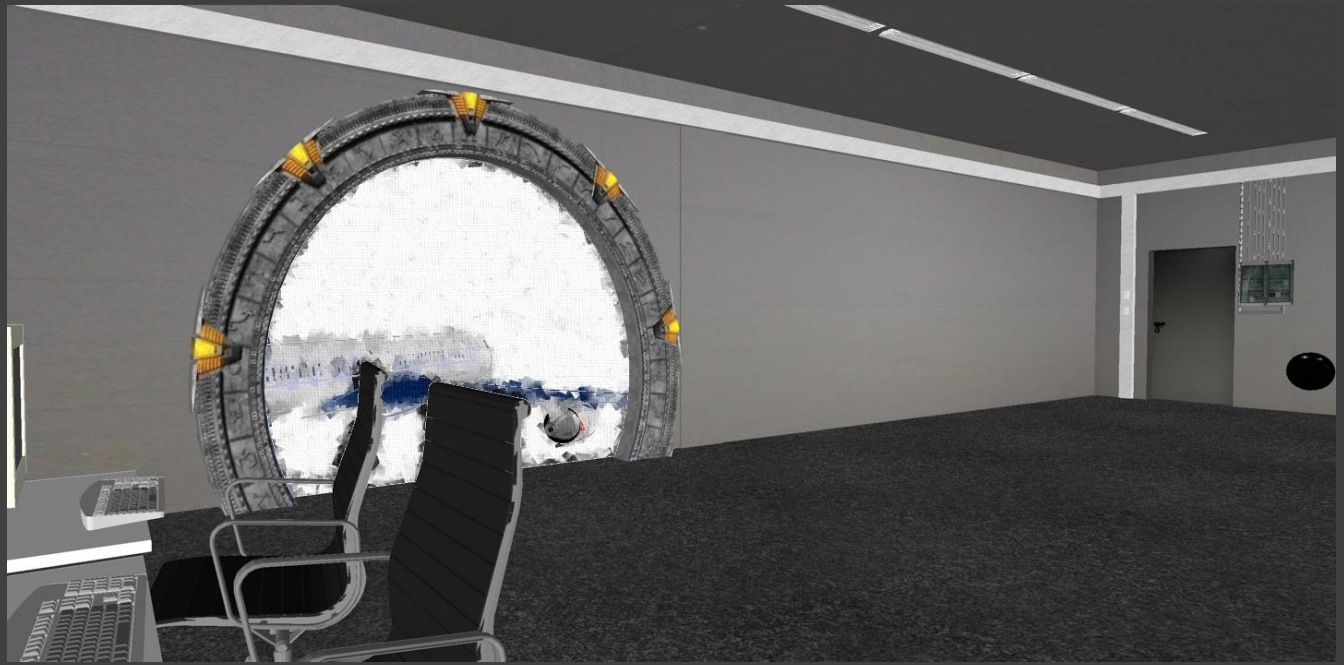
- Textur helps fusing retinal images
- Use monocular depth cues to improve place illusion
- IPD matters a lot for size, gigantism & lilliputism

Depth Perception in VR



https://www.inf.uni-hamburg.de/en/inst/ab/hci/people/steinicke.html

Depth Perception in VR



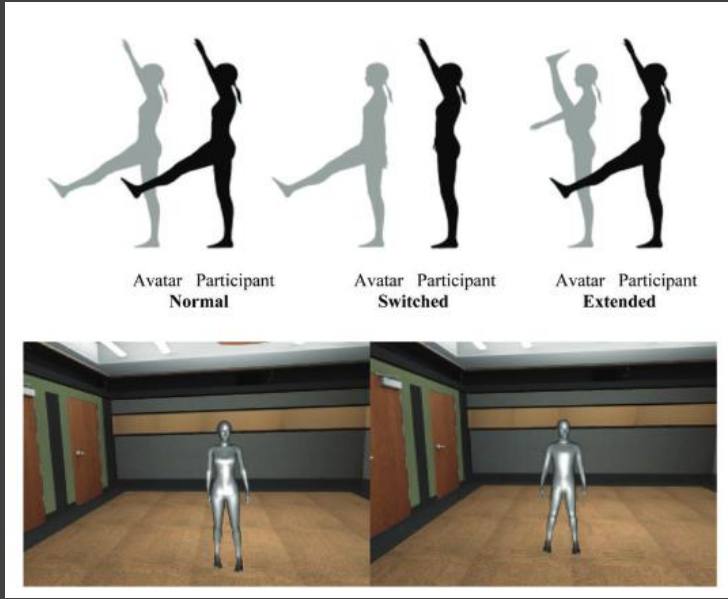
https://www.inf.uni-hamburg.de/en/inst/ab/hci/people/steinicke.html

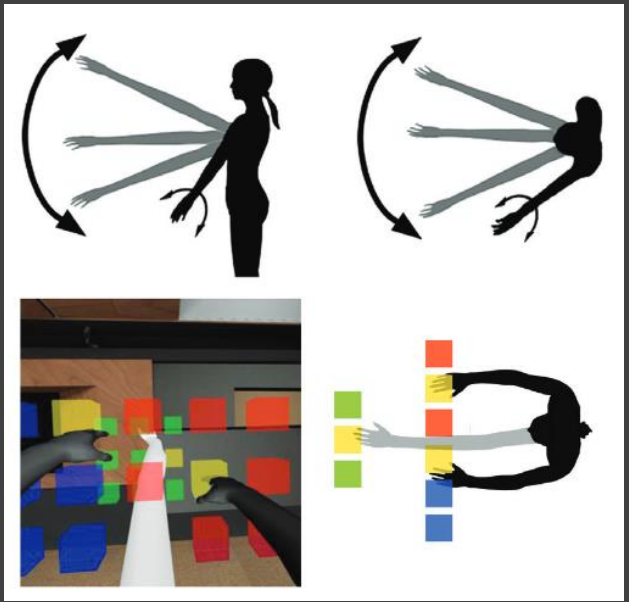
Body and Movement

http://blog.sportlaedchen.de/pilates-und-yoga/yoga-uebungen-ruecken-anfaenger-fortgeschrittener/

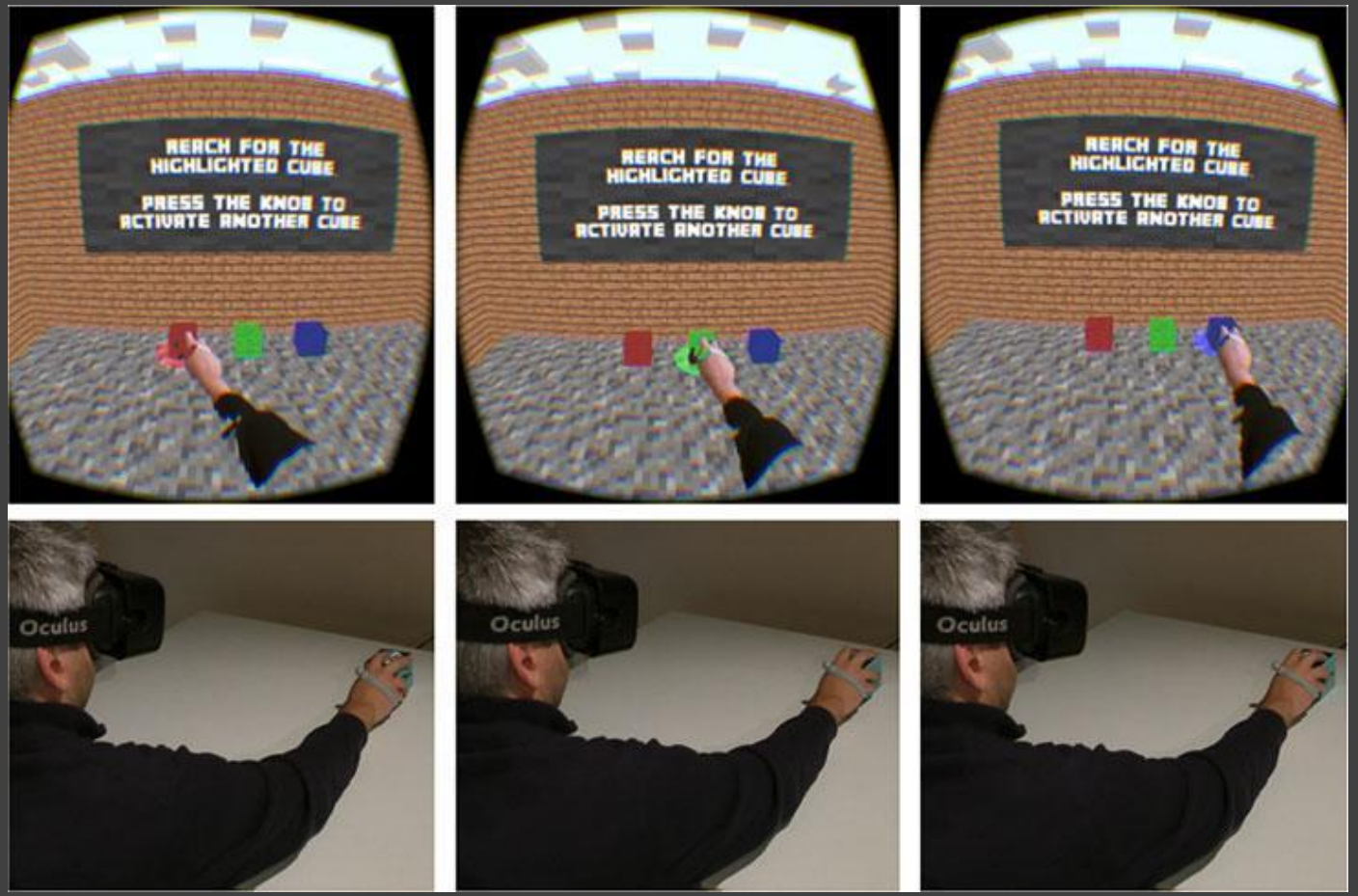
- Avoid not matching body visualization
- Adjust to player. Height, movement speed, IPD
- Keep consistence in graphics and scaling

