Oscillatory Correlates of Primacy Effects Following Perceptual Shifts

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Introduction

Recent work by Davelaar (2013) has suggested that start-of-list primacy effects are due to novelty of start-of-list features compared to pre-list experiences. Similar mid-list behavioral boosts to memorability have been observed following shifts in perceptual or task-related features (Geiselman, 1975; Polyn et al., 2009).

Prior work by Sederberg et al. (2006) has examined how patterns of oscillatory activity change over list position. This research expounded on the neural correlates of an item's position within the list as well as its successful encoding. We aimed to characterize the oscillatory responses following perceptual shifts and to contrast them with these previously observed start-of-list effects. We used a variant of a classic paradigm in which this mid-list behavioral boost has been observed across shifts in presentation modality (Murdock & Walker, 1969).

Experiment Paradigm
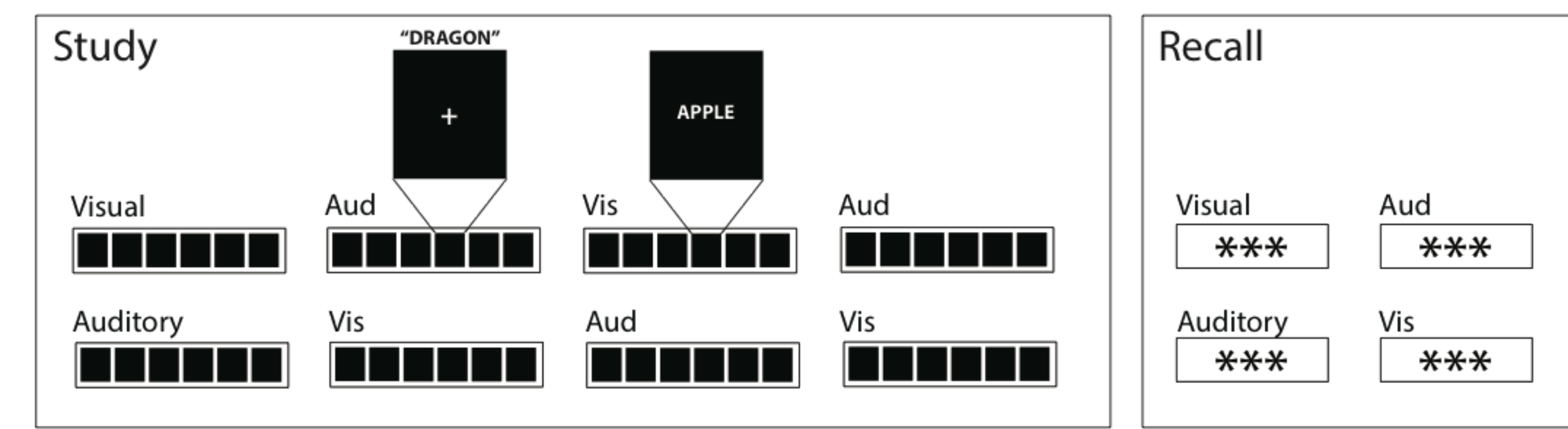
22 participants each studied and recalled a total of 32 lists over two sessions.

Each list contained 24 items that were presented either visually (on screen) or auditorily (over headphones). Items were organized into four 6-item trains, with presentation modality shifting between trains.

