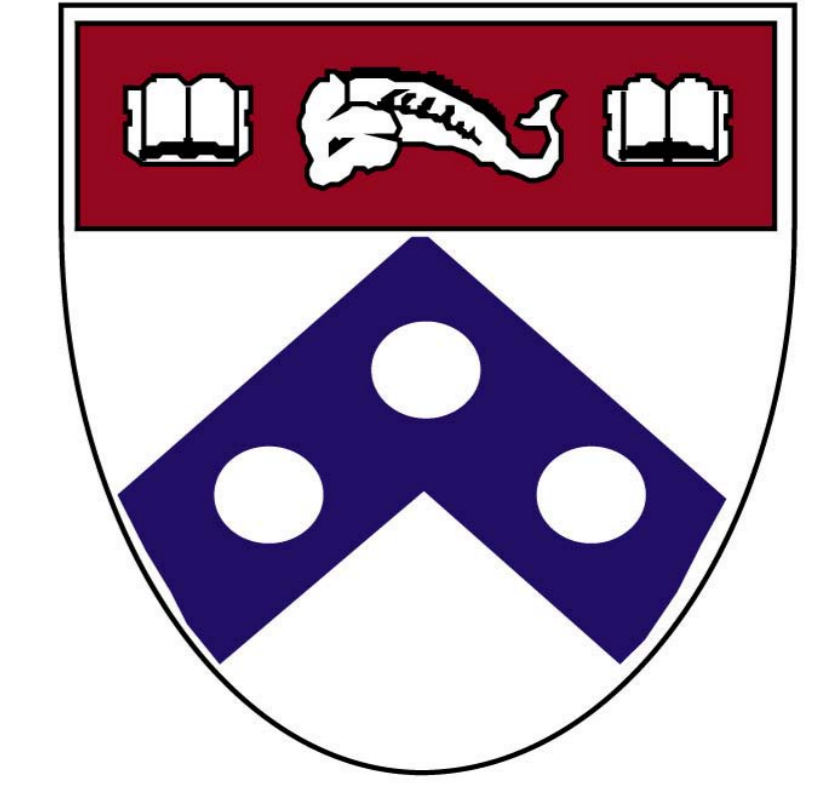


Event-related potentials to landmarks during “Yellow Cab” – a virtual spatial navigation task

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Introduction

Previous findings

- P300 (target recognition) with parietal maximum for **target** > **non-target** (Donchin & Coles, 1988).
- P3a (orienting/arousal for non-targets) with frontal maximum for **non-target** > **target** (Squires et al., 1975; Courchesne et al., 1975; Katayama & Polich, 1998).

Hypotheses

- Our major question was whether event-related potentials (ERPs) that have previously been linked to novelty detection and to explicit recognition of old vs. new items would differentiate between the viewing of target and non-target landmarks in *Yellow Cab* – a virtual taxi-driver game.
- A secondary question was whether these hypothesized ERP differences would vary with subjects ability to efficiently navigate to their target landmarks.

We used high-density scalp EEG to assess the electrophysiological correlates of implicit landmark recognition in *Yellow Cab*.