Flexibility





http://vhil.stanford.edu/pubs/2014/won-jcmc-homuncular.pdf

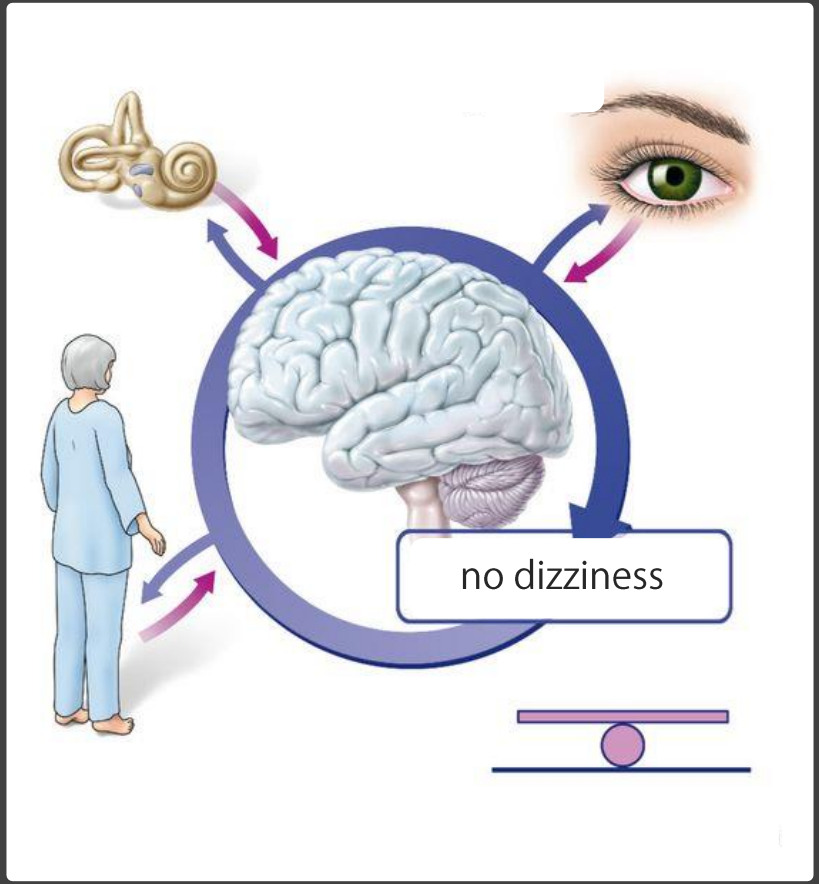


Azmandian, M., Hancock, M., Benko, H., Ofek, E. & Wilson, (2016) A. Haptic retargeting: Dynamic repurposing of passive haptics for enhanced virtual reality experiences.

- More sense for space in arms length
- Include sound the body would make
- Use haptic feedback when possible

Vestibular System

Optical System



Proprioception

Balance

http://www.hennig-am.de/schwindel.html

SIMULATOR SICKNESS QUESTIONNAIRE

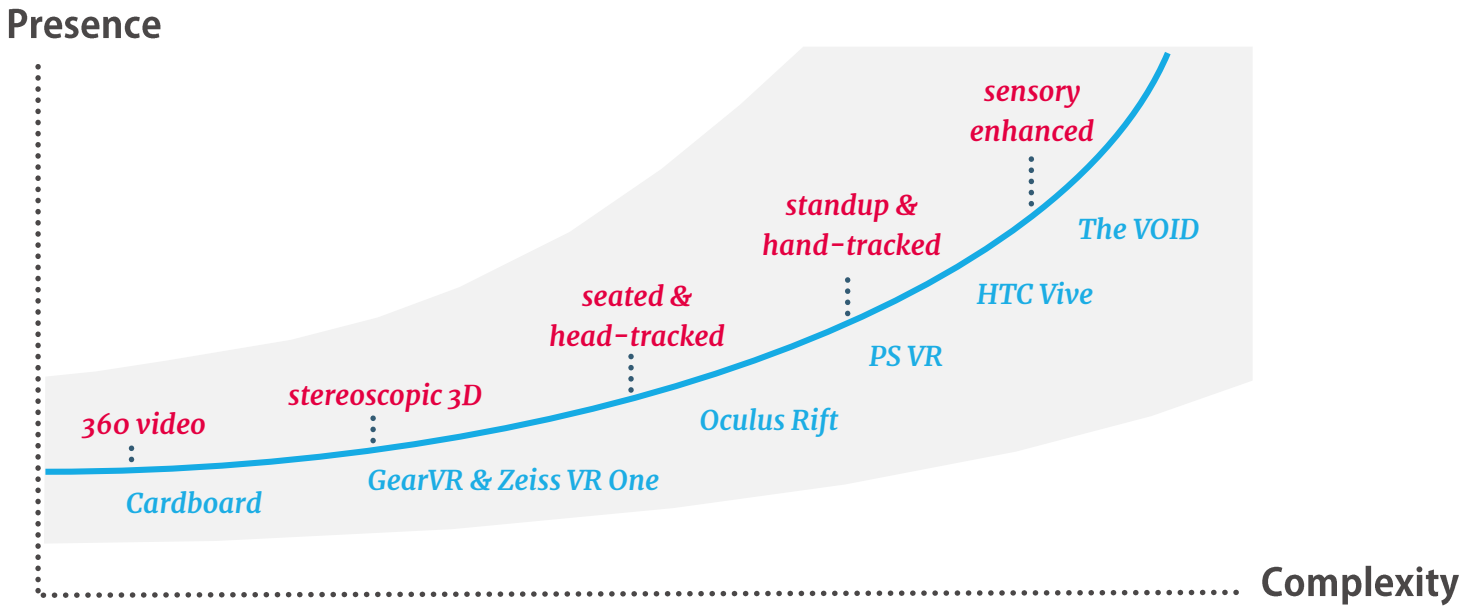
Kennedy, Lane, Berbaum, & Lilienthal (1993)

1. General discomfort	None	Slight	Moderate	Severe
2. Fatigue	None	Slight	Moderate	Severe
3. Headache	None	Slight	Moderate	Severe
4. Eye strain	None	Slight	Moderate	Severe
5. Difficulty focusing	None	Slight	Moderate	Severe
6. Salivation increasing	None	Slight	Moderate	Severe
7. Sweating	None	Slight	Moderate	Severe
8. Nausea	None	Slight	Moderate	Severe
9. Difficulty concentrating	None	Slight	Moderate	Severe
10. « Fullness of the Head »	None	Slight	Moderate	Severe
11. Blurred vision	None	Slight	Moderate	Severe
12. Dizziness with eyes open	None	Slight	Moderate	Severe
13. Dizziness with eyes closed	None	Slight	Moderate	Severe
14. *Vertigo	None	Slight	Moderate	Severe
15. **Stomach awareness	None	Slight	Moderate	Severe
16. Burping	None	Slight	Moderate	Severe

- Don’t accelerate the camera independent from user
- Keep horizon aligned
- Don’t take away head orientation control

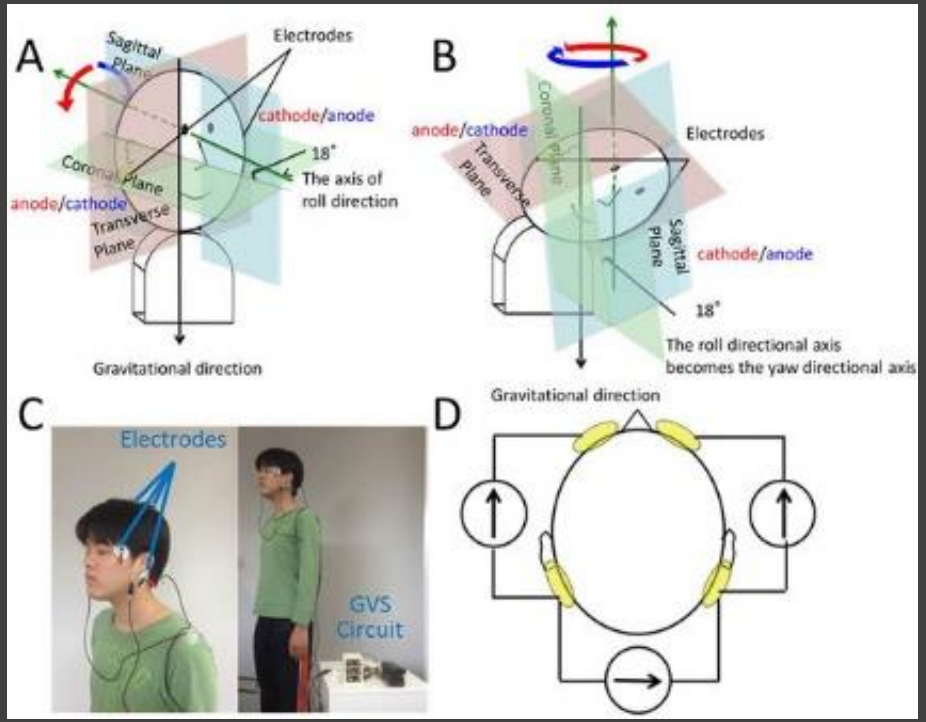
VR EXPERIENCES

Presence and complexity of different VR setups




MOVEO
HRUSH
MULTI
PARTY

Galavanic Vestibular Stimulation

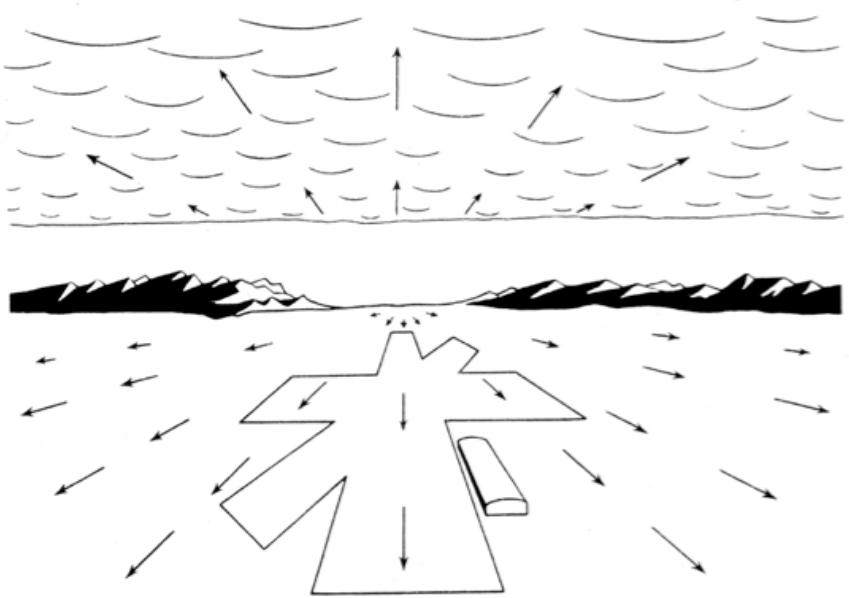


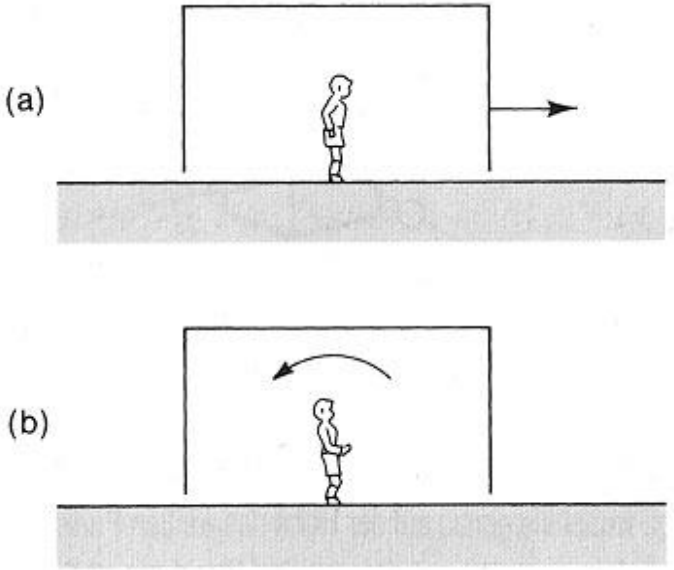
Four-pole galvanic vestibular stimulation causes body sway about three axes, Kazuma Aoyama, Hiroyuki Iizuka, Hideyuki Ando & Taro Maeda, 2014

