Wayfinding

- Cognitive element of navigation
  - Determining a path
  - Acquiring spatial knowledge
  - Using spatial knowledge
- Wayfinding in virtual worlds can be used to improve navigation in
  - Real world
  - Virtual world
Why is Wayfinding in 3D UIs Hard?

- Virtual worlds lack real world cues
  - Missing physical motion constraints
    - Walls you can walk/fly through,…
  - Lack of vestibular motion cues
    - Use of virtual motion techniques or other nonisomorphic motion techniques
  - Constrained visual cues
    - Restricted FOV, fixed focus, low frame rate, lack of detail (simple shading models and low-res textures),…
  - Mismatch between real and virtual motion
    - Latency

Why is Wayfinding in 3D UIs Hard?

- Distances are underestimated in first-person immersive VEs (e.g., J. Loomis and J. Knapp, 2003)
  - See target and then “blind walk” (without seeing the world) to it. Users walk shorter distances when they see the target in VE than when seeing it in RE (i.e., they underestimate distances in VE)
  - Experiments with a VE co-located with a RE it replicates:
    - Insignificant underestimation for photorealistic (PR) VE
      V. Interrante et al., Presence 2006
    - Significant underestimation for non-photorealistic (NPR) wireframe VE
      L. Phillips et al., APGV 2009
    - Significant underestimation for NPR wireframe combined with PR VE (NPR+PR)
      L. Phillips and Interrante, IEEE VR 2011
  - Note: “Blind walking” experiments differ in how light is obscured (e.g., eyes closed vs. blindfolded)
    - Blind walking results in greater underestimation when light is more fully obscured (e.g., more opaque blindfold)
      JA Jones et al, IEEE VR 2013
Distance Underestimation in VEs
Co-located PR VE Phillips & Interrante, IEEE VR 2011

Distance Underestimation in VEs
Co-located NPR VE Phillips & Interrante, IEEE VR 2011
Distance Underestimation in VEs
Co-located NPR+PR VE Phillips & Interrante, IEEE VR 2011

Wayfinding

- User makes decisions (whereabouts, trajectory) by processing input (environmental information) to produce output (travel)
- Environmental information stored in LTM as cognitive map
  - An animal's mental "map" of its environment representing its spatial knowledge — E. Tolman, 1948
- Wayfinding uses and builds cognitive map to gain
  - Spatial orientation (knowledge of position and orientation)
  - Situation[al] awareness (spatial orientation + understanding of cognitive map + ability to predict)
    - "perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" — M. R. Endsley, 1988
- Task-specific