

# PERCEPTUAL AND SOCIAL FIDELITY OF AVATARS AND AGENTS IN VIRTUAL REALITY

Benjamin R. Kunz, Ph.D.  
Department Of Psychology  
University Of Dayton

# Virtual Reality: A Powerful Medium

- Computer-generated imagery



- Immersion: technical capability of VR system to present interactive virtual environment (VE)



- Presence: sense of *being in* virtual environment (Slater & Wilbur, 1997)



- Fidelity: authenticity; faithfulness to real-world experiences

# Virtual Reality: A Powerful Medium

---

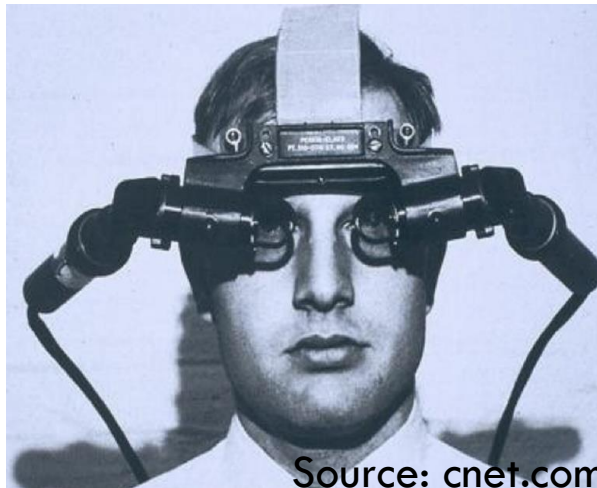
- Imagery + immersion + presence = fidelity