- Always consider user posture and context

  ... sitting, walking, public, chair, couch

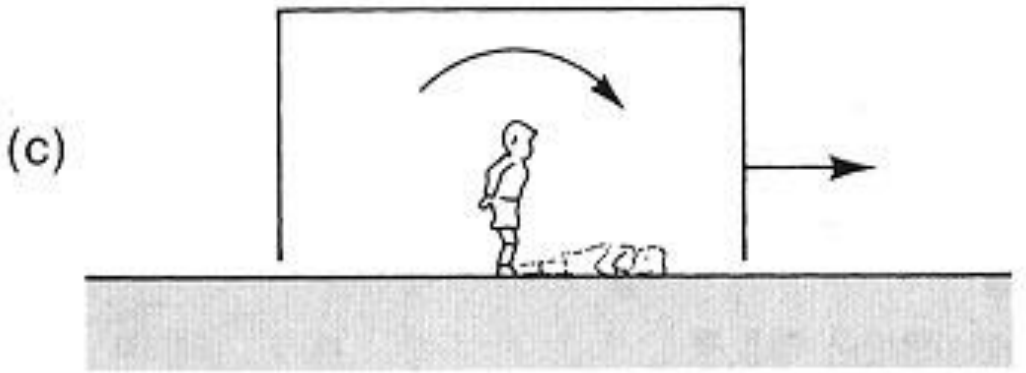
Optical Flow





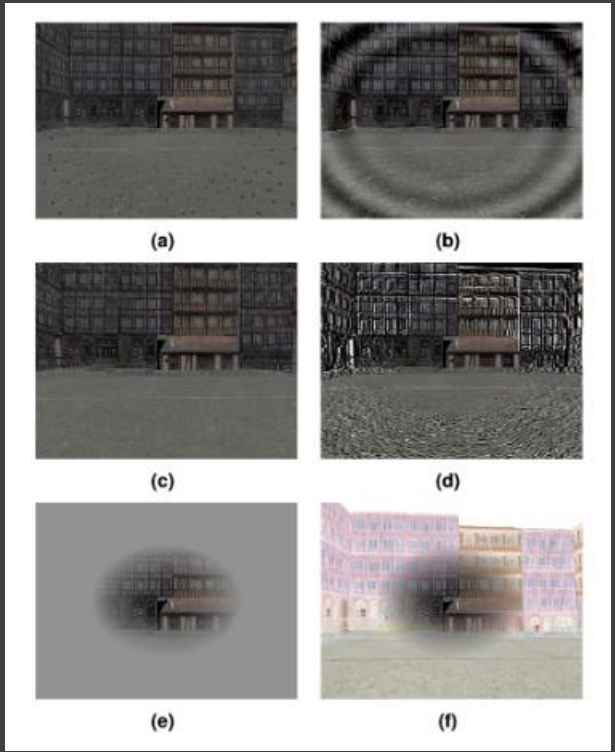
(Lee & Anderson, 1974):

Optical Flow



(Lee & Anderson, 1974):

Modified Optical Flow

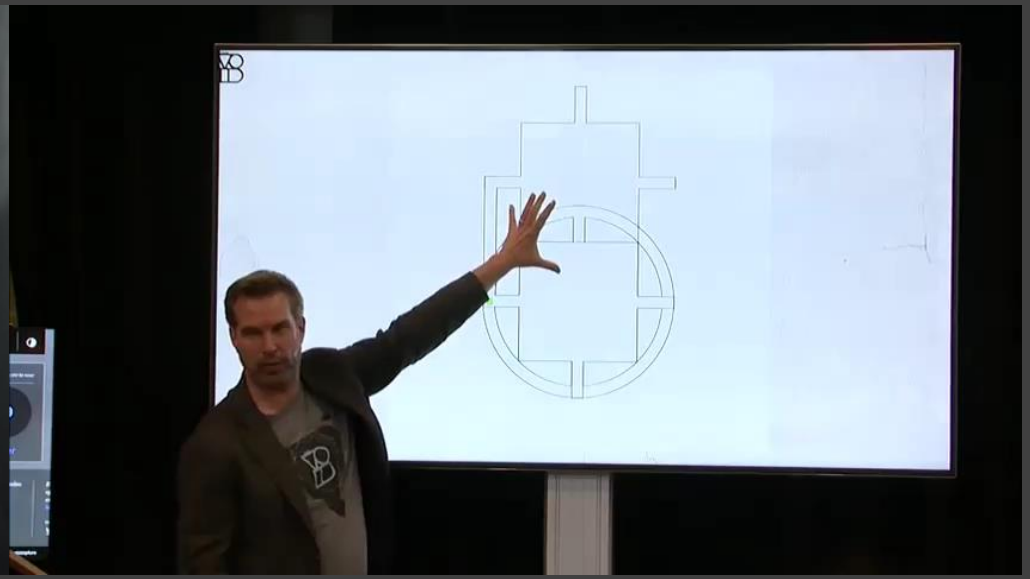


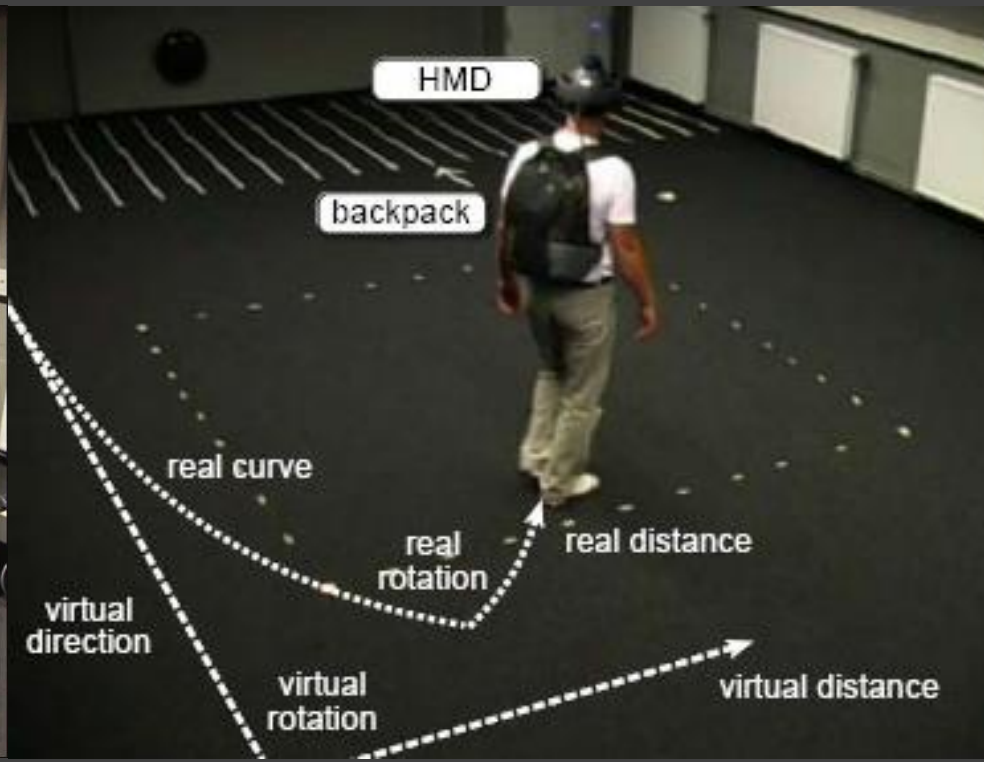
https://basilic.informatik.uni-hamburg.de/Publications/2012/BSWL12/article.pdf

http://uploadvr.com/eagle-flights-solution-to-vr-movement-looks-incredible/

- Teleportation from personal space to pers. space
- Control optical flow especially in peripheral vision
- Player locked backgrounds can help

Redirected Walking





Detection Thresholds for Redirected Walking, Prof. Dr. Frank Steinicke, Dr. Gerd Bruder
Cognitive Resource Demands of Redirected Walking, Gerd Bruder, Paul Lubos, Frank Steinicke
IEEE Transactions on Visualization and Computer Graphics (TVCG), page (accepted) - 2015

- Get inspired by magic and illusionists
- Use moments of astonishment.
- It’s allowed to experiment and use tricks