Two free recall periods immediately followed each list, with each period targeting a specific modality.
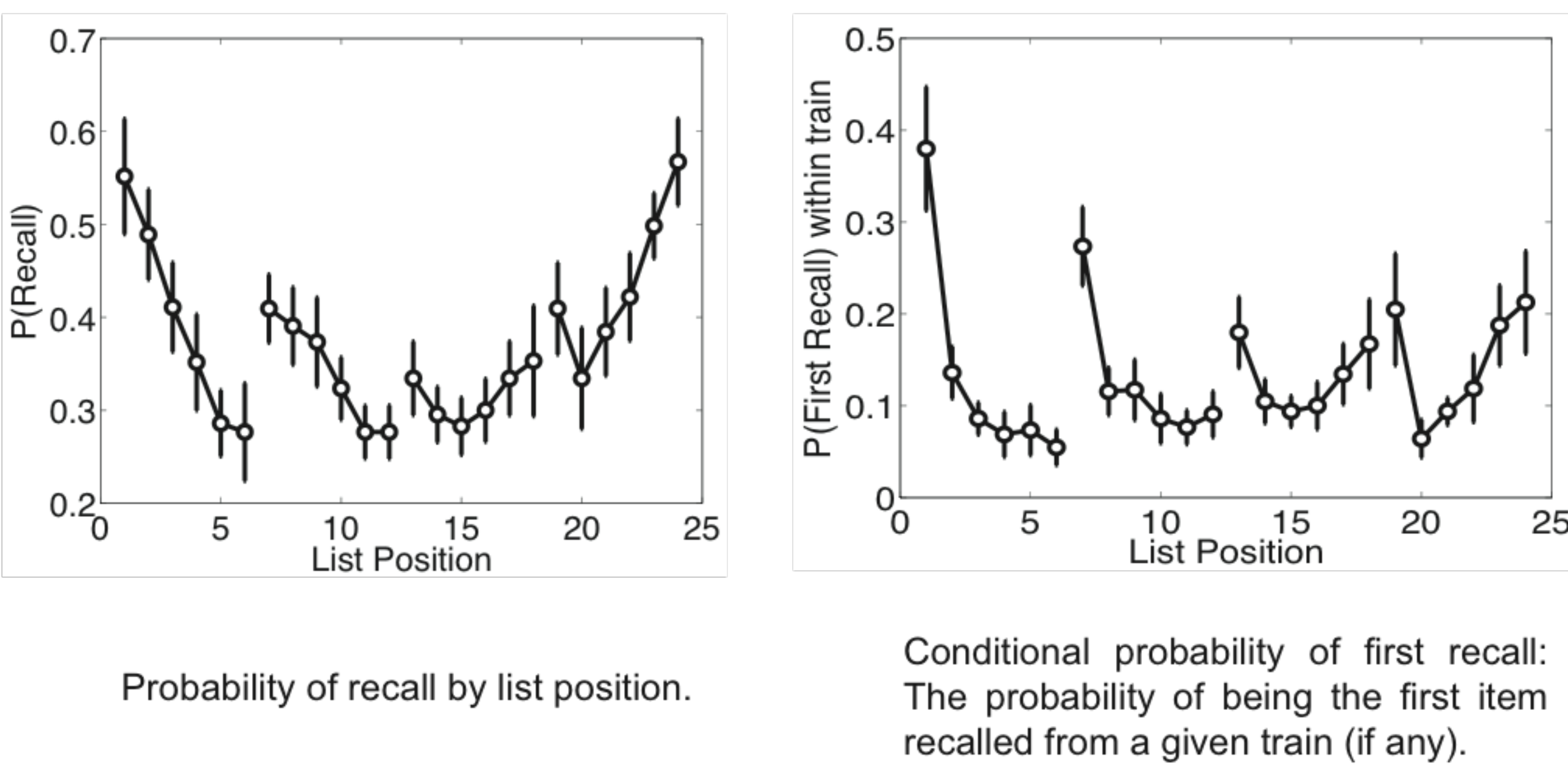
Scalp EEG Methods
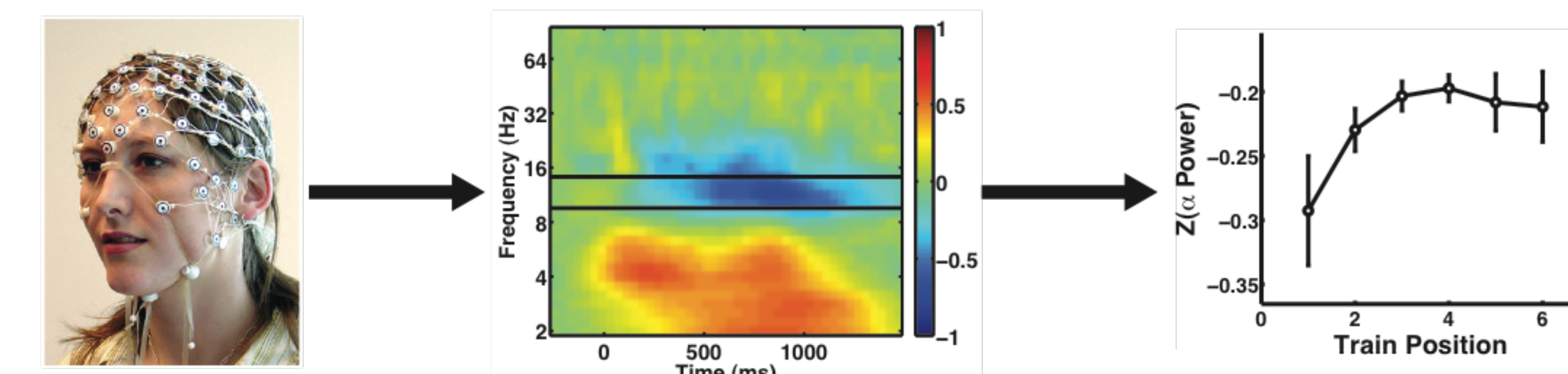
We collected scalp EEG from each participant using a 128-electrode cap. Wavelets were used to measure oscillatory power. We calculated the average oscillatory power over six frequency bands (ranging 2-100 Hz) to examine how these signals changed over various study items of interest.

Behavioral Findings

Increased recall performance for start-of-list items, in percent recalled by list position and conditional probability of first recall, compared to mid-train items (p<0.001).

