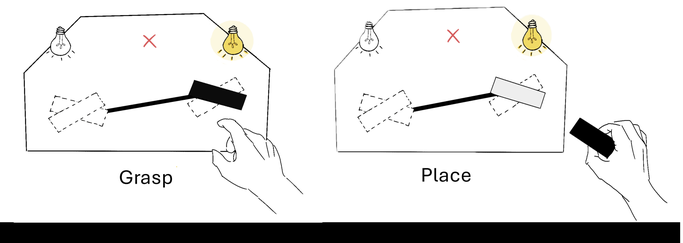
EEG-Based Neural Representations of Visually Guided Reaching and Placement Movements

Petros Georgiadis, Erez Freud, Peter Kohler, Douglas Crawford
Department of Biology, York University, Toronto ON, Canada
Center for Vision Research, York University, Toronto ON, Canada
Center for Integrative Neuroscience, York University, Toronto ON, Canada

Introduction

- Every-day interactions with our environment depend on visually guided actions, such as reaching for and placing objects.
- While most research has focused on the initial reaching movement, the equally important placement phase is often overlooked.
- To fully decode the brain activity underlying everyday behaviour, we must study complete motor sequences and identify neural patterns associated with both movement intention and execution.

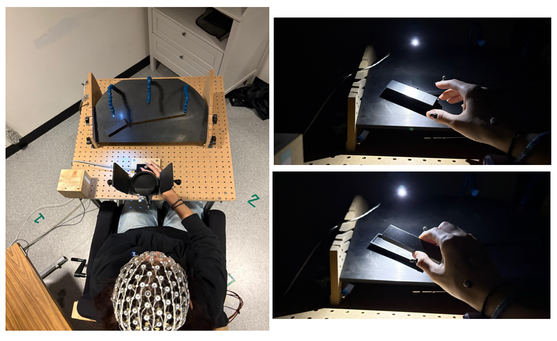


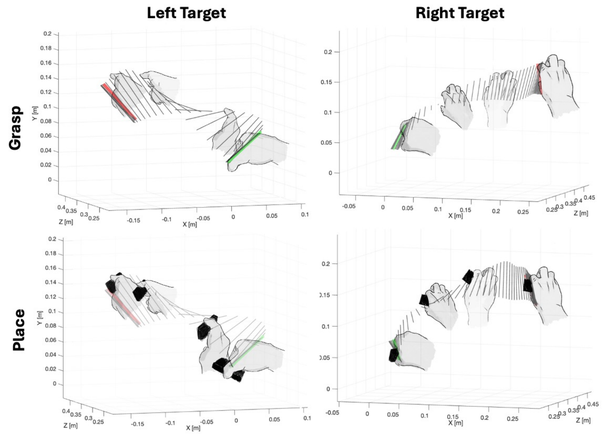
Hypotheses

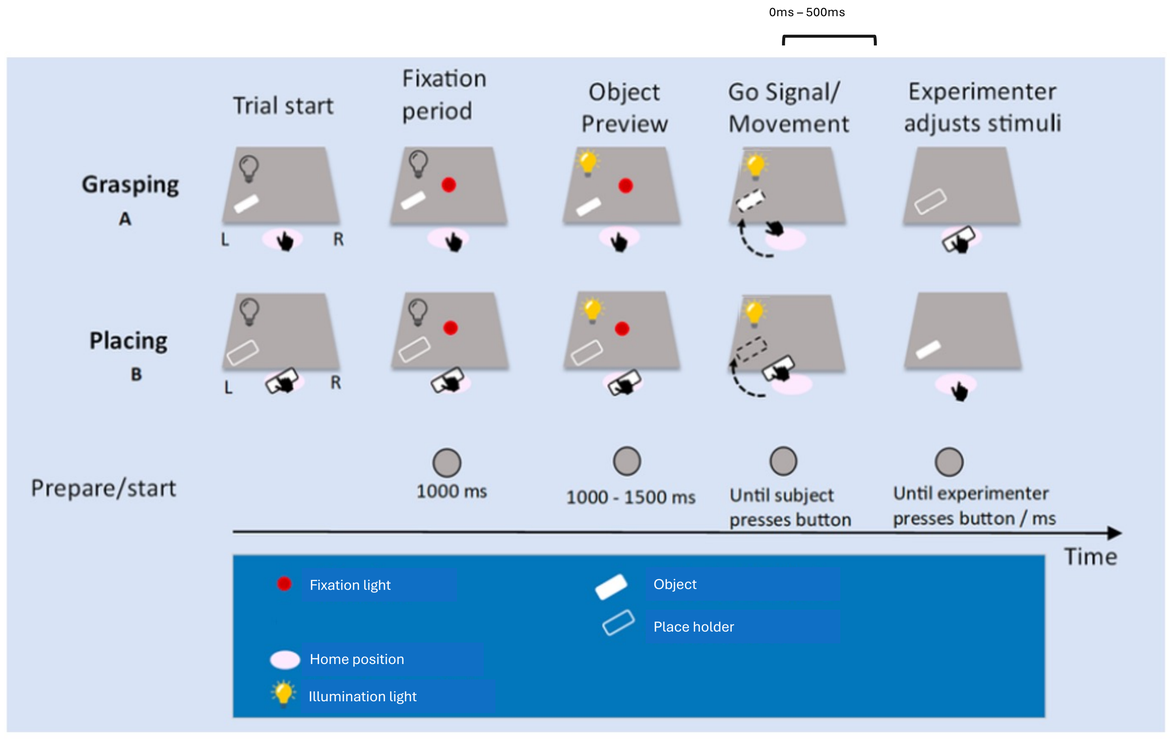
- Differential event-related potential (ERP) activity of parietal and frontal channels between the two tasks, reflecting differences in sensory processes.
- Distinct overall scalp topographies between the two tasks, reflected in the brain movement-preparatory signals (Andersen & Cui, 2009).