➢ **Create a magical place rather than realism**

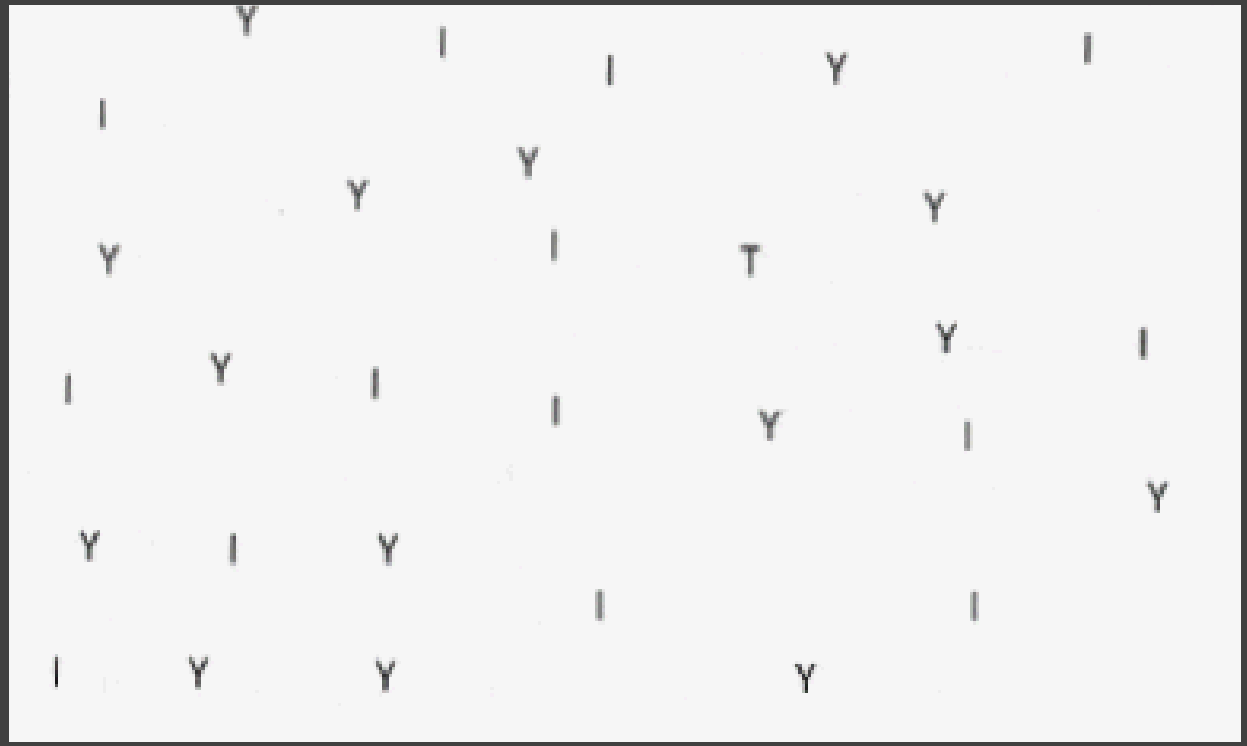
Eye Tracking

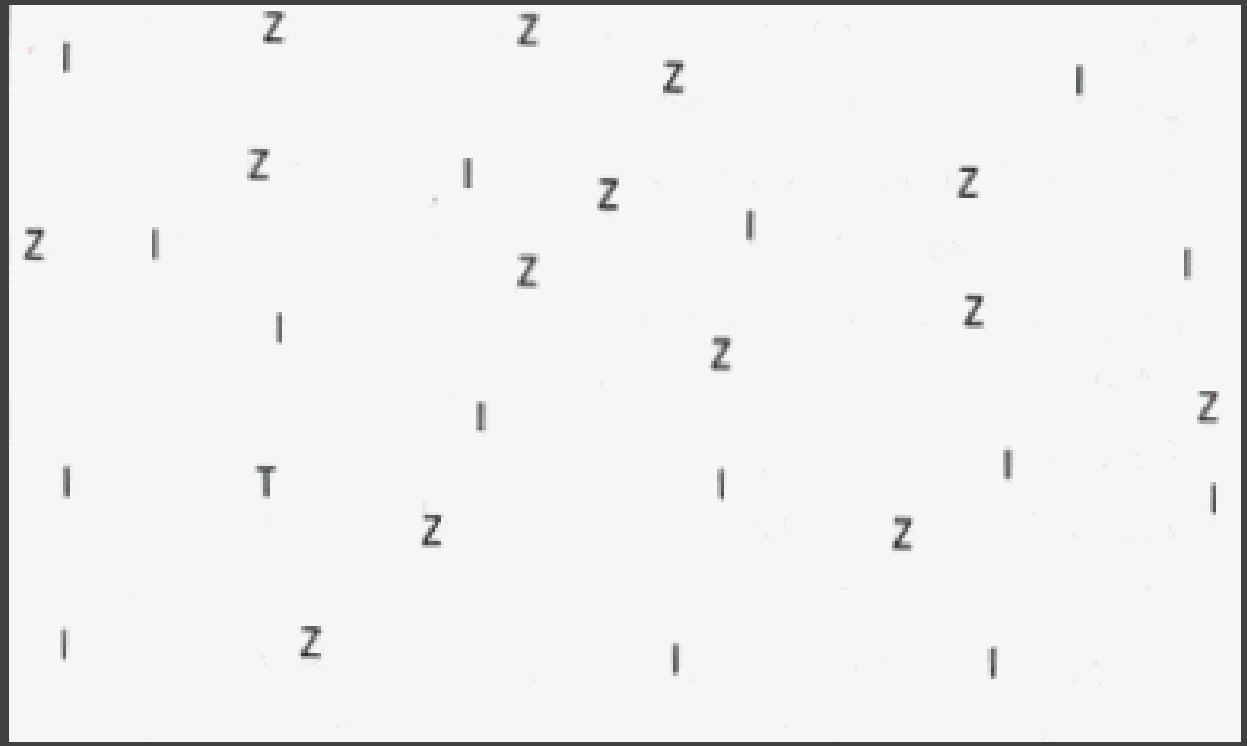

SMI
SensoMotoric Instruments
SMI HOME
Escape Game
Abbey Demo
Mogura Tataki

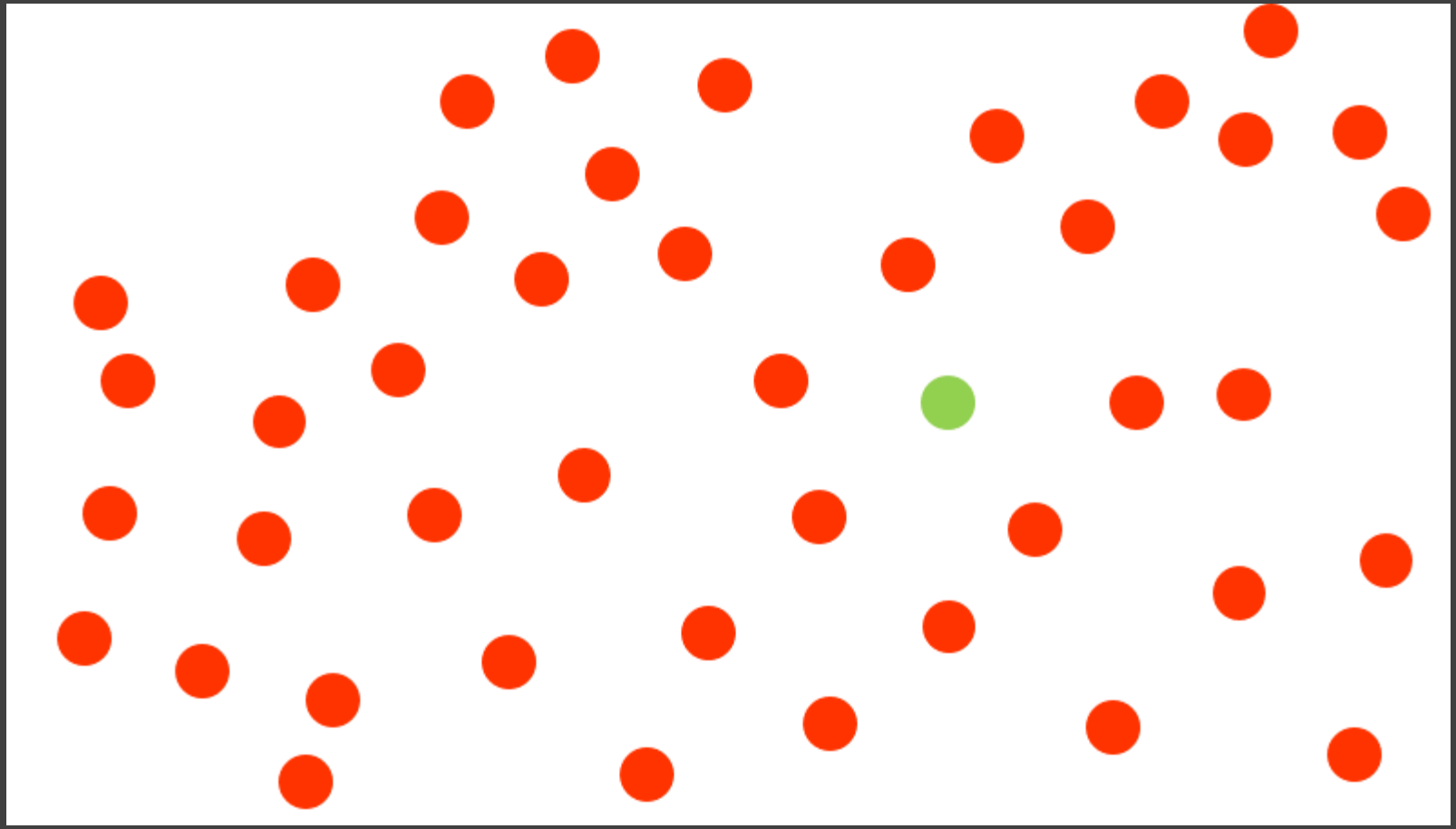
- Eye contact with avatars
- Natural eye and head movements “Neck follows eyes”
- Change environment when user blinks

