

An In-Depth Look at the Benefits of Immersion Cues on Spatial 3D Problem Solving

Goals

- ✚ Explore use of fNIRS in evaluating new immersive technologies
- ✚ Determine benefits of stereoscopic display in spatial reasoning
- ✚ Evaluate the use of fNIRS in HCI setting
- ✚ Assess the immersion of users in an interactive stereoscopic environment with haptic feedback

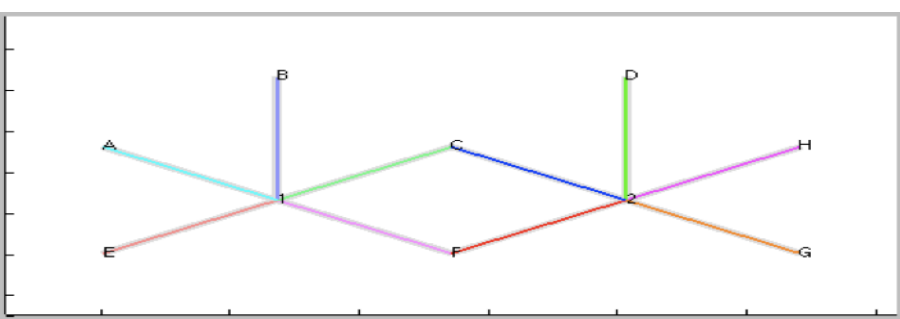
Findings and Future Work

Findings:

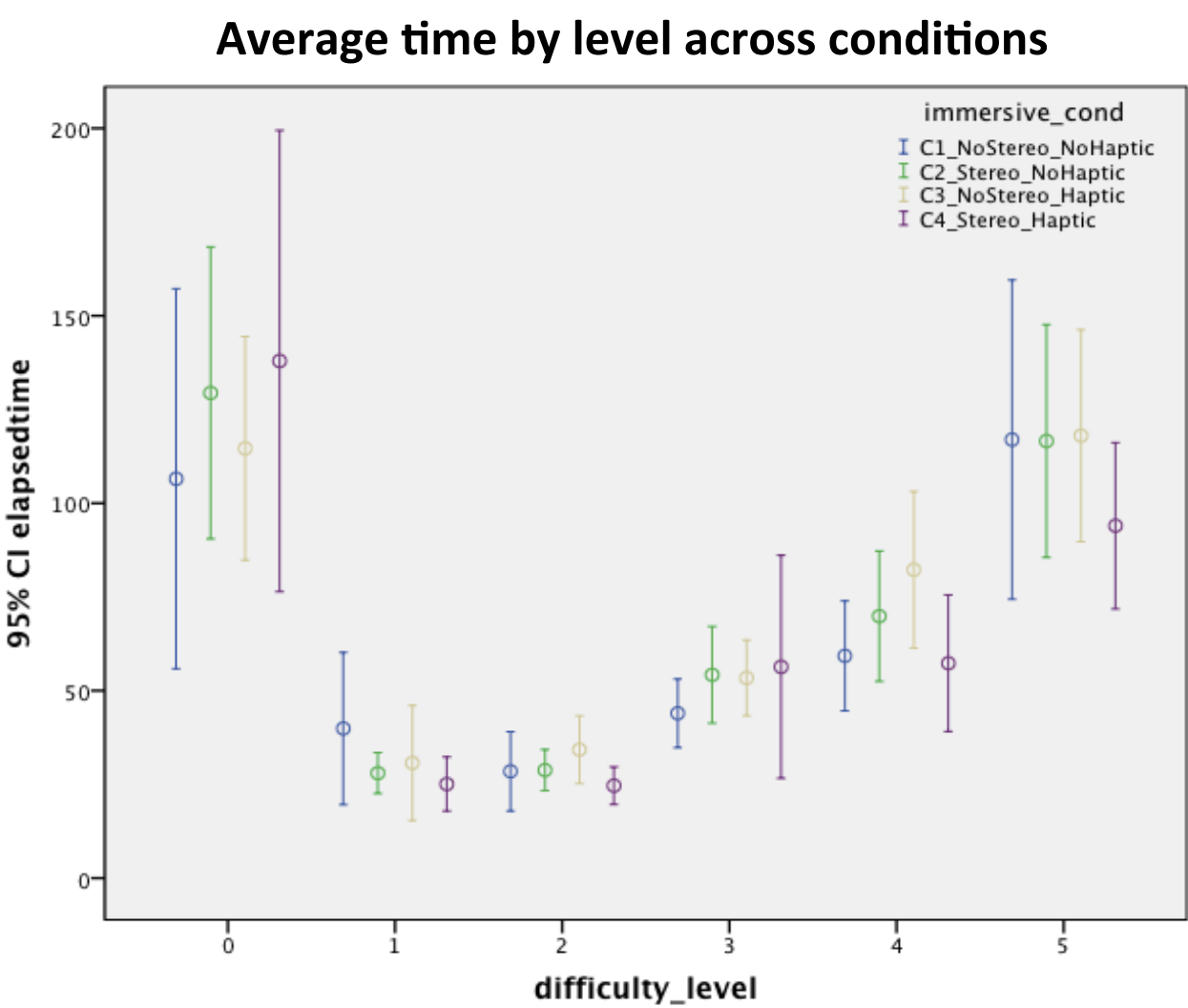
- ✚ Collected data from 48 participants, over 4 immersive conditions
- ✚ Traditional data measures (i.e. time, presence) do not show statistical significance between conditions
- ✚ Preliminary analysis shows differences in fNIRS signal, depending on difficulty level and immersive cues. The response varies by fNIRS channel location.