Methods

- 23 Healthy right-handed participants (22 ±2.5 years, 7 males)
- Repeat the sequence of (1) gasping and (2) placing an object at 4 possible configurations (2 orientations by 2 locations)
- Visual feedback available during the execution of the movement (visually guided task).
- EEG data recorded through a Geodesic Sensor Net (HydroCel GSN 129, EGI) at 1000Hz
- Thumb and index finger location recorded through Optitack (NaturalPoint Inc., USA) at 120Hz

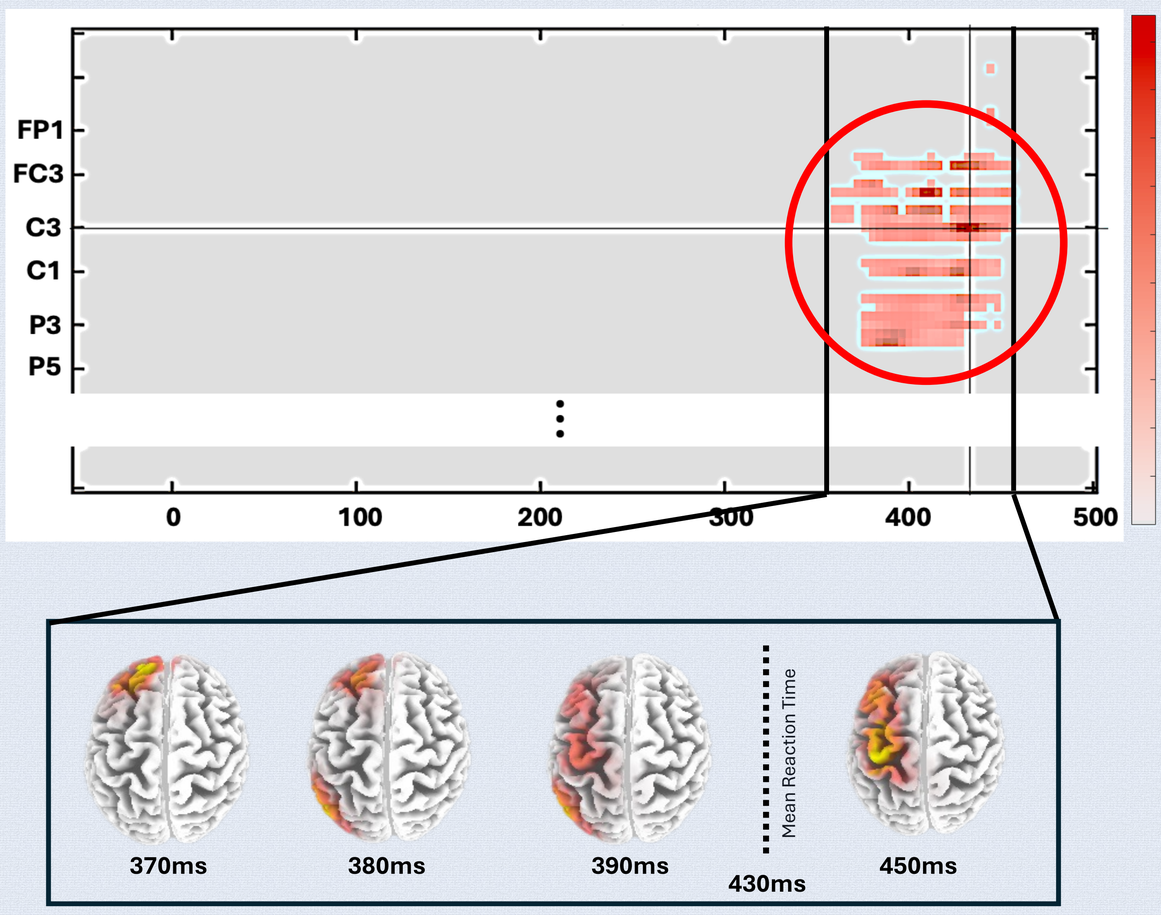