➢ **Knowing about the users attention**

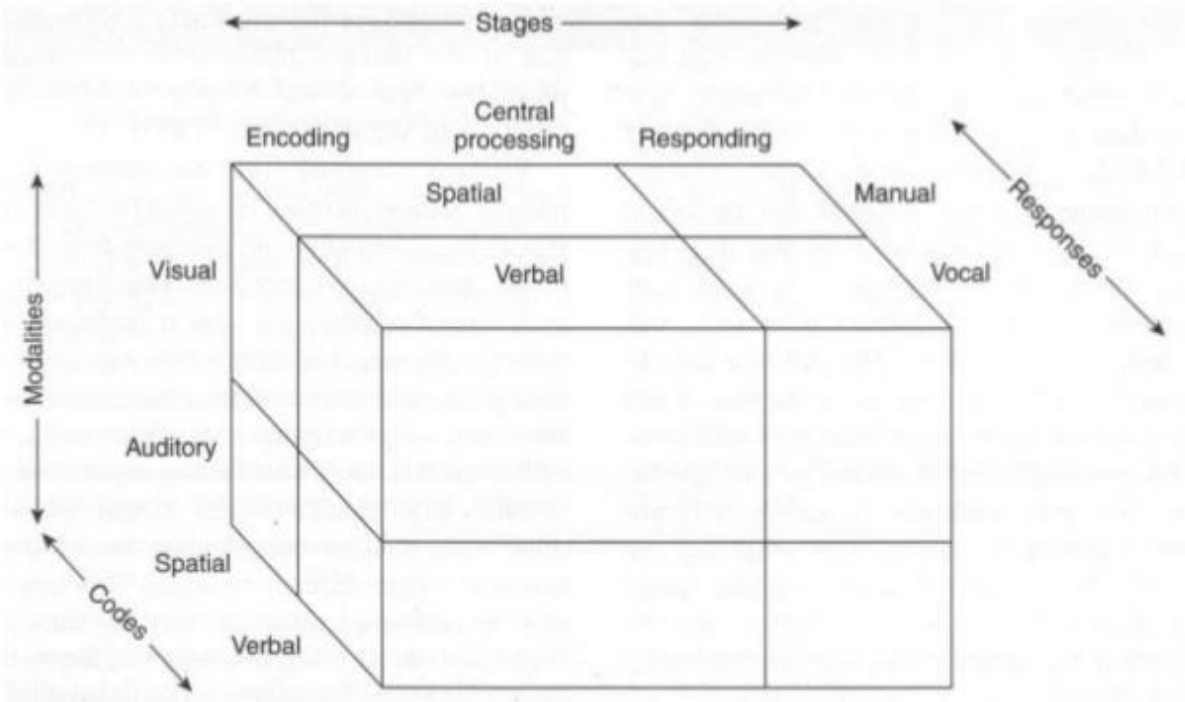
Attention







Theory of Multiple Ressources, Wickens

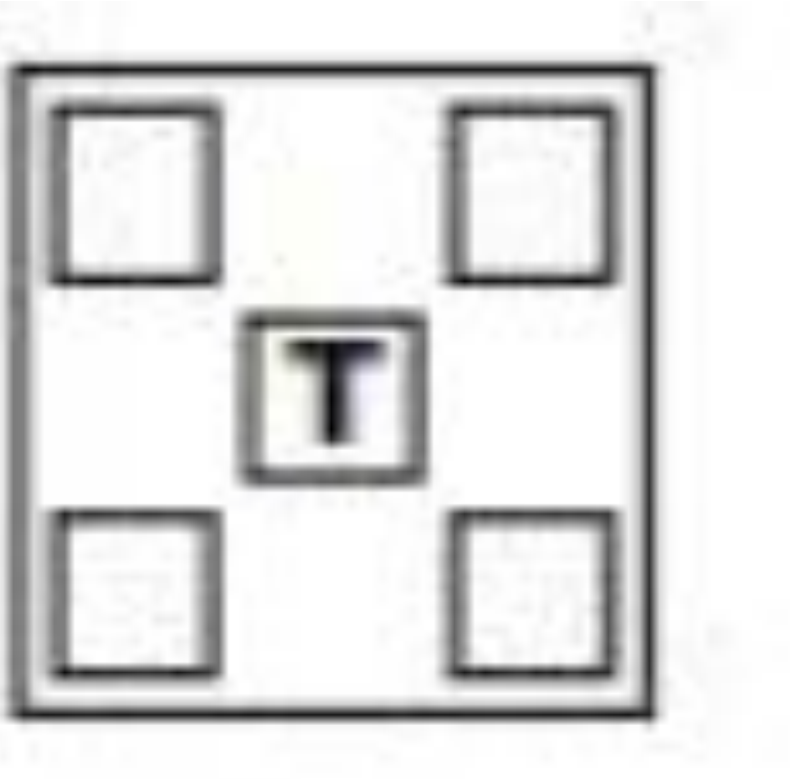


- Uniqueness, details and contrasts draw attention
- ... but can be distractive
- Use multisensoy cues

Count how many times
the players wearing
white pass the ball

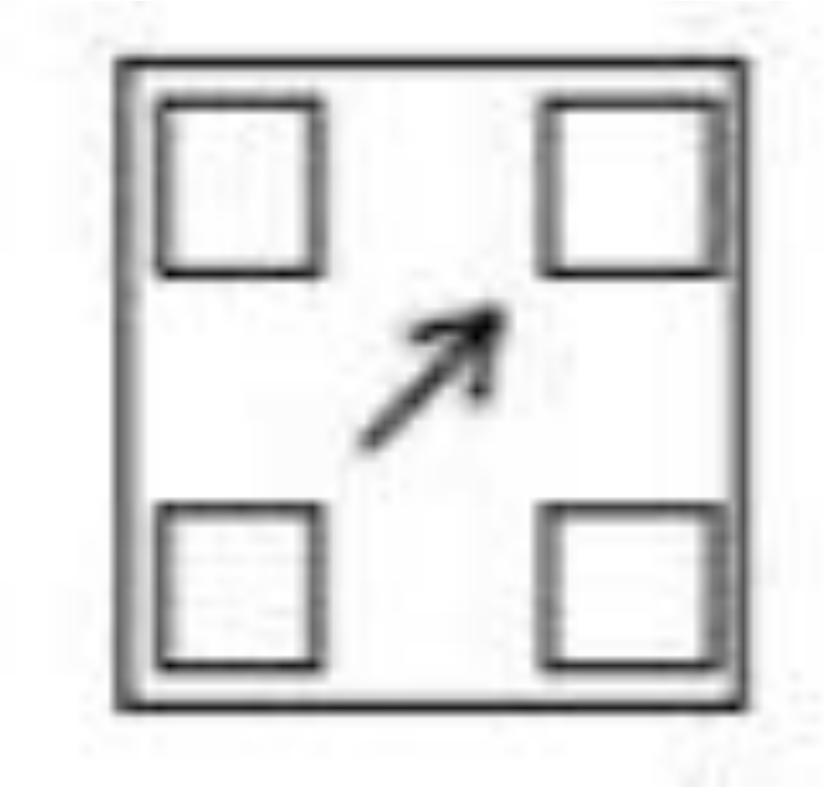
Reflexive and voluntary orienting of visual attention

Müller & Rabbitt 1989



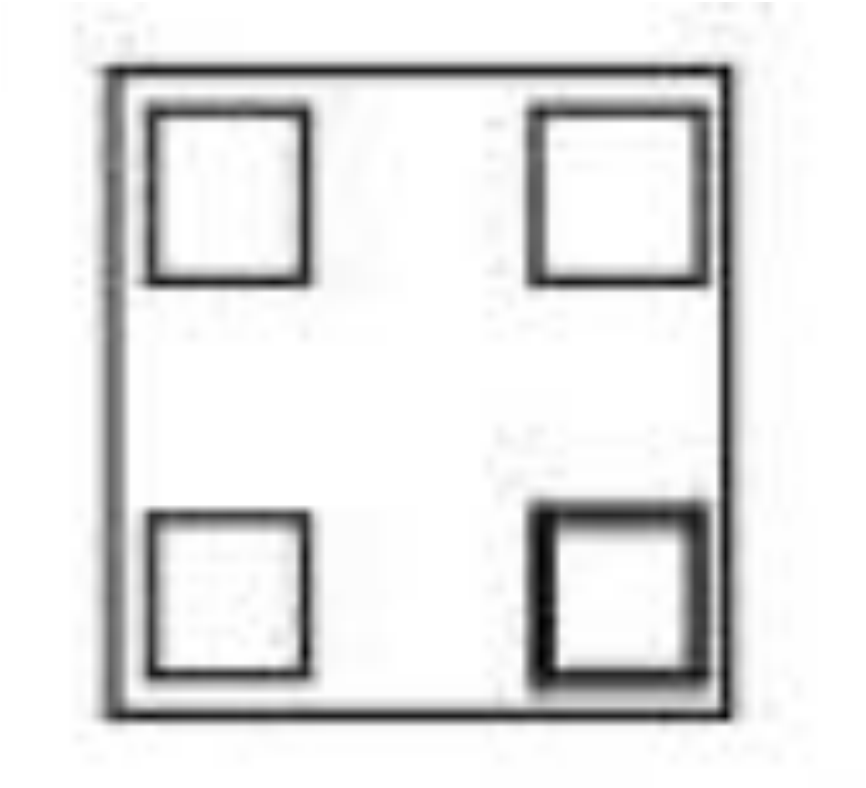
Reflexive and voluntary orienting of visual attention

Müller & Rabbitt 1989



Reflexive and voluntary orienting of visual attention

Müller & Rabbitt 1989



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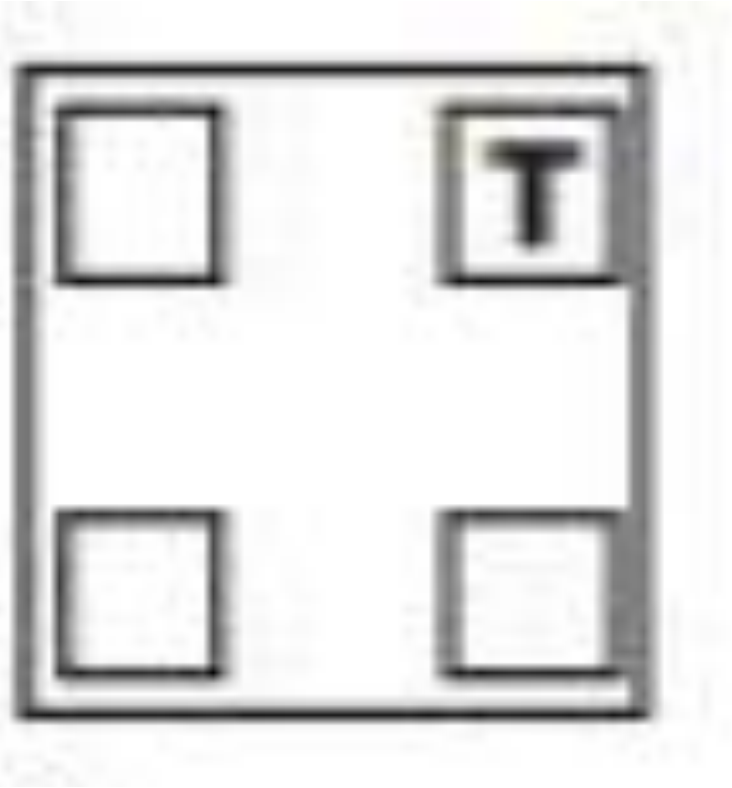
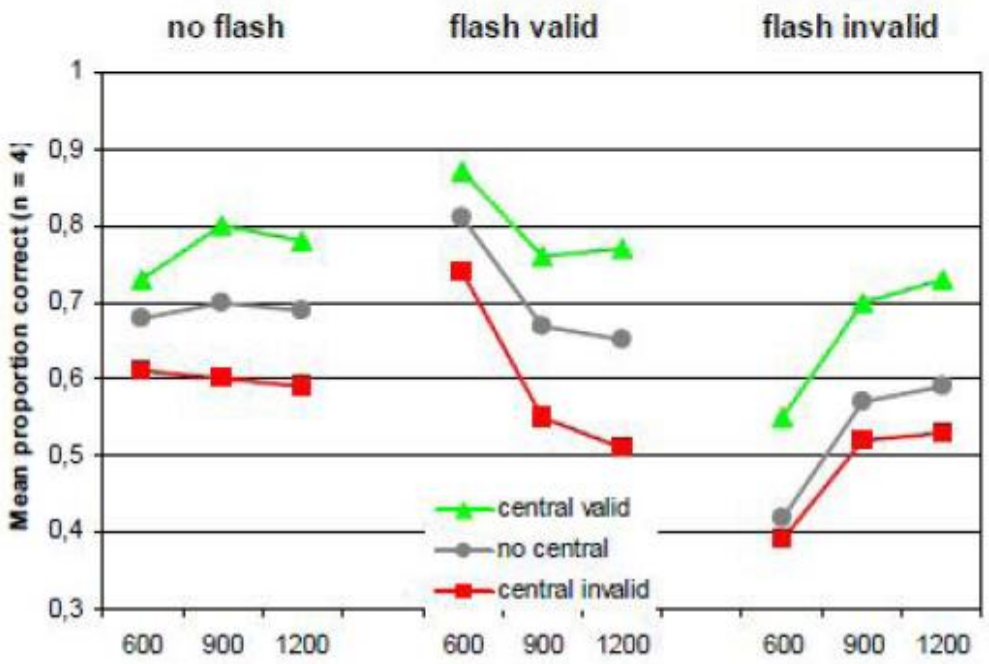