# Virtual Reality: A Powerful Medium

- Imagery + immersion + presence = fidelity



CAVE



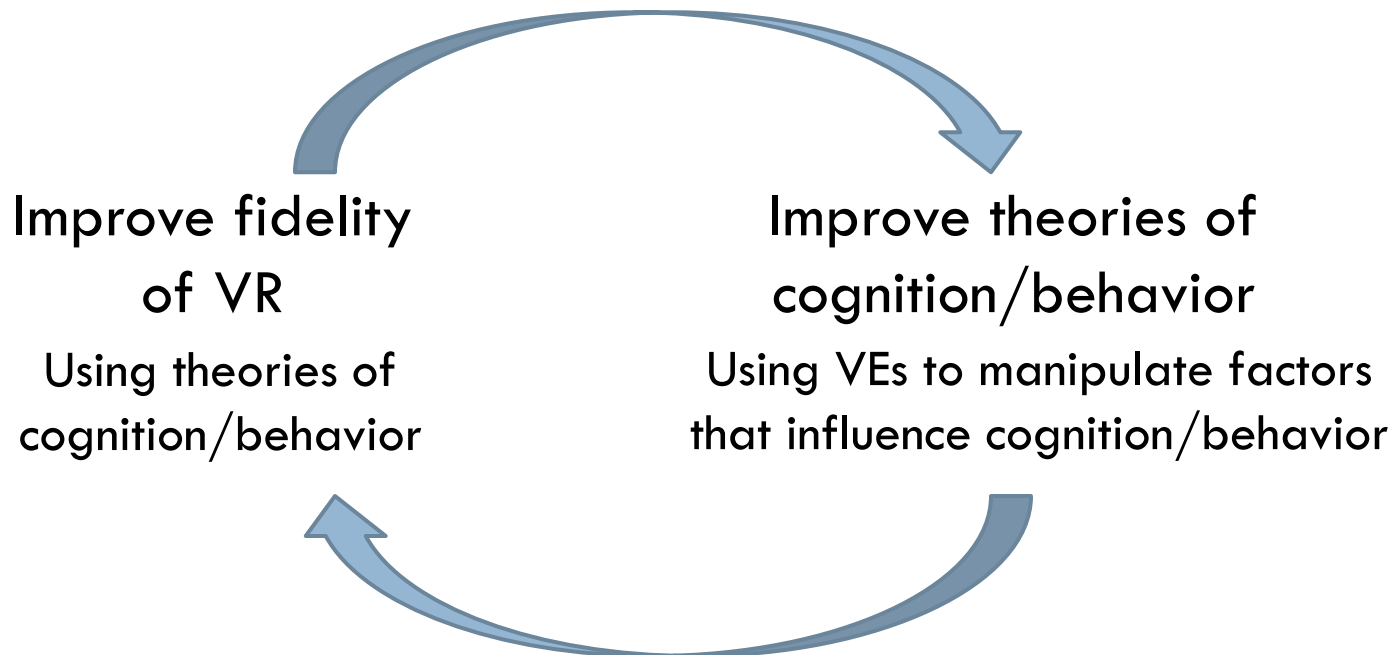
Source: cnet.com



HMD

# Virtual Reality: The Potential

- Greater fidelity = greater utility of VR
  - ▣ Training, education, design/prototyping in VR should transfer to real world (and vice versa)



# Fidelity of Virtual Reality

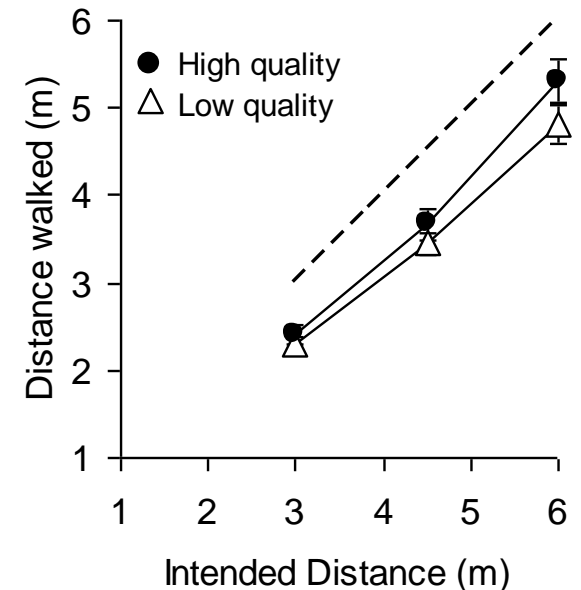
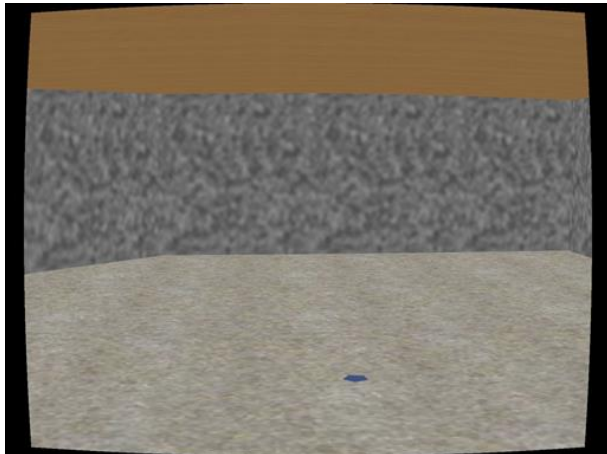
- Spatial fidelity in VE
  - ▣ Perceive VE as plausible environment
- Self-fidelity in VE
  - ▣ Psychologically part of- within VE (presence)
- Social fidelity in VE
  - ▣ Part of a virtual social milieu (social presence)

# Fidelity of Virtual Reality

- VR does not typically depict user's body
  - ▣ Difficult to track and render user's limbs
  
- Visible virtual body (avatar) increases fidelity

# Spatial Fidelity

- Perceive VE as plausible environment
  - How? Provide visual cues about geometry of objects, space
  - Users perceive overall spatial layout
  - BUT distances underestimated in VEs (40-80% of intended)
    - NOT the quality of visuals (Kunz et al., (2009))





# Spatial Fidelity

- Perceive VE as plausible environment
  - ▣ How? Provide visual cues about geometry of objects, space
  - ▣ Users perceive overall spatial layout
  - ▣ BUT distances underestimated in VEs (40-80% of intended)
    - NOT the quality of visuals
    - NOT from missing depth cues
    - PARTIALLY (perhaps) limited field of view
    - PARTIALLY (perhaps) ergonomics/mechanics of HMD

New displays reduce  
(don't eliminate)  
distance compression



Source: extremetech.com

# Spatial Fidelity

- Perceive VE as plausible environment
  - ▣ How? Provide visual cues about geometry of objects, space
  - ▣ Users perceive overall spatial layout
  - ▣ BUT distances underestimated in VEs (40-80% of intended)
  - ▣ So what's missing from VEs?
    - The user's body!