Future Work:

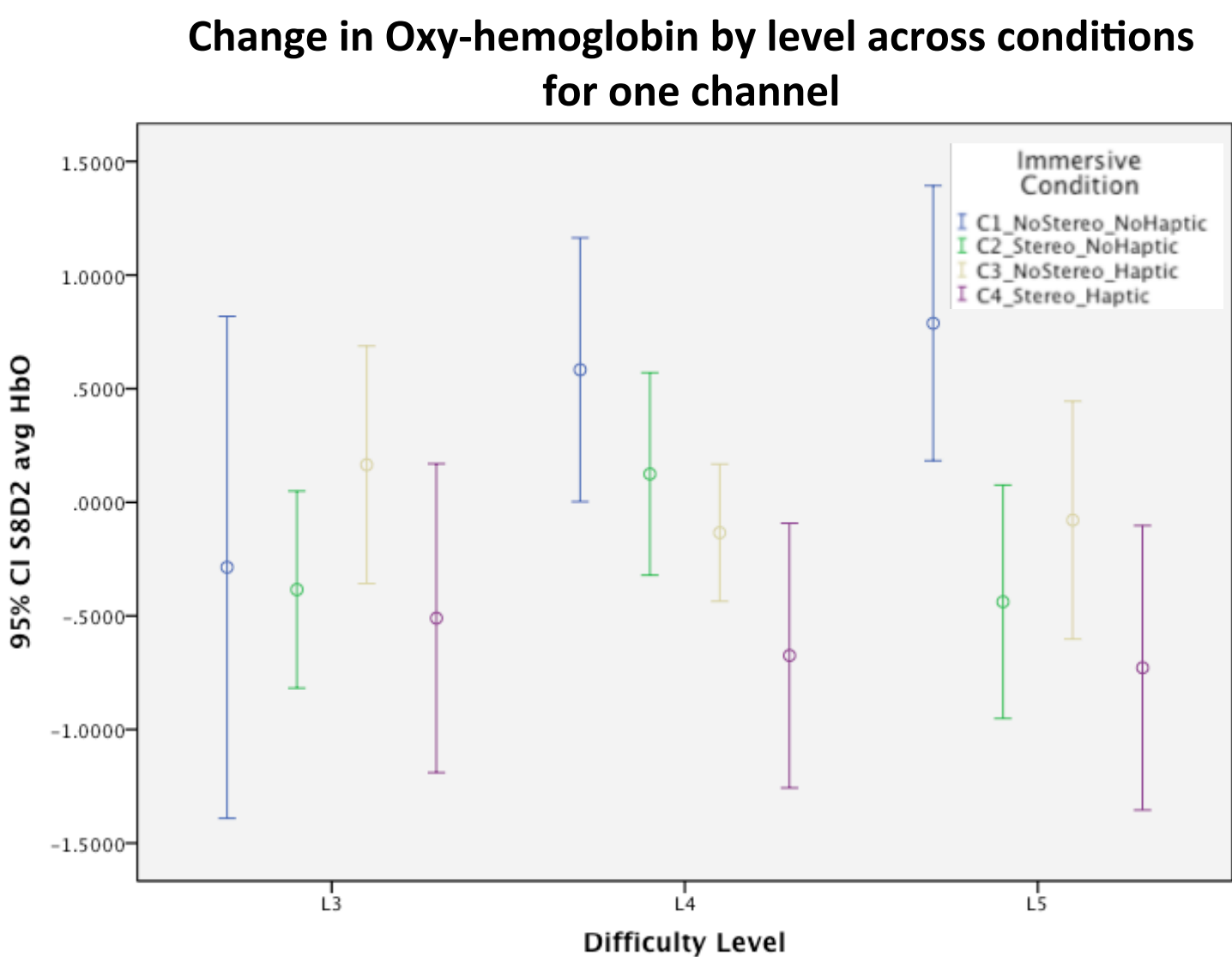
- ✚ Deeper analysis on the spatial activation patterns
- ✚ Combine brain activity with other measures to distinguish interaction-related workload from task-related workload
- ✚ Establish best practices for using fNIRS to deeply investigate user experience with novel input devices