The Yellow Cab Task

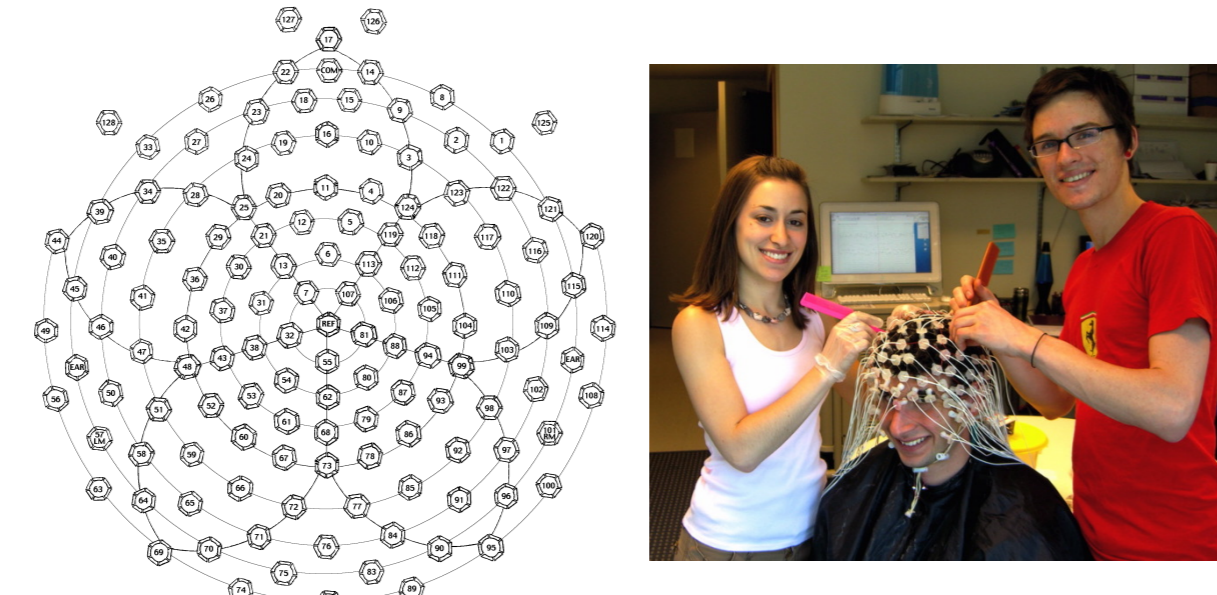


- Participants played the role of a taxi-driver in a virtual town, looking for specific destinations to which passengers ask to be delivered (“goal-seeking”), called **target stores** (Newman et al., in press).
- Each town: 6 × 6 grid, with a single store or building on each block (36 landmarks). 5 stores and 31 buildings in a town, each with a unique façade.
- During the delivery, the 4 stores that are not the target store are considered **non-target stores**.

Definitions:

- **Fast delivery:** < 1 block above optimal path (M=-0.19 excess blocks)
- **Slow delivery:** > 1 block above optimal path (M=6.0 excess blocks)

Scalp EEG



- 128-channel system from Electrical Geodesics, Inc.
- 200 M Ω high-impedance amplifier.
- Recorded at 500 Hz.
- 20 young adults (ages 19 to 27; eleven male, nine female).
- Right-handed; normal or corrected-to-normal vision.

Analytical Methods

Selecting events

- All events are from periods in which participants have picked up a passenger and are searching for the **target store**.
- Do not know where a participant is looking on the screen; consequently, some latency variability may exist in the appearance of the store and the participant's recognition of a store.
- **Standardized event selection**
 - Set a *screen threshold* to mark when an object is considered “seen”.
 - At a screen threshold of 0.35%, 95% of brief target store appearances would not be counted as seen.
 - Since we don't know when a subject actually sees a store, ERPs do not line up exactly.