# Spatial Fidelity

- Perceive VE as plausible environment
  - ▣ How? Provide visual cues about geometry of objects, space
  - ▣ Visual body plays role in spatial perception
    - Frame of reference /ground user in VE
    - Scale for perceiving space

# Self Fidelity

- Perceive self as part of- within VE (presence)
  - ▣ How? Provide evidence of consequences of actions
  - ▣ Pit room: some perception of being at edge of pit
  - ▣ BUT subjective reports of *presence* not high
  - ▣ So what's missing from VEs?
    - The user's body!



# Self Fidelity

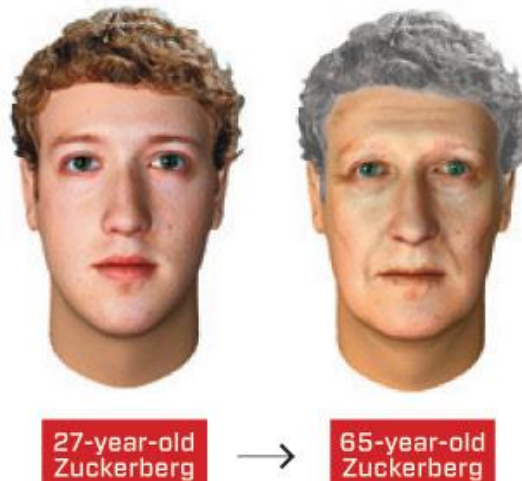
- Perceive self as part of- within VE (presence)
  - ▣ How? Provide evidence of consequences of actions
  - ▣ Visual body plays role in self perception
    - Ownership of virtual bodies/limbs depends on visual/motor/tactile integration

# Self Fidelity

- Perceive self as part of- within VE (presence)
  - ▣ How? Provide evidence of consequences of actions
  - ▣ Visual body plays role in self perception
    - Self perception theory (Bem, 1972): People infer info about selves from their own physical state

# Self Fidelity

- Perceive self as part of- within VE (presence)
  - ▣ How? Provide evidence of consequences of actions
  - ▣ Visual body plays role in self perception
    - Taller avatar → aggressive posturing in negotiations in VR and in real-world (Yee & Bailenson, 2007)
    - Older avatar → increase retirement allocations (Hershfield et al., 2011)



Source: wired.com

# Social Fidelity

- Part of a virtual social milieu (social presence)
  - ▣ How? Other virtual denizens deliver nonverbal communication cues
    - Avatars: virtual characters controlled by humans
    - Agents: virtual characters controlled by AI
  - ▣ Users treat avatars and agents like humans (even if they know they're controlled by AI)
  - ▣ BUT only if avatars and agents employ visible communication cues (eye contact, gestures)



# Social Fidelity

- Part of a virtual social milieu (social presence)
  - ▣ How? Other virtual denizens deliver nonverbal communication cues
  - ▣ Visible bodies (of avatars/agents) influences social fidelity
    - Proxemics: leave socially acceptable personal space between avatars and agents (Bailenson et al., 2003)
    - Conformity: mimic gambling patterns made by avatars and agents (Swinth et al, 2001)