10 channels of brain data from fNIRS device



The time to complete each level, while not consistently statistically significant between conditions, does increase with difficulty level.



The fNIRS response reveals differences in brain response, depending on immersive condition, particularly in Level 5 (most difficulty)

Methodology

zSpace:

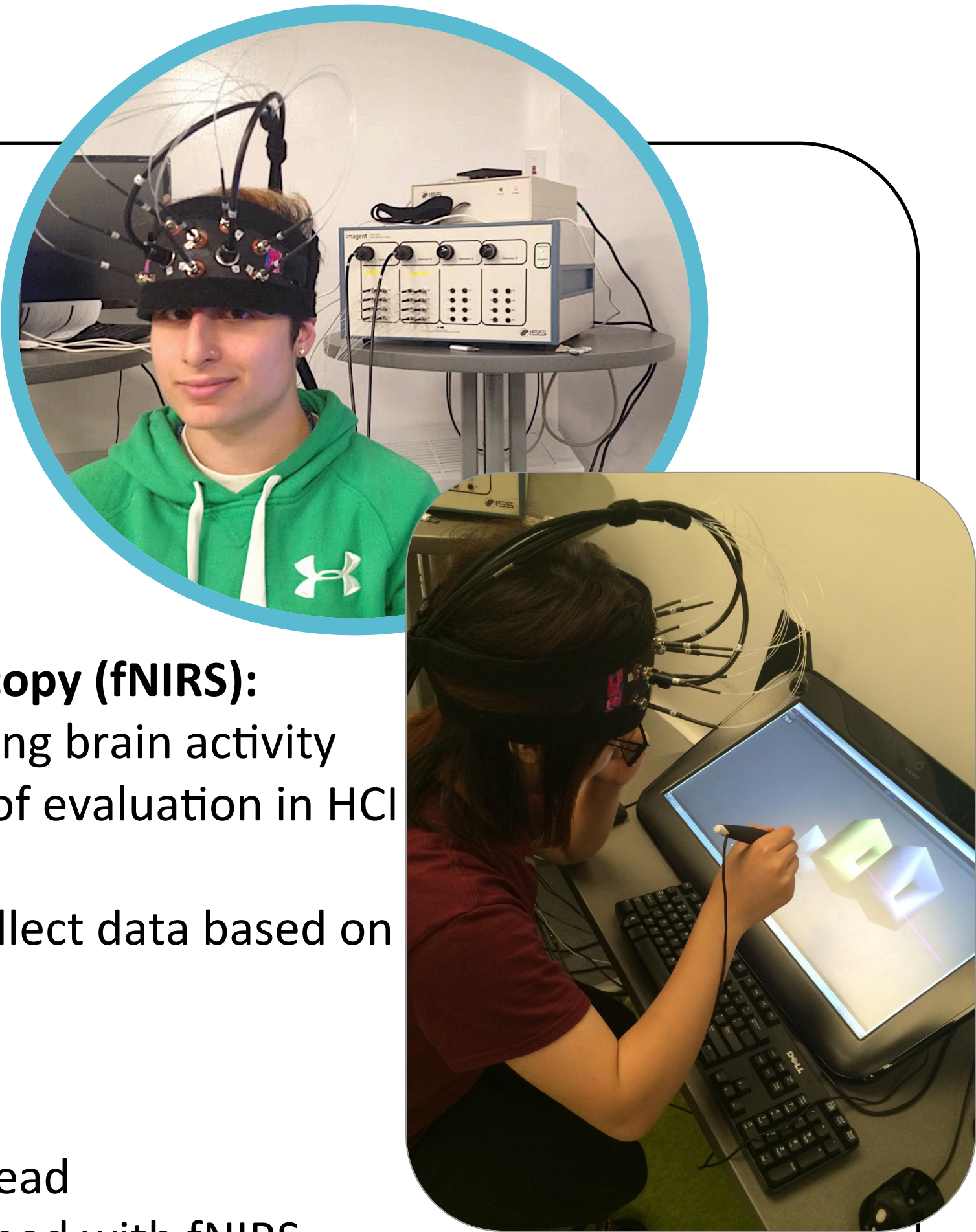
- ✚ Head tracking with 3D glasses
- ✚ Stereoscopic Vision
- ✚ 6 Degrees of Freedom
- ✚ Haptic feedback