Mid-list trains (2 and 3) showed increased recall performance for items immediately following a modality shift compared to mid-train items (p<0.01).

Probability of recall by list position.

Conditional probability of first recall: The probability of being the first item recalled from a given train (if any).

Both start-of-list and post-shift items exhibit increased memorability. Novelty-based theories suggest these effects may be due to a similar encoding mechanism. We examine this claim by observing the neural responses.

Oscillatory List Position Effects

Start-of-list Primacy   Mid-list Shift

δ (2-4 Hz)

α (10-14 Hz)

γ (44-100 Hz)
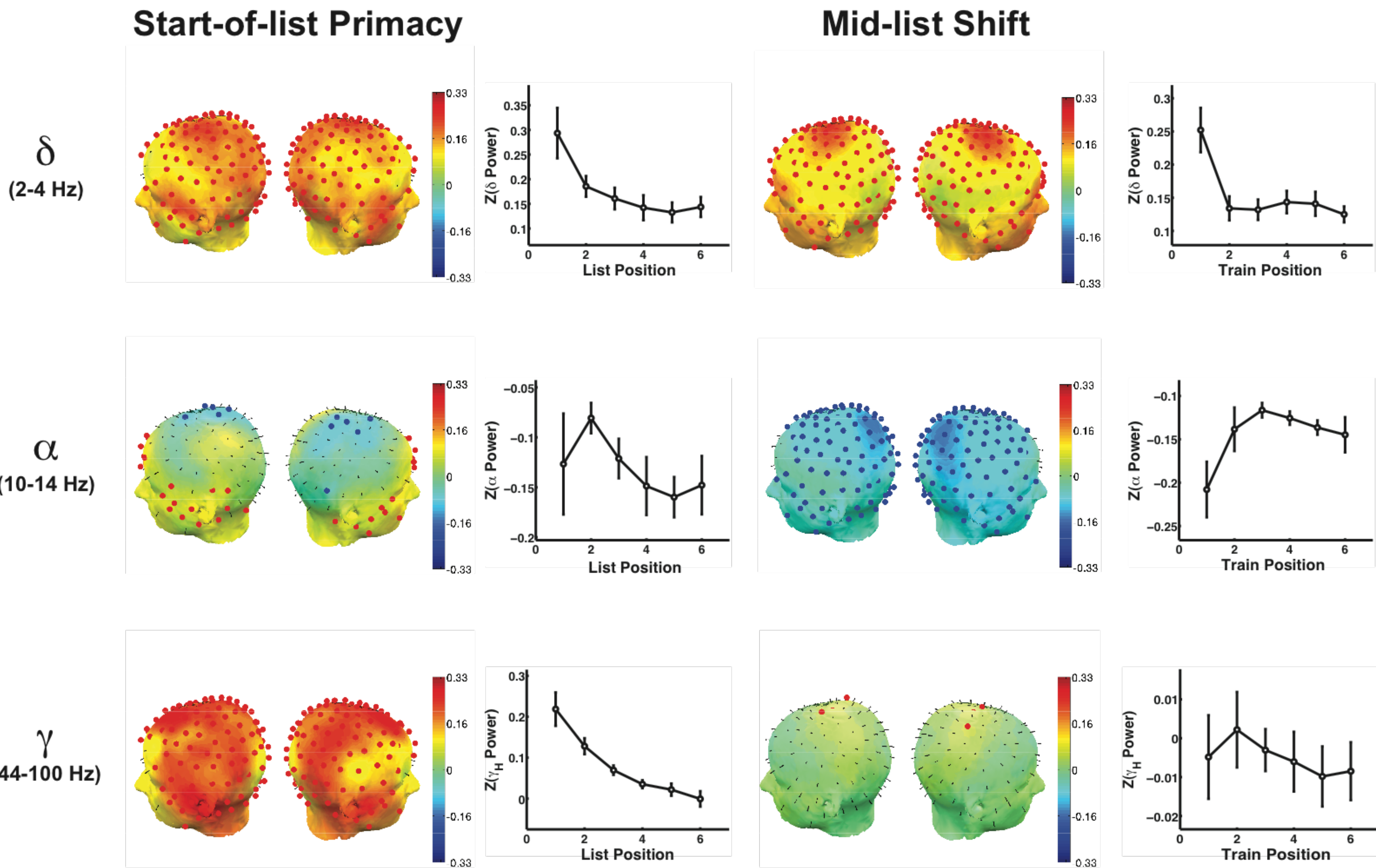
Start-of-list positions showed patterns of **high delta and gamma power** that decreased as a function of list/train position, consistent with previous findings by Sederberg et al. (2006).

Post-shift positions showed patterns of **high delta power** that decreased as a function of list/train position, and **low alpha power** that increased across train positions. No change in gamma power.

