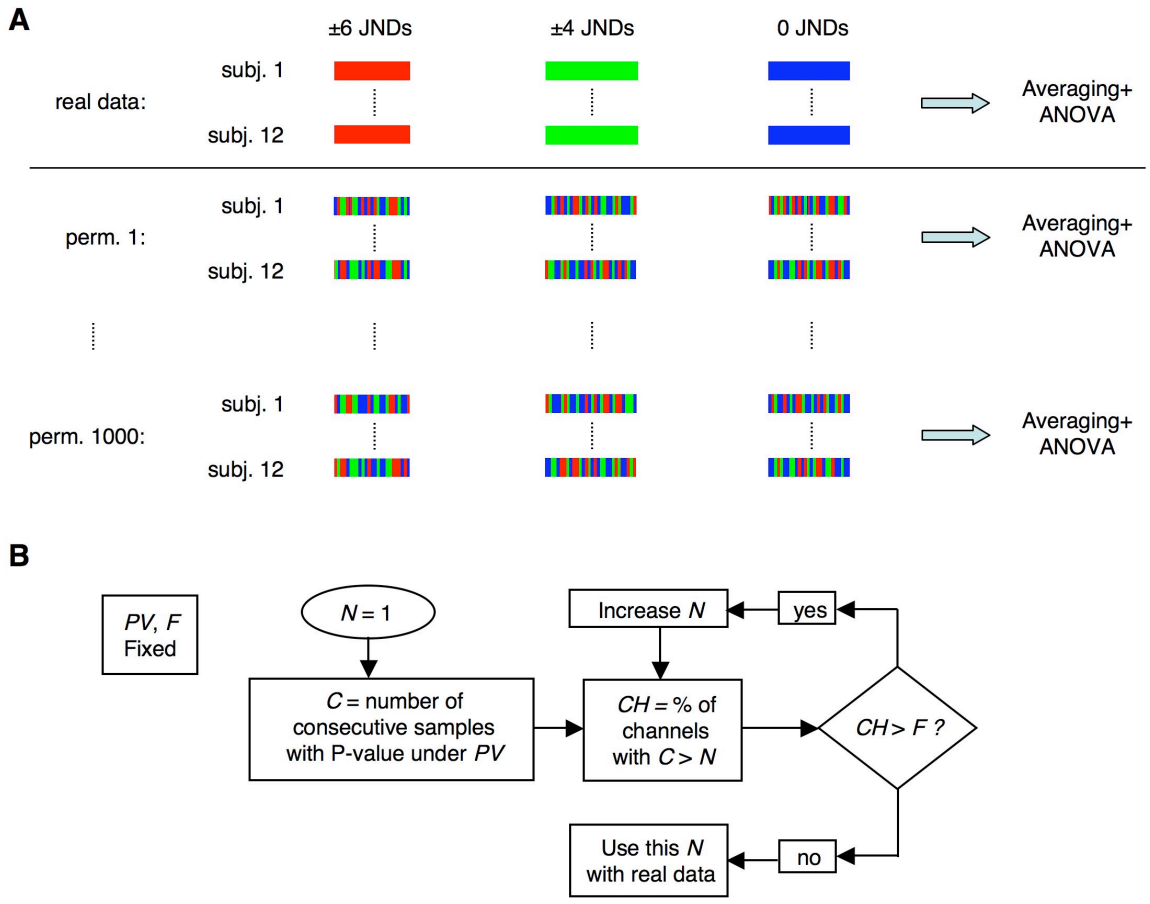
Supplementary Methods



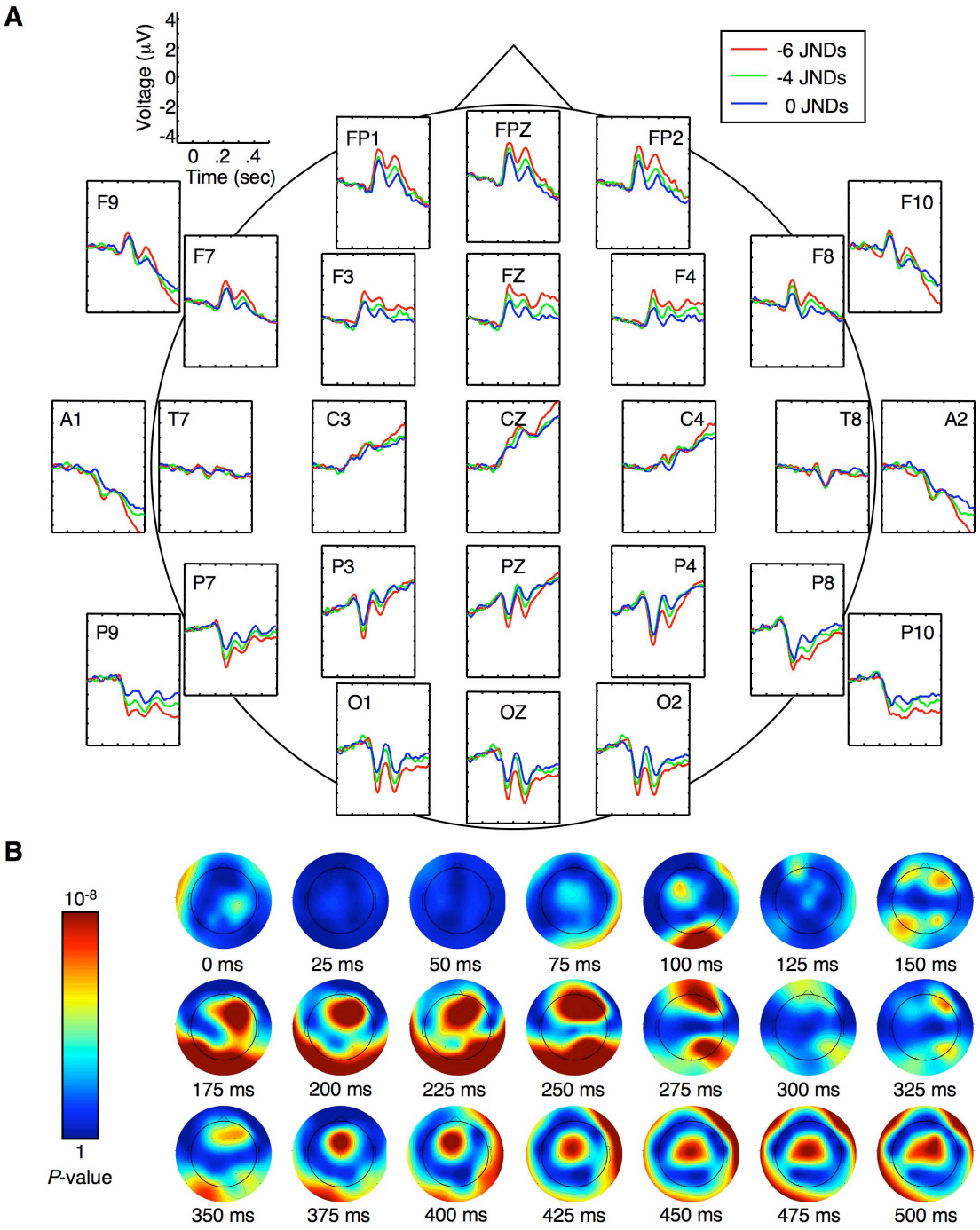
Supplementary Fig. 1. Random permutation procedure. A: 1,000 surrogate datasets were created by randomly assigning each trial to one of the three groups, without regard to probe frequency. Note that the spatial and temporal correlations within each trial were preserved; only probe frequency was shuffled. The same statistical tests performed on the real data were then used with the random data. B: Flowchart describing the statistical procedure. To determine the number of consecutive samples with a *P*-value below 0.05 required to reach a 1% FDR, we used the statistical results from the surrogate data, gradually increasing *N* until a sufficiently low number of significant results was reached. The value of *N* at this point (26) was set as criterion for the real, unshuffled data.

