PERCEPTUAL AND SOCIAL FIDELITY OF AVATARS AND AGENTS IN VIRTUAL REALITY

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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

Source: cnet.com
Virtual Reality: The Potential

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

Diagram:

- Improve fidelity of VR
  - Using theories of cognition/behavior
- Improve theories of cognition/behavior
  - Using VEs to manipulate factors that influence cognition/behavior
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)

(Biocca, 1997; Lee, 2004; Wirth et al., 2007)
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)

![Graph showing the comparison between intended distance and distance walked for high and low quality visuals.](image)
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

Mohler, Creem-Regehr, Thompson, & Bülthoff (2008; 2009)
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!

http://www.bbc.com
Slater, 2009
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

Lenggenhager et al. (2007)
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

- Improve fidelity of VR
  - Using theories of cognition/behavior

- Improve theories of cognition/behavior
  - Using VEs to manipulate factors that influence cognition/behavior
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?