Reflexive and voluntary orienting of visual attention

Müller & Rabbitt 1989

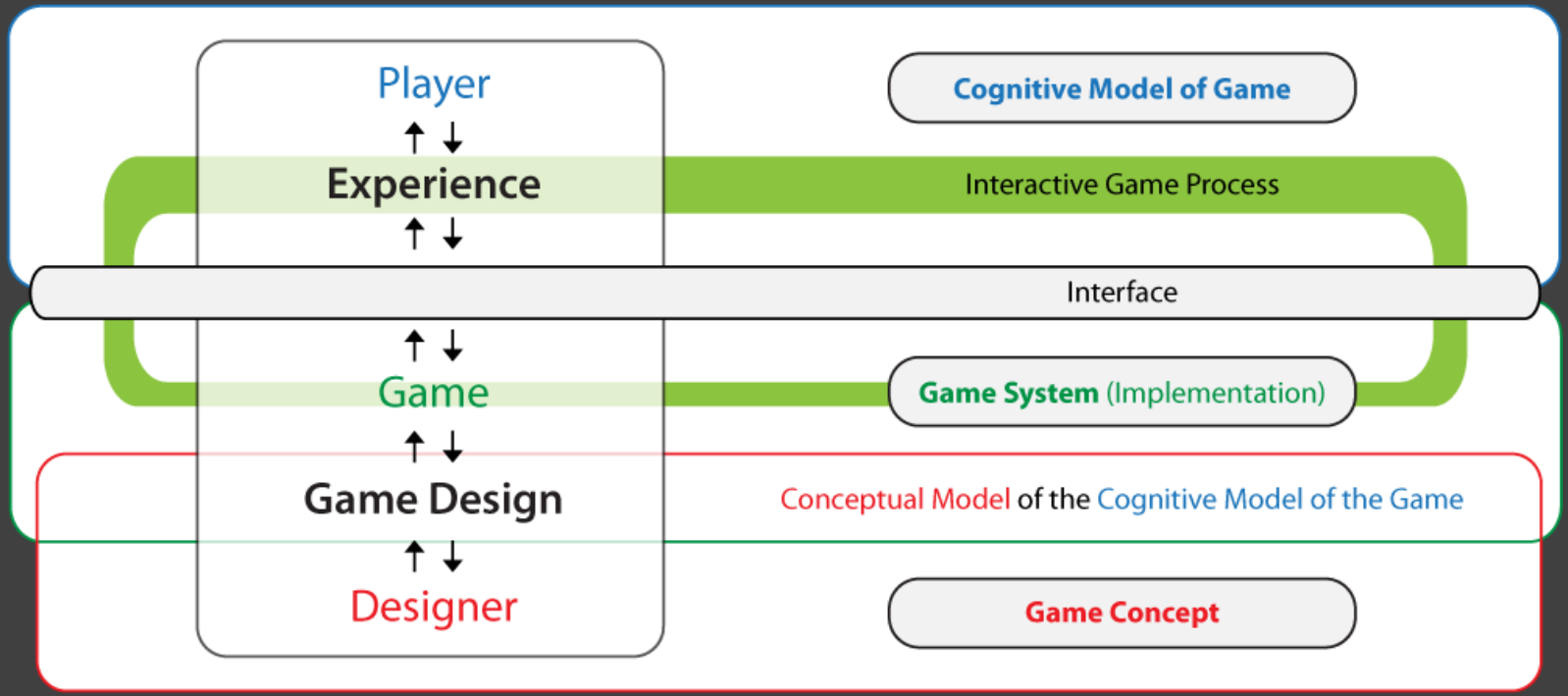



Das Auto.
Think New. Think Technology.
Volkswag
World Rally Champions
Bull
MICHELIN
Castrol
ZF


WRC

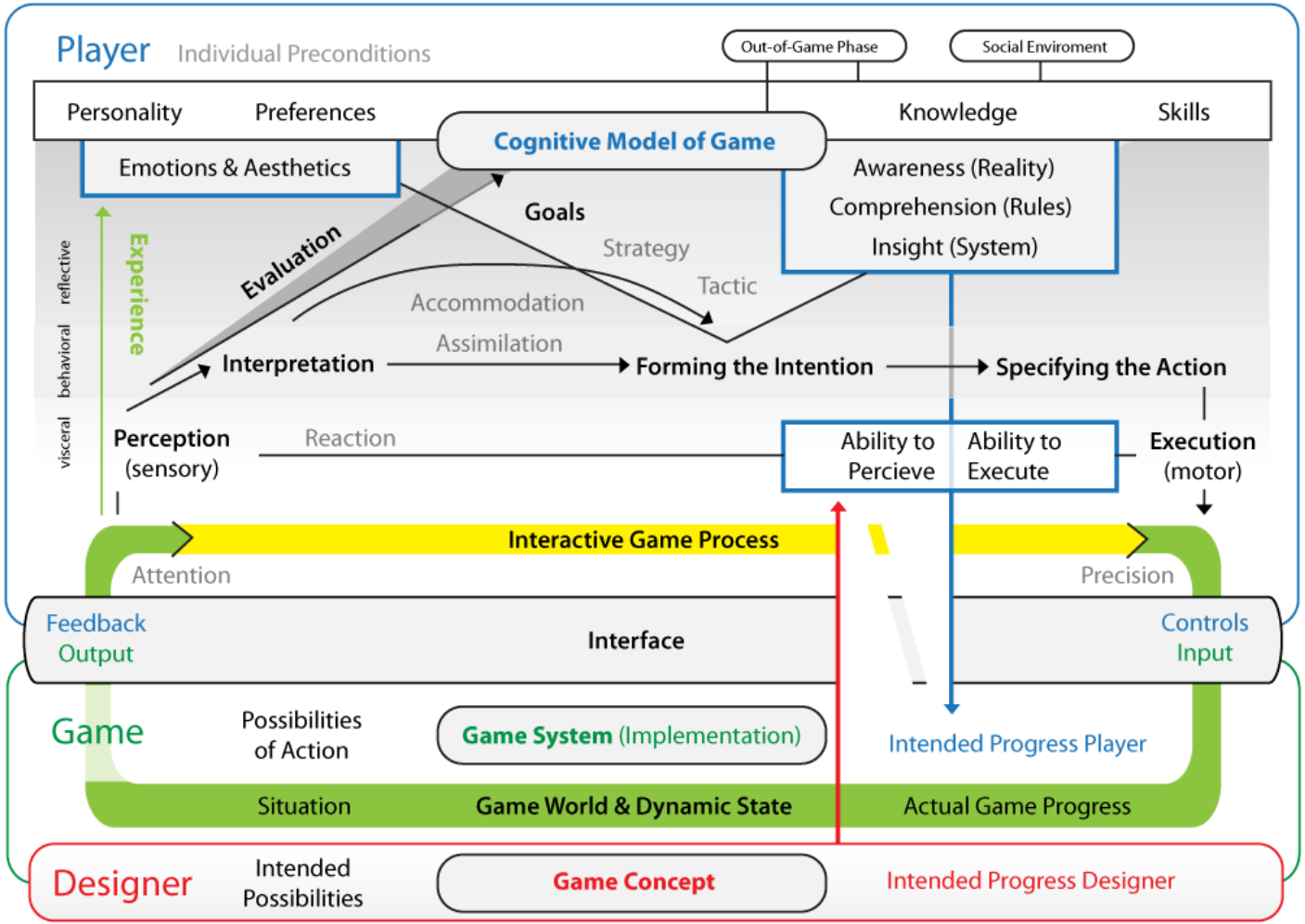
- Attention through animation and blinking
- Create interest by orientation and look direction of NPCs
- React to your user

Interacting



http://bedenk.de/sign/player-game-designer/

- Put yourself in the user perspective
- Use natural and direct interaction
- Bring the interaction to the user



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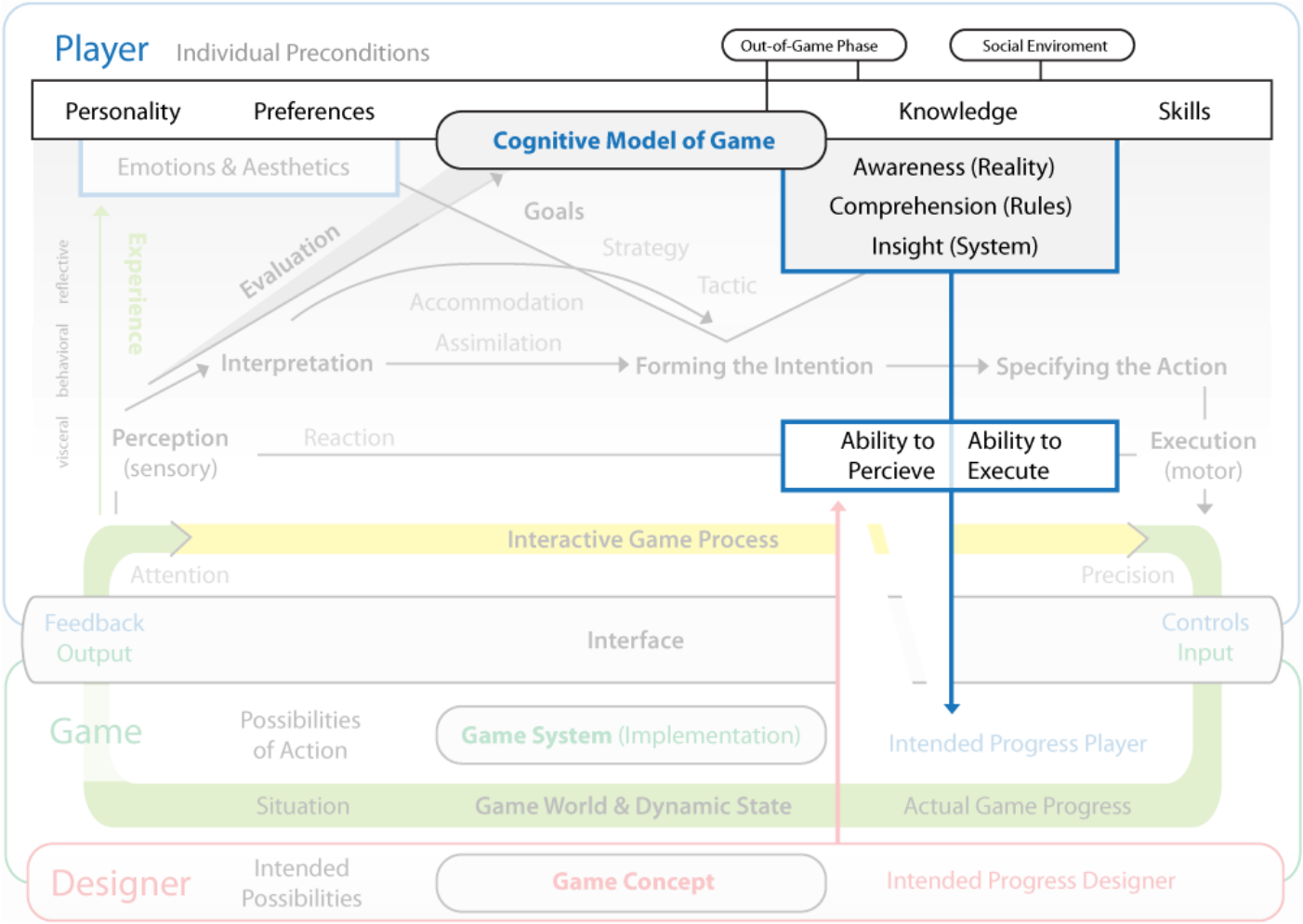