Supplementary Results

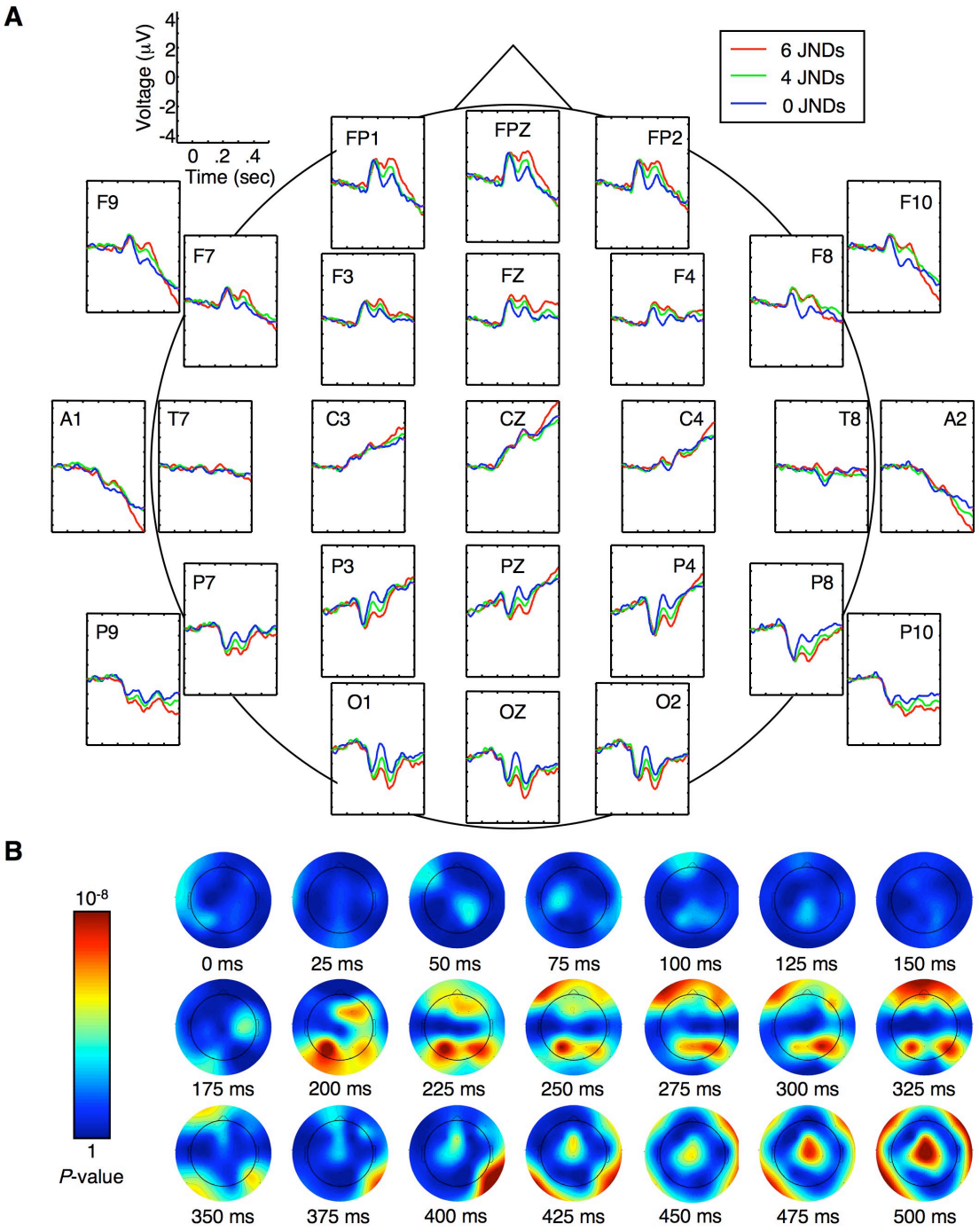
This study demonstrates early modulation of brain activity by the similarity between the probe stimulus and the study items held in memory. Since the main result of the paper rests upon our treatment of probe-item similarity as non-directional — we grouped together probes at equal distances from the geometric mean of the study items' vertical frequency — it is important to make sure that low- and high-frequency probes have a similar influence of the ERPs, namely stronger responses for less similar probes. Supplementary Figs. 2 and 3 replicate Fig. 2A from the main text, but without aggregating across probe frequencies. Indeed, the direction of modulation is highly similar in the two cases, as is the progression from posterior to anterior electrodes.