# Social Fidelity

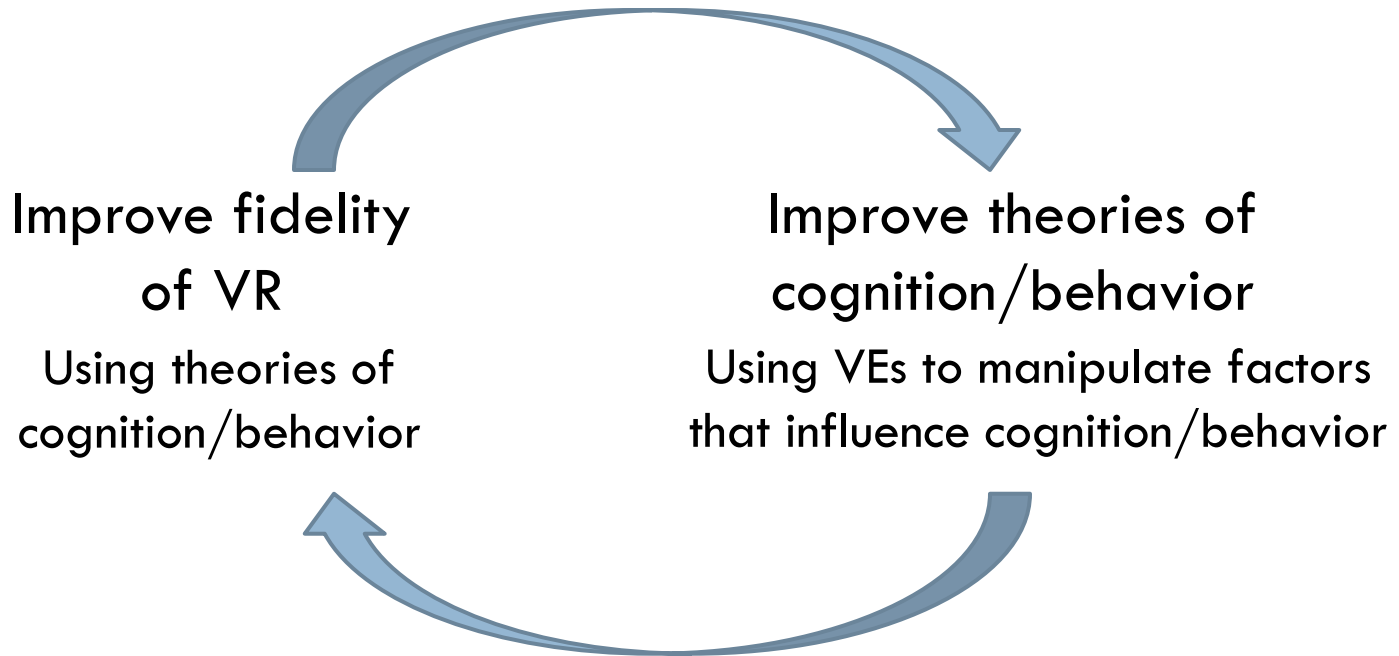
- Part of a virtual social milieu (social presence)
  - ▣ How? Other virtual denizens deliver nonverbal communication cues
  - ▣ Visible bodies (of avatars/agents) influences social fidelity
    - The Chameleon effect (Chartrand, 1999): people liked interviewees that subtly mimicked them (people were unaware of mimicry)

# Social Fidelity

- Part of a virtual social milieu (social presence)
  - ▣ How? Other virtual denizens deliver nonverbal communication cues
  - ▣ Visible bodies (of avatars/agents) influences social fidelity
    - Favorable feelings toward agents who mimic user's body language (Bailenson & Yee, 2006)
    - Mutual gaze in a virtual classroom (Bailenson et al., 2003)



# Virtual Reality: Summary



- ▣ Visual body contributes to spatial, self, social fidelity of VE
  - Embodied cognition: study of the mind in the context of its relationship to a physical body that interacts with the world
  - Cognitive processes grounded in sensory-motor representations

# Virtual Reality: Challenges Ahead



- Improving motion capture to improve avatar fidelity
  
- Visual body contributes to spatial, self, social fidelity of VE
  - Embodied cognition: study of the mind in the context of its relationship to a physical body that interacts with the world
  - Cognitive processes grounded in sensory-motor representations

# Thank you!

□ Questions?