Functional Near-Infrared Spectroscopy (fNIRS):

- ✚ Non-invasive method of measuring brain activity
- ✚ Proven useful as a new method of evaluation in HCI settings
- ✚ 10 sensors and two detectors collect data based on hemoglobin levels

Testing zPuzzle with fNIRS:

- ✚ Measurements taken of user's head
- ✚ Baseline brain activity is established with fNIRS
- ✚ zPuzzle conditions are assigned and completed
- ✚ Post-task survey administered with NASA-TLX and MEC-SPQ
- ✚ Paper and pencil tests examine spatial reasoning skills

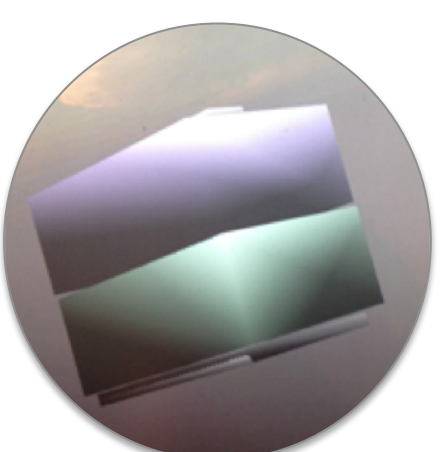


Testing Conditions

Immersive Cues	C1	C2	C3	C4
Stereo vision		✓		✓
Haptic feedback			✓	✓
6-DOF Stylus	✓	✓	✓	✓



LEVEL 1



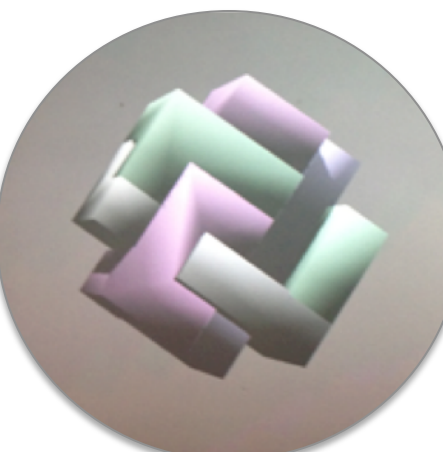
LEVEL 2



LEVEL 3



LEVEL 4



LEVEL 5