To provide full details about the distribution of *P*-values from Fig. 2B, Supplementary Fig. 4 shows topographical maps of the *P*-values for every time sample (4 ms resolution).

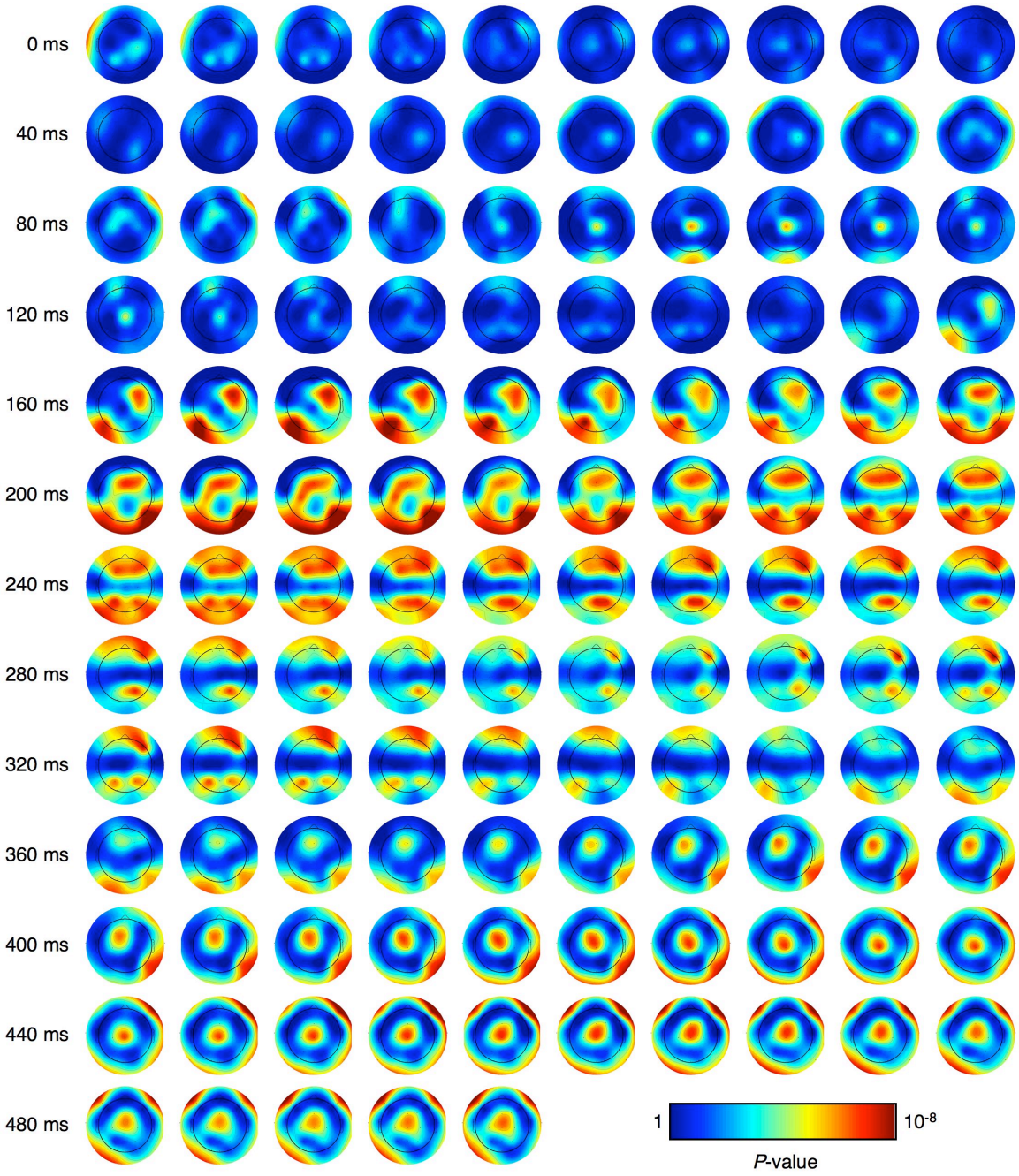
To address the possibility that sensory adaptation might have accounted for our results, we examined whether the ERPs were influenced by the temporal order of the spatial frequencies of the study items. For this analysis, we separated low- and high-frequency probes (Supplementary Figs. 5 and 6, respectively). In both cases, not a single electrode showed a significant effect of whether S_1 or S_2 were higher in frequency. This null result suggests that adaptation is unlikely to be the main reason for the strong effect of probe-item similairy on the ERPs.