Subsequent Memory

Later Recalled - Later Forgotten

Mid-list Shift   Mid-train

α (10-14 Hz)
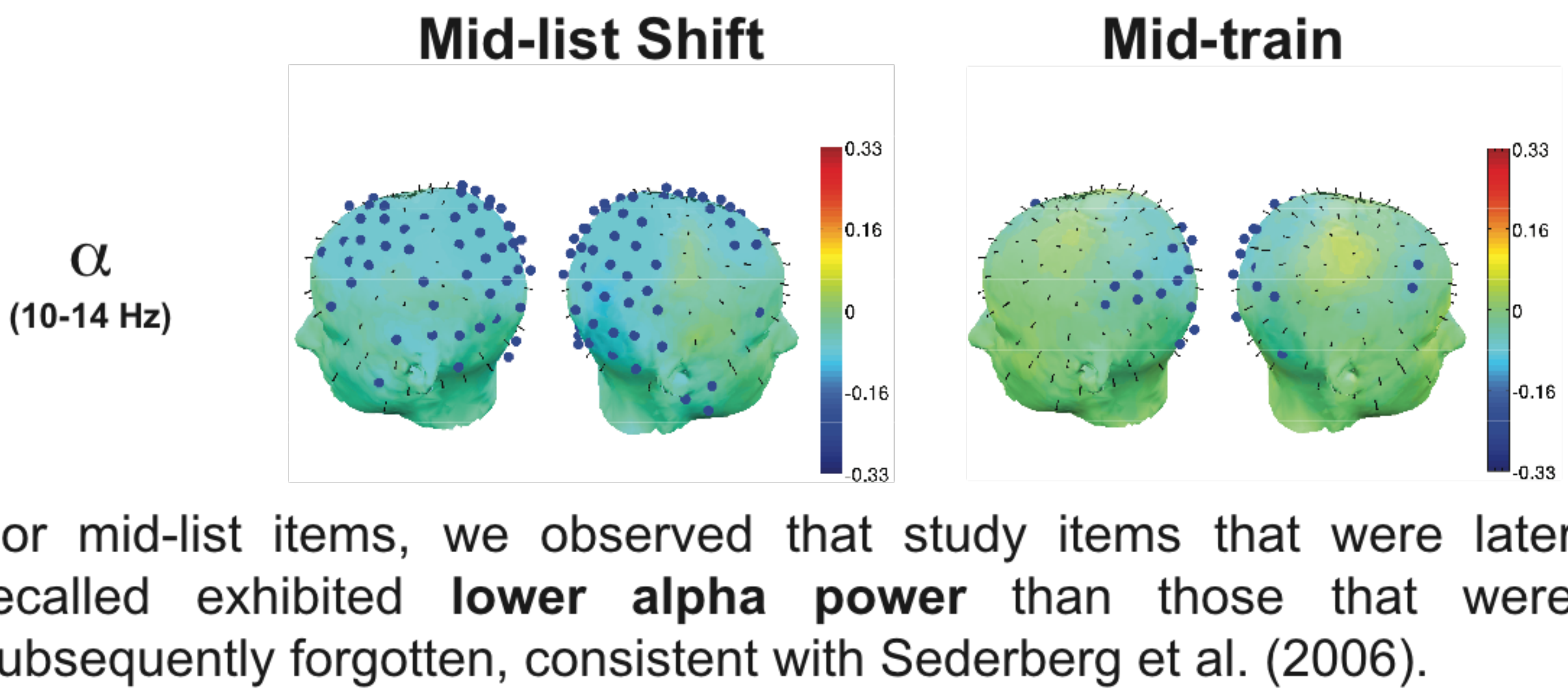
For mid-list items, we observed that study items that were later recalled exhibited **lower alpha power** than those that were subsequently forgotten, consistent with Sederberg et al. (2006).

Furthermore, preliminary analyses indicated that this subsequent memory effect may be stronger or more widespread for items following a modality shift. The topography is otherwise the same, suggesting a similar mechanism is involved in the successful encoding of both classes of items.

Summary

	Sederberg, et al. 2006	Start-of-list Primacy	Mid-list Shift
Delta (2-4 Hz)	↑	↑	↑
Alpha (10-14 Hz)	↓		↓
Gamma (44-100 Hz)	↑	↑	

In addition to replicating the high gamma power associated with start-of-list positions observed by Sederberg et al. (2006), we observed low alpha power following perceptual shifts in presented item features.

Sederberg et al. (2006) suggested that this drop in alpha power is related to a reduction in working memory load, allowing one to focus attention on the incoming stimulus. These results suggest that perceptual shifts engage a similar process, which is consistent with the improved memorability for post-shift items.

In future work we will attempt to confirm this hypothesis by linking this neural phenomenon with encoding processes embedded in a computational model.

Acknowledgments