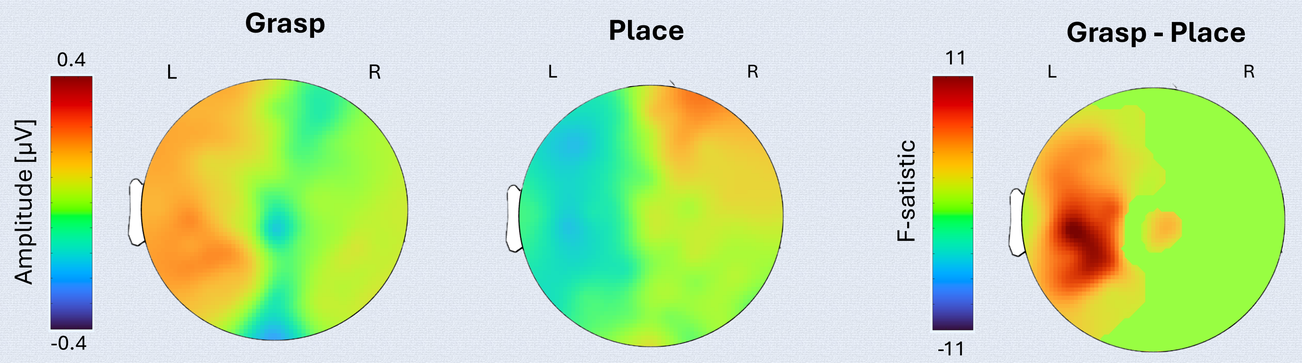


Results

Bootstrapped (n=1000) Cluster-corrected Beta coefficients Grasp-Place

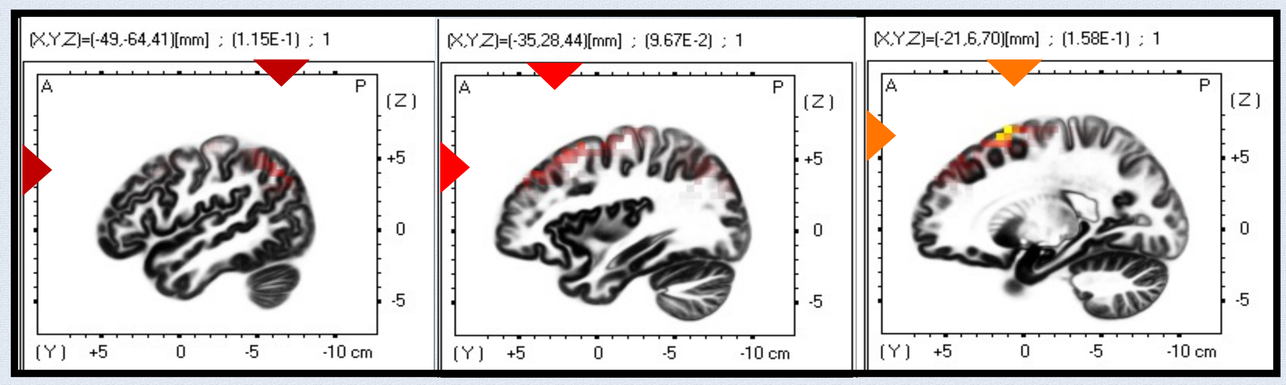


ERP Topography 360 – 450ms



ROIs of Grasp-Place effects

Left Hemisphere View



Conclusions

- **Contralateral frontoparietal regions** encode task-specific information *before* movement begins.
- while **sensory, motor, and premotor areas** show distinct activation patterns that persist *after* movement initiation.

Average F-stat map 360-450ms