Small is (often) Beautiful

Interaction as if Human Functional Neuroanatomy Mattered

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Our research

- Cognitive Science of immersion
- How human cognitive architecture interprets the "richness" of the sensory environment and context it provides
  - Mental representation at perceptual and cognitive levels
  - Attention and spatial indexing (FINST theory)
  - Functional neuroanatomy : e.g. "2 visual systems" theory
  - Functional and apparent space constancy
- Impact of spatial manipulations, tranformations

Metacognitive Gap

- Intuitions about thoughts,goals and plans ("folk Psychology") are reasonably accurate
- Intuitions about how people see, hear, and remember are very inaccurate
- Lack of awareness of the limits of intuition is the "Metacognitive gap"

Space constancy

- Space Constancy is the perception of a stable visual world with consistent rules
  - Functional space constancy (FSC): Ability to interact w. targets through pointing, grasping, etc.
  - Apparent space constancy (ASC): Ability to make accurate judgments about the environment
- Space constancy contributes to location judgments, eye movements & action
- Lack of SC causes performance errors and simulator sickness

Our big displays

- NewMIC Immersive Theatre: 3 walls,pivots
- UBC Landscape Immersion Lab panorama display for groups < 15
- UBC eLumens 3 meter dome (4 person)

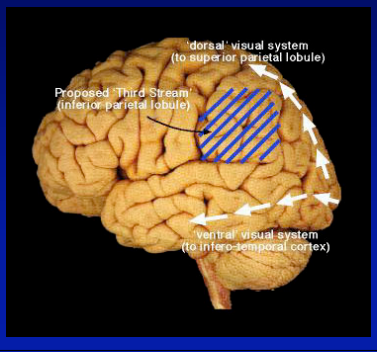
Why have a big display?

- You have too much money
- You want a bigger lab
- You have a large audience
- To create a broad visual context or virtual world
  - Embodied interaction
- To play with space
  - Viewpoint manipulations (e.g. zooms, rotations, etc.)
  - Spatial transformations (e.g. pliable zooms)
  - Navigation and wayfinding

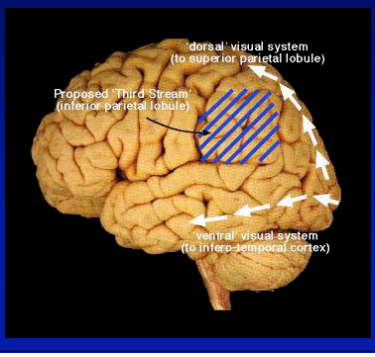
My position on large displays

- Presence of room context with a smaller display may help reduce illusions and errors
- Lacking real-world context, larger, more immersive displays *must* support space constancy
- Functional Neuroscience can help predict performance on a given task/stimulus/display
  - Lack of feedback may improve performance
- Individuals differ, customize for personal equation

This is your brain



This is your brain in VR



Same brain, eh?*

- **Moore's law: Transistor density doubles every 24 months**
  - Disk density doubles every 12 months
  - Brain volume doubles every 3 x10^7 months

(obligatory Canadian content)

Big displays and the brain

- **Large display (>>30 deg) advantages**
  - Support learning large-scale virtual environments (wayfinding)
- **Large display (>>30 deg) disadvantages**
  - May produce visual and multimodal illusions if context is wrong
  - May require more accurate synchrony of multimodal events and rapid updating for SC
  - May need special display technologies for SC
- **Reducing immersion can salvage performance**

Big displays vs. the brain

- **Sampling flickering stimulus (raster) during saccade disrupts Functional SC (eye movements)**
- **Misleading visual context disassociate:**
  - Apparent SC (cognitive measures) if visual target
  - Functional SC (pointing) if auditory target
- **Interacts with individual differences**
- **2-visual system theory suggests a range of illusions may be produced with similar effects for cognition vs. pointing**

Recent Results (Po)

- Localize target with voice or pointing
- Displaced frame leads to verbal errors (ASC)
  - 3 out of 7 males, 7 out of 7 female subjects made errors
- Most of the subjects that made verbal errors did not make pointing errors (FSC) w/o cursor.
  - 6 out of 10 were correct
- If they have a cursor (FSC -> ASC) 0 are accurate
- Time lagged cursor (>FSC) 3 out of 6 are accurate
- Exactly as predicted by 2 visual systems theory

Current research projects

- Personal equation-- can we customize environments for users' individual perceptual, attentive, cognitive, and motor characteristics?
- Multiple users, same time & place
  - Spatial language, shared pointer, multiple pointers
  - Multiple shared displays
- Multiple users at a distance
  - Heterogeneous displays
  - Attribution of causality within/across displays to specific user (or agent)
  - Support for metarepresentation

Conclusion

- Immersive displays should support space constancy
- Functional Neuroscience can help predict performance on a given task/stimulus/display
- Use of room context with a smaller display may reduce illusions and errors
- Low-immersion interaction (e.g. lack of visual feedback) may also improve performance
- Individuals differ in effects, so customize for their "personal equation"