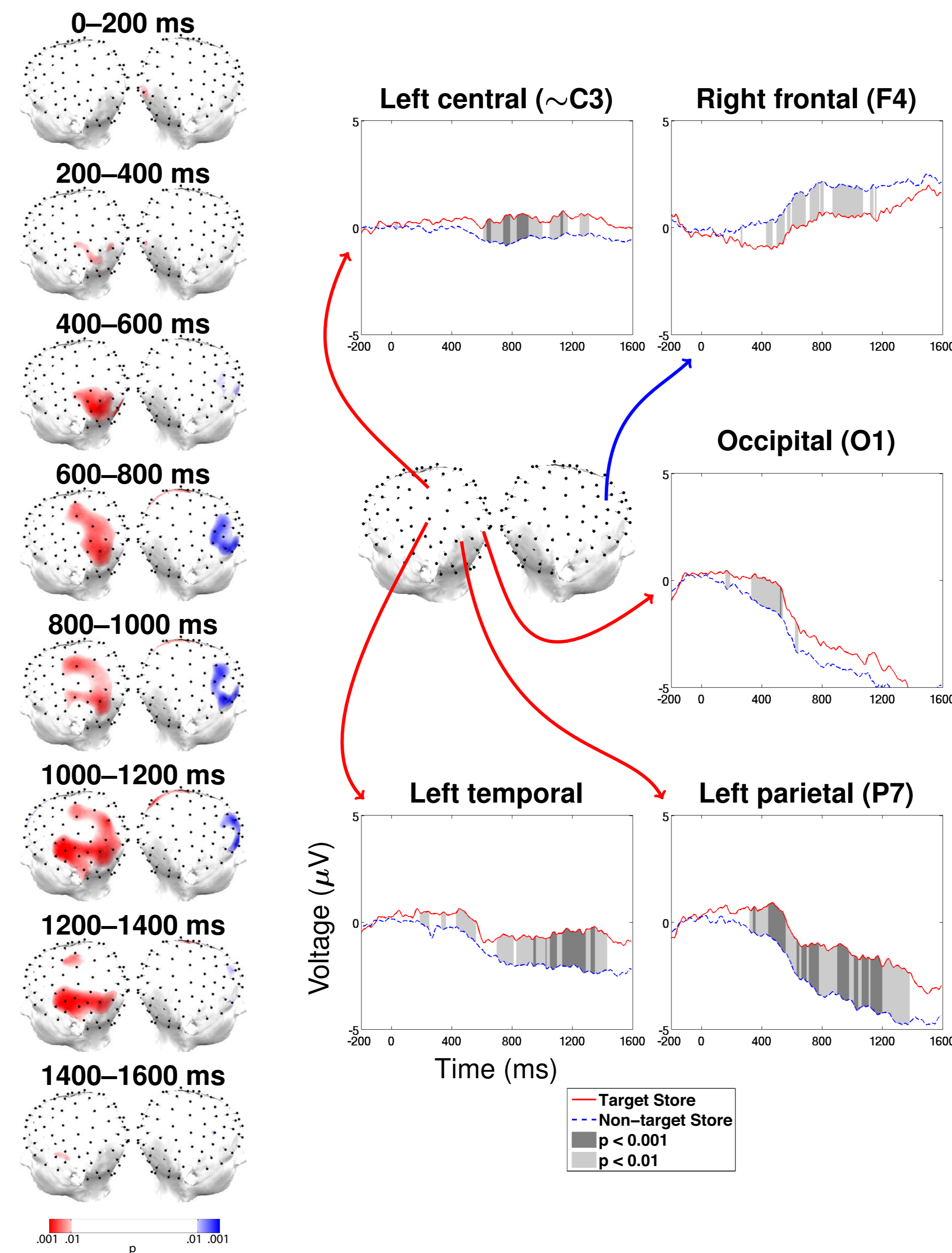
0.35% of the screen is occupied by the store.

Post-processing EEG data

- Eye-movement artifact detection (electro-oculogram > 100 μ V)
- Bad-channel detection (manual inspection of the EEG)
- Average rereference

