Spatial and semantic memory for kinesthetic learning in large-scale visual displays

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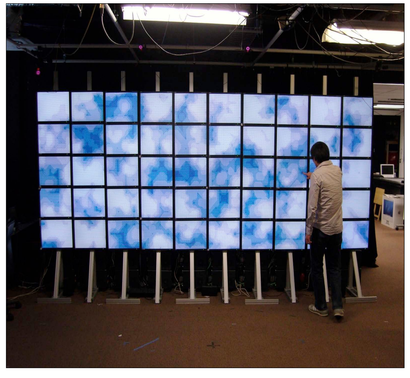
ABSTRACT

The advent of large-scale, high definition interactive computer displays make it possible to investigate the relationships between the scale of visual stimuli, active locomotion and spatial memory processes. The present study examined how efficiently observers can encode both episodic and implicit memories of the semantic and spatial information present on a large (3m wide) high definition computerized display. Research shows that physically larger visual displays improve cognitive performance on spatial tasks through kinesthetic learning. However, it is unclear whether kinesthetic learning uniquely enhances spatial memory compared to semantic learning, and whether enhanced memory performance affects different mnemonic processes such as familiarity and recollection. Participants performed a standard episodic memory task in which they were required to recognize whether or not they had seen a single noun during the study phase of the experiment. Participants gave verbal confidence ratings for yes/no responses, and also gave confidence ratings for their ability to walk and point to the spatial location of remembered items (which were no longer visible during the test phase). The confidence ratings allowed for ROC analysis of memory performance, including the estimation of the strength of recollection and familiarity processes. On the whole, participants were more sensitive (better d-prime) and had stronger bias to identify items and previously seen for items that were viewed at eye level during encoding. This study will have implications for both spatial memory and wayfinding in large-scale immersive displays

GOALS

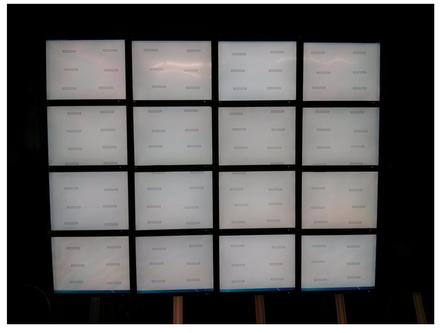
- Distinguish between spatial and semantic learning in large-scale immersive displays
- Examine relationship between kinesthetic learning and spatial navigation
- Consider options to enhance user performance on large-scale interactive displays
- Examine relationship between confidence and accuracy of familiarity and recollection



MATERIALS/METHODS

Materials:

- Large, high resolution 16 monitor touch screen display
- OptiTrak head and pointer tracking for spatial navigation
- Likert scale to measure confidence levels for semantic accuracy and text location



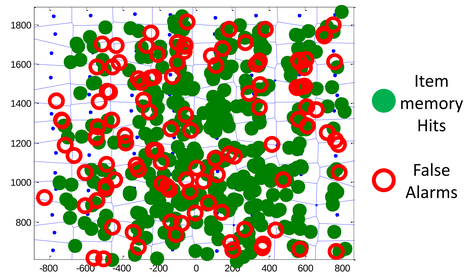
Behavioral experiment:

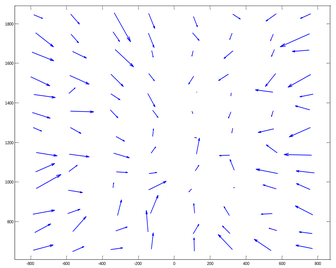
Participants were required to recognize whether or not they had seen a single noun during the study phase. Stimuli are word sentences of the form subject, verb, and object, selected from MRC Psycholinguistic Database, with controls on word frequency, word length, and concreteness. Participants gave verbal confidence ratings for yes/no responses, and also gave confidence ratings for their ability to walk and point to the spatial location of remembered items (which were no longer visible during the test phase). They were then given a memory test. Participants' head and pointing finger locations were tracked in 3D during study and test phases, which allowed measurements of locomotion behavior and of spatial source memory accuracy

Memory test for participants' responses include:

1) Semantic memory - their reply to missing word in sentence and level of confidence.
2) Spatial memory – their ability to find location of text on display and level of confidence

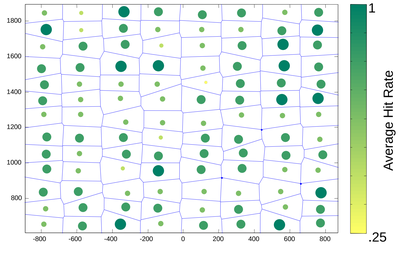
RESULTS



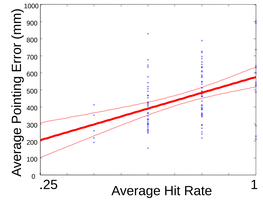


Hit item location pointing errors refer to the center of the display

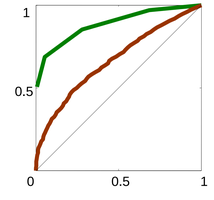
Average recognition memory hit rates



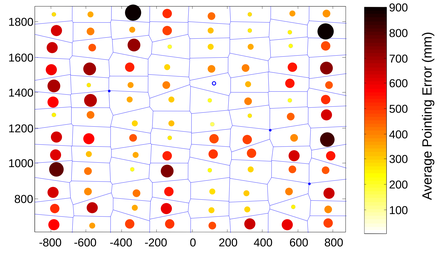
Recognition memory inversely correlated with spatial source memory



ROC analysis:
Item memory better than spatial source memory



Average hit item location pointing error



CONCLUSIONS & FUTURE WORK

- Word recognition memory and spatial source localization were inversely correlated
- Individual participants showed better spatial source performance for items at their own eye height
- Neuroimaging of the roles of spatial scale and its effects on the relationship between recognition memory and spatial source localization judgments
- Practical applications for large displays