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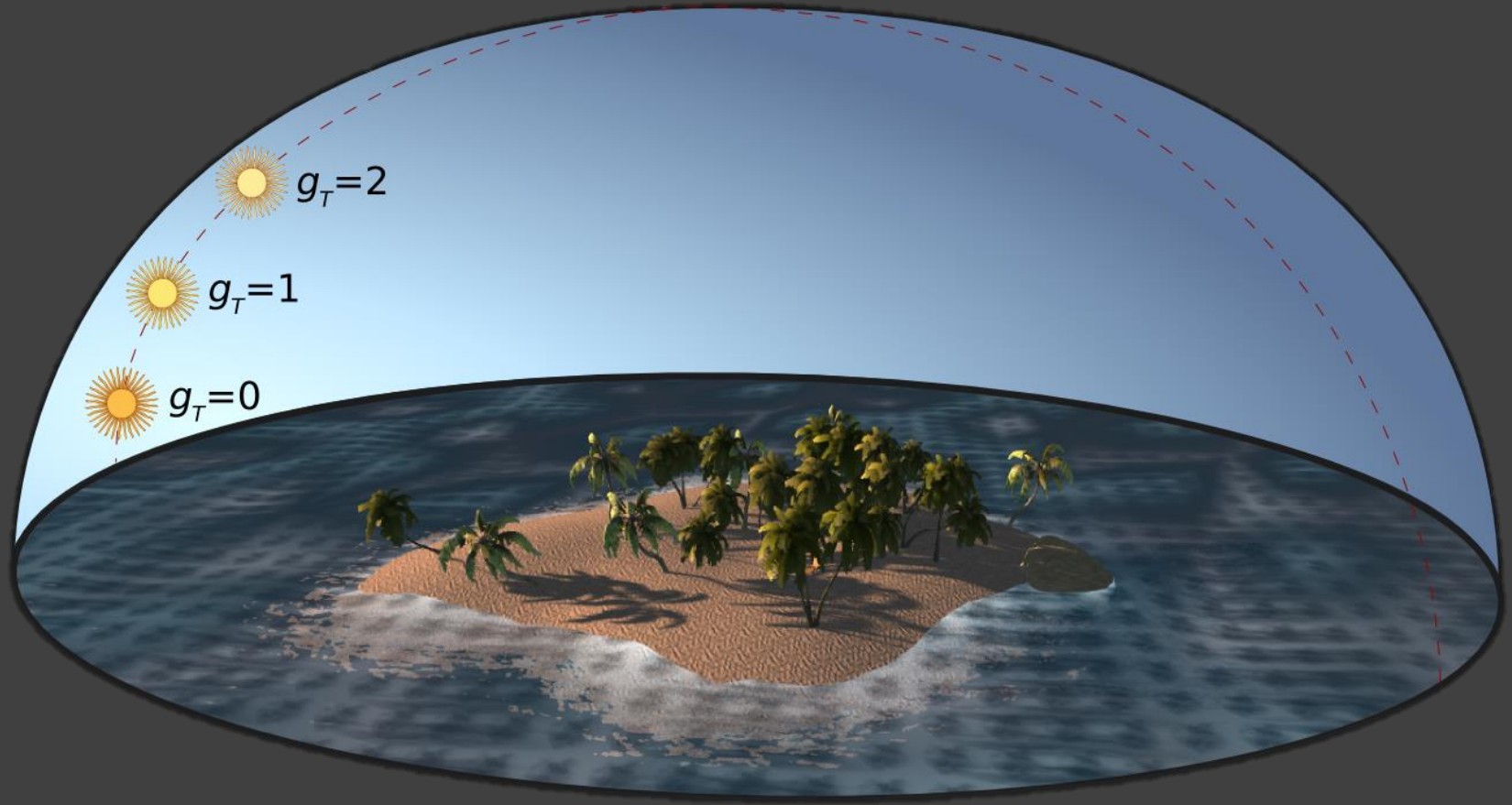
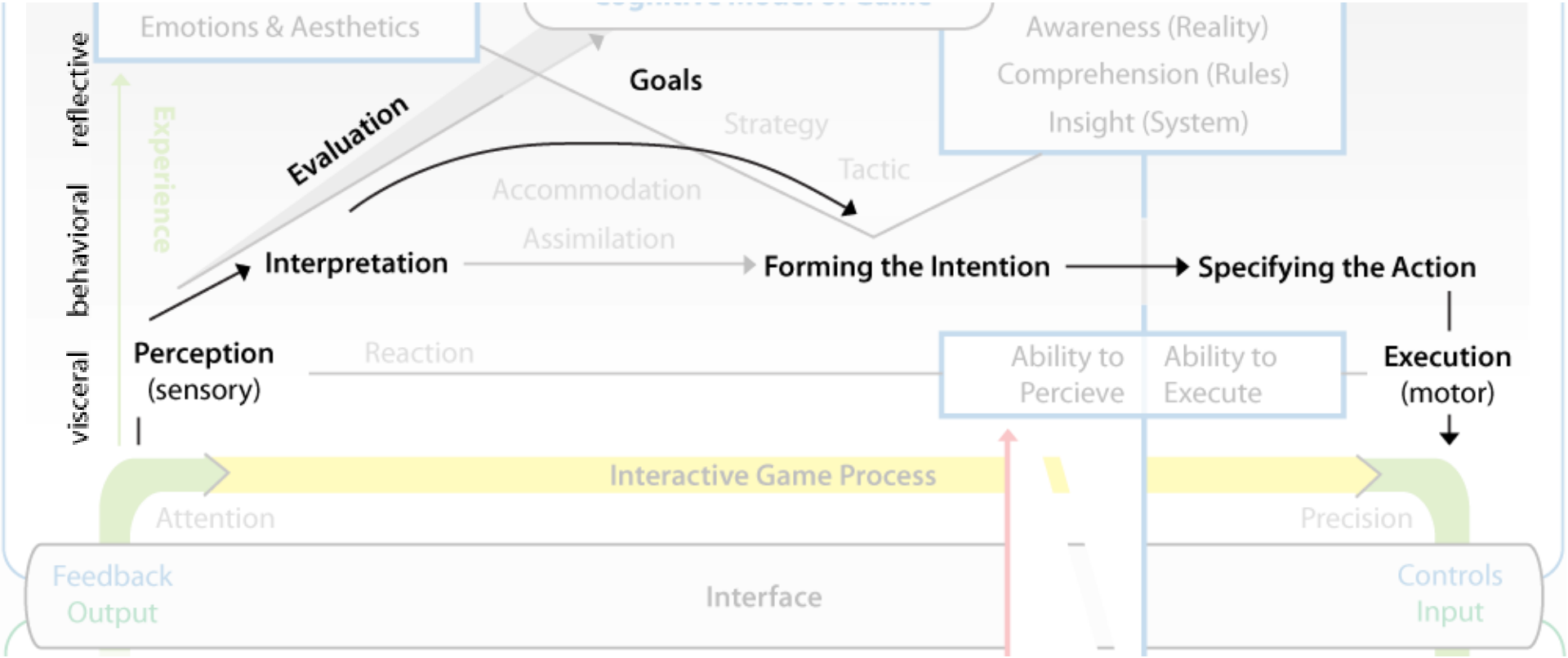


Who turned the clock? Effects of Manipulated Zeitgebers, Cognitive Load and Immersion on Time Estimation
Christian Schatzschneider, Gerd Bruder, Frank Steinicke
IEEE Transactions on Visualization and Computer Graphics (TVCG), Special Issue on IEEE Virtual Reality (VR), page 1--9 - 2016

- Don‘t require unnecessary activeness „simulation fatigue“
- Control expectations i.e. with priming, marketing
- Create meaningful interactions



http://bedenk.de/sign/player-game-designer/


https://www.reddit.com/r/gaming/comments/49vfa2/leaning_on_virtual_desks/

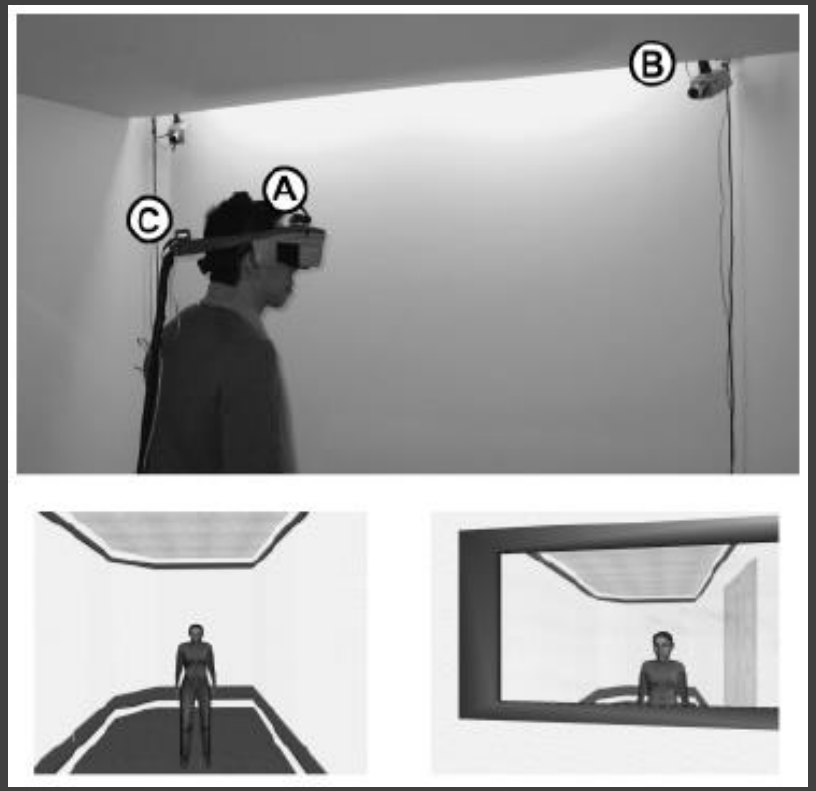
- Avoid shallow interaction
- Give clear cues to possible interactions
- Overlearned actions can cause conflict