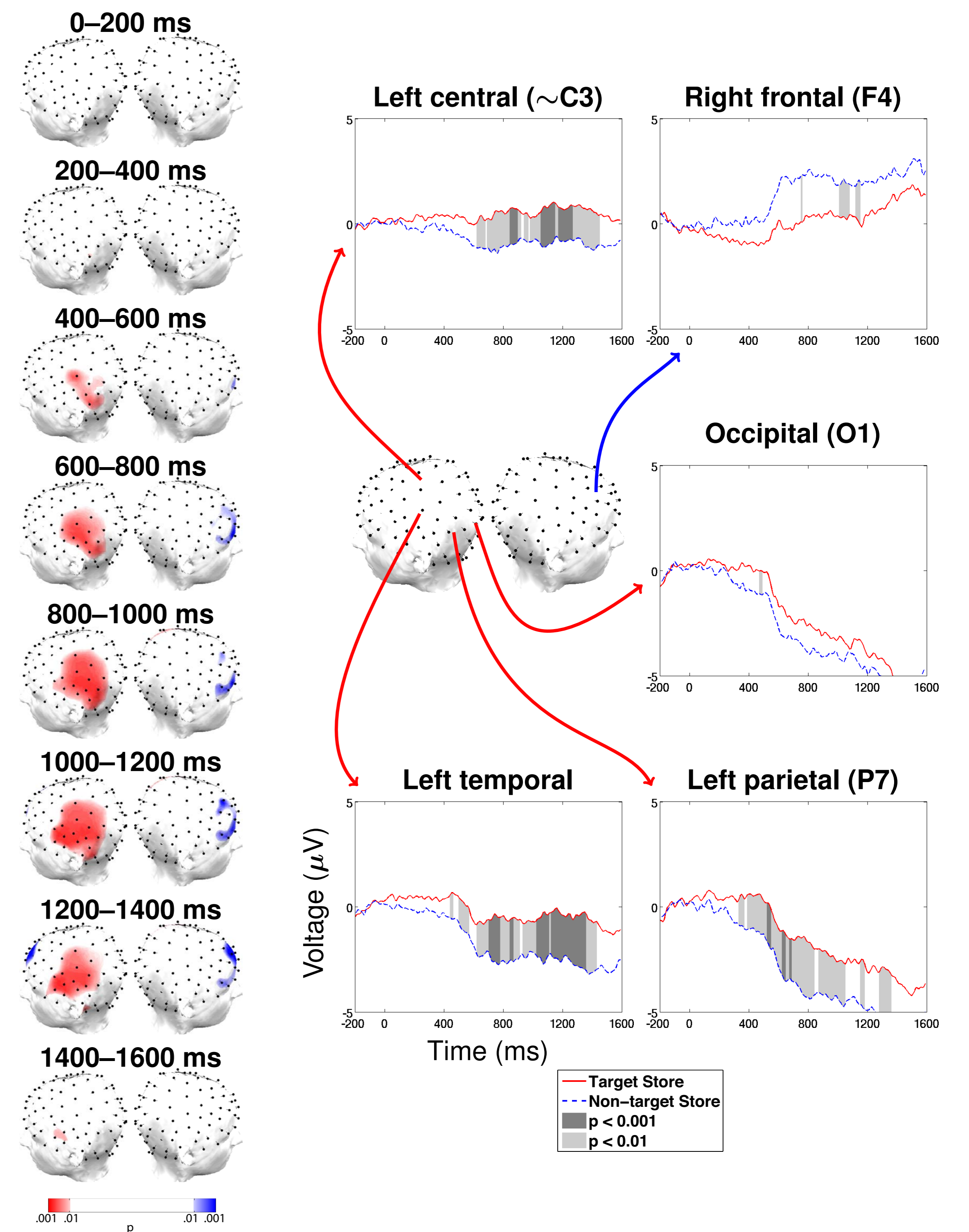
Results: All deliveries

Target Store vs. Non-target Store



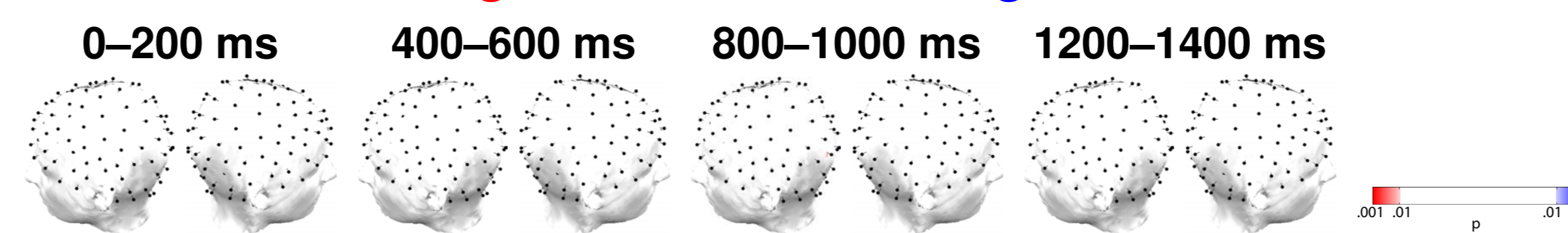
Results: Fast deliveries only

Target Store vs. Non-target Store



Results: Slow deliveries only

Target Store vs. Non-target Store



Conclusions

- The P3 differentiates viewing of **target** and **non-target** landmarks during navigation.
 - This manifests itself as an increase in left parietal voltage for recognition of a **target store** (match), and an increase in right frontal signals for recognition of a **non-target store** (mismatch).
- This P3 profile only appears when subjects navigate efficiently to their destination.
 - This dependence on navigation efficiency suggests that the P3 effects are modulated by attentional state.

References

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- By time locking the voltage signal to the appearance of targets on the screen during navigation we were able to report the first analysis of ERPs in a virtual navigation task.
- Future studies could use eye-tracking technology to more precisely lock electrophysiological signals to visual events.