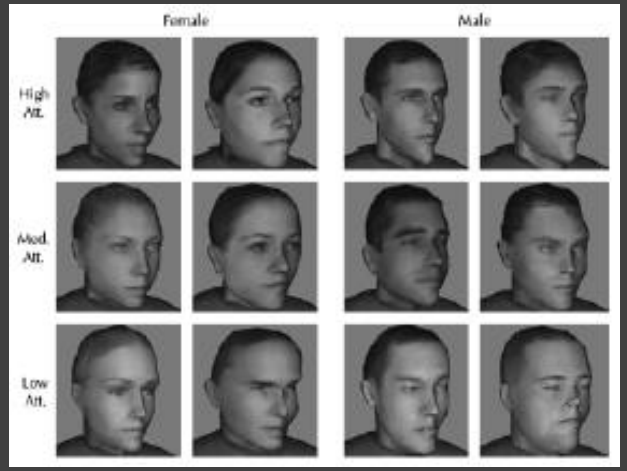
➢ **Don’t try to create everything simulators**

Emotional & Social


5D
attraction

- Easy onboarding to allow for comfort
- “Messy hair”, “Looking stupid”
- Reduce feeling of isolation





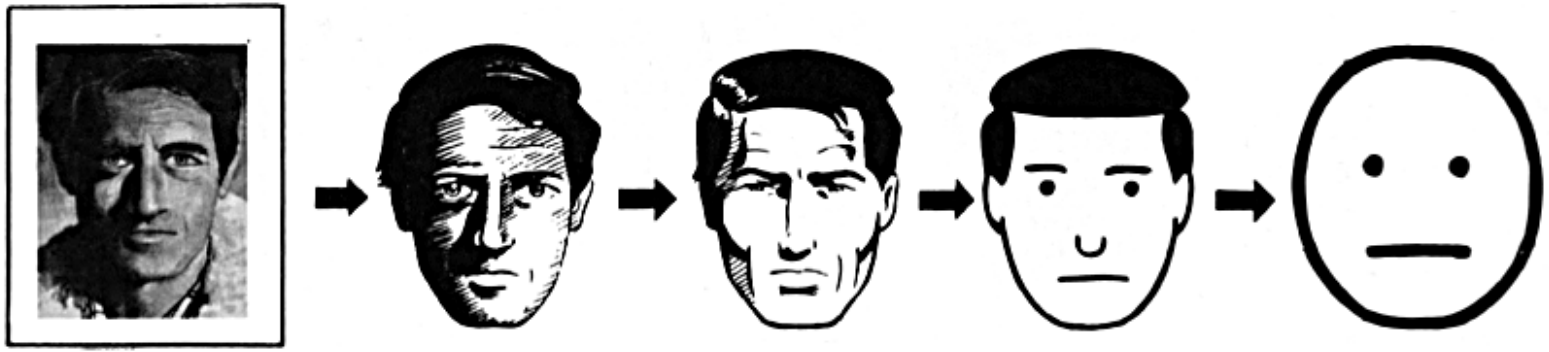
attractive:
M=0.98m

unattractive:
M=1.74m

attractive:
M=7.19 Infos

unattractive:
M=5.42 Infos

Yee, N. & Bailenson, J. (2007). The Proteus Effect: The Effect of Transformed Self-Representation on Behavior. Human Communication Research, 33, 271-290.



Scott McCloud, *Understanding Comics: The Invisible Art* (1994: Harper Paperbacks)

- Think about identity and anonymity
- Avoid uncanny valley of visuals and behavior
- Abstraction better than faulty details

- Allow for social interaction in a common virtual room
- Use strong feeling of empathy
- Plausibility illusion hard to recover when lost

Think Outside the Box

- One avatar looks at everyone else in the room
- Dynamically switch avatars
- Create an never-ending room by rotation
- Dynamically change the surrounding

> make the impossible possible

Make great VR experiences!

A lot of your old tricks still work!

Psychology

Design

VR

Iterative Approach

Technology

THOMAS' VR UX CHECKLIST V0.5

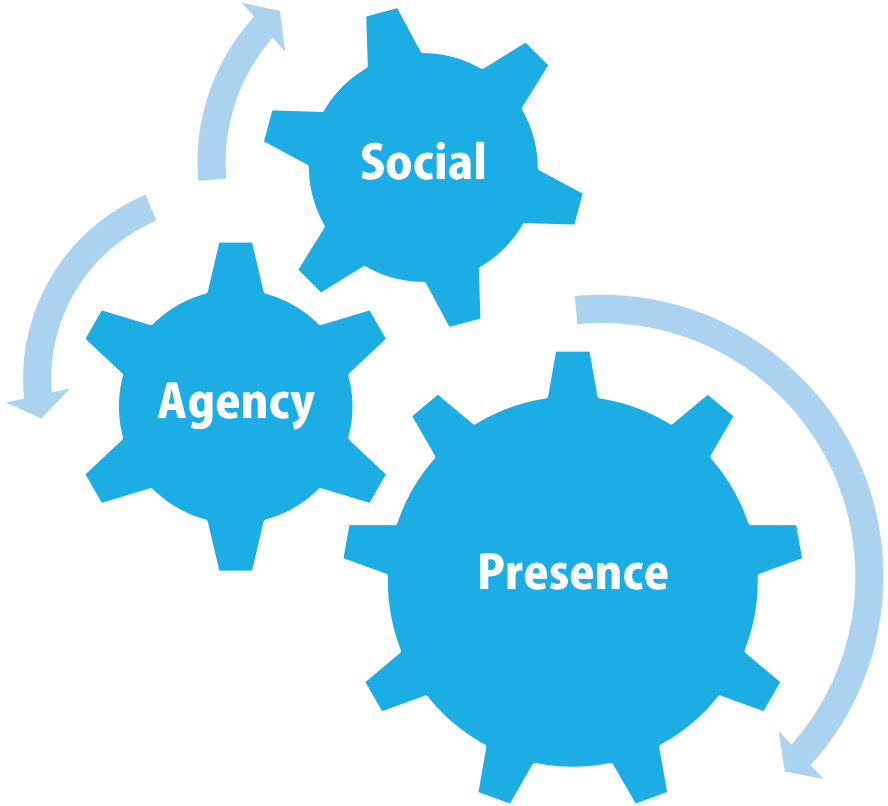
Positive

- meaningful interaction
- natural spacial interface / mapping
- interactive story-telling
- multi-sensory
- emotionally relevant
- technical fidelity
- believable and consistent
- validity through social interaction

Negative

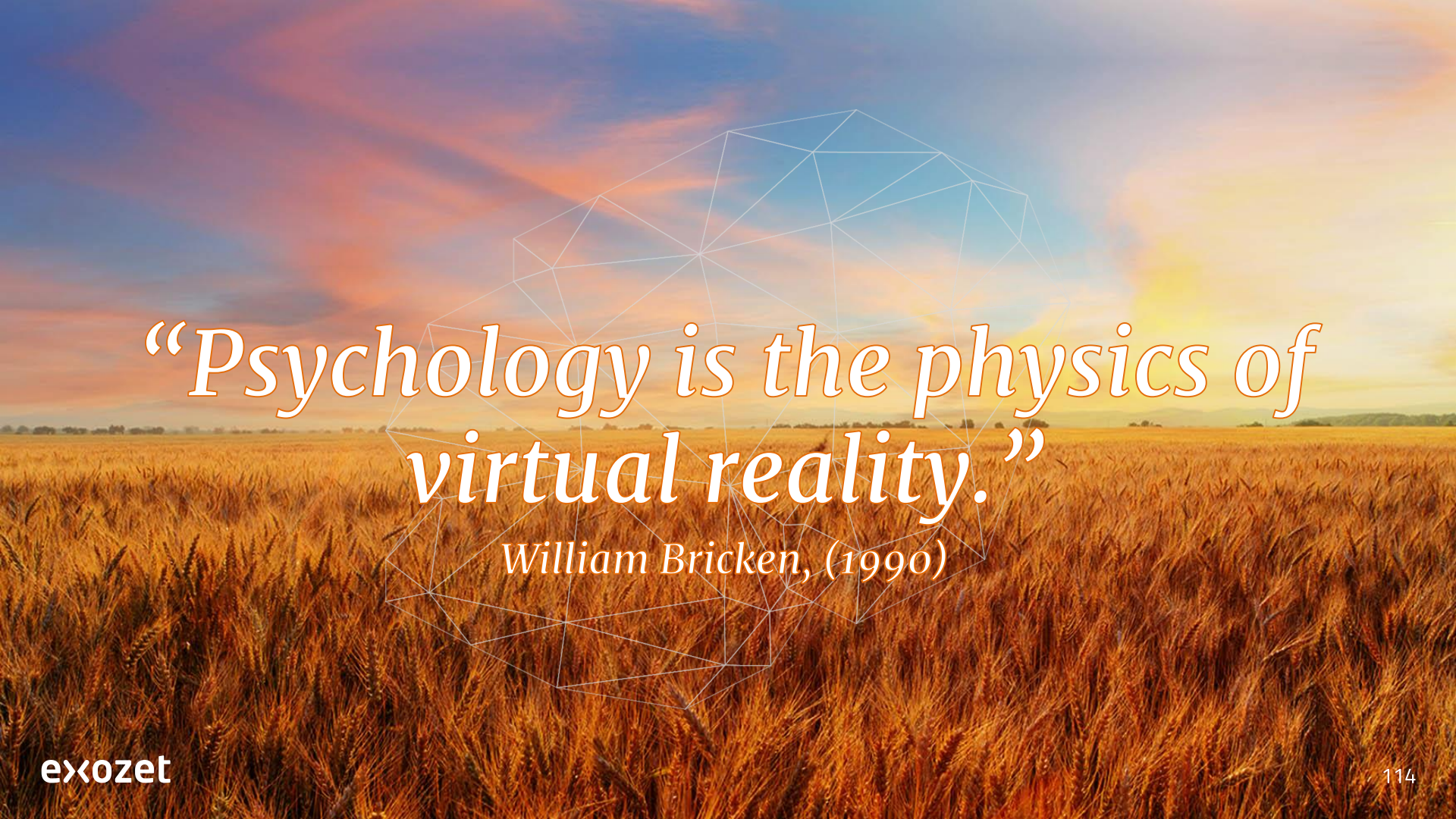
- shallow / no interaction
- non-diegetic GUI
- linear story-telling
- proprioceptive disconnect
- impersistent and conflicting world
- performance lag
- breaking expectations
- void of life

VR AS A NEW MEDIUM



Manipulating Space

Game Changer!


“Psychology is the physics of virtual reality.”
William Bricken, (1990)

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