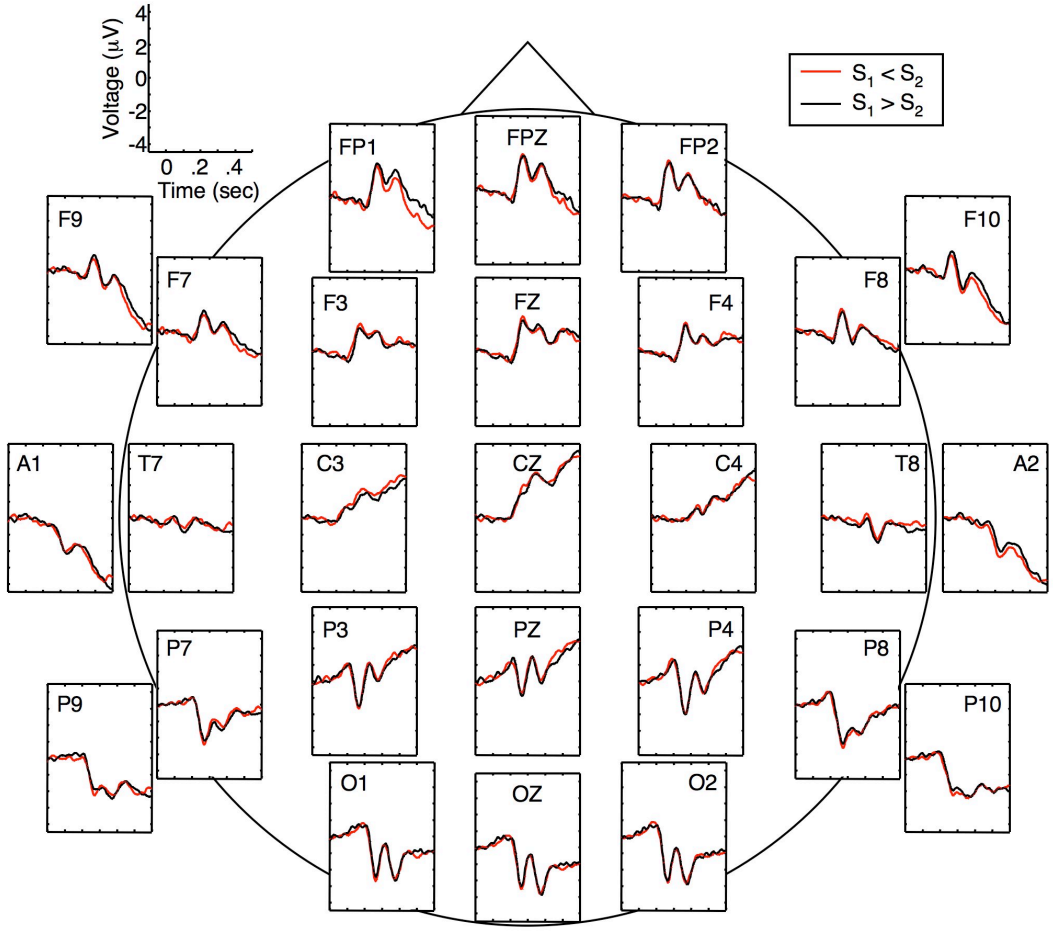
Supplementary Fig. 2. ERP results for low-frequency probes. A: Average ERP traces; Only probes whose vertical frequency was lower than or identical to the geometric mean of the study item frequencies are included. Number of trials for each condition (red, green, blue; mean±SD): 119.9±6.2, 122.1±4.6, 121.8±6.2. B: Topographical distributions of the P-values, sampled at 25 ms intervals. Red regions indicate strong modulation of the ERP by probe frequency, and blue regions indicate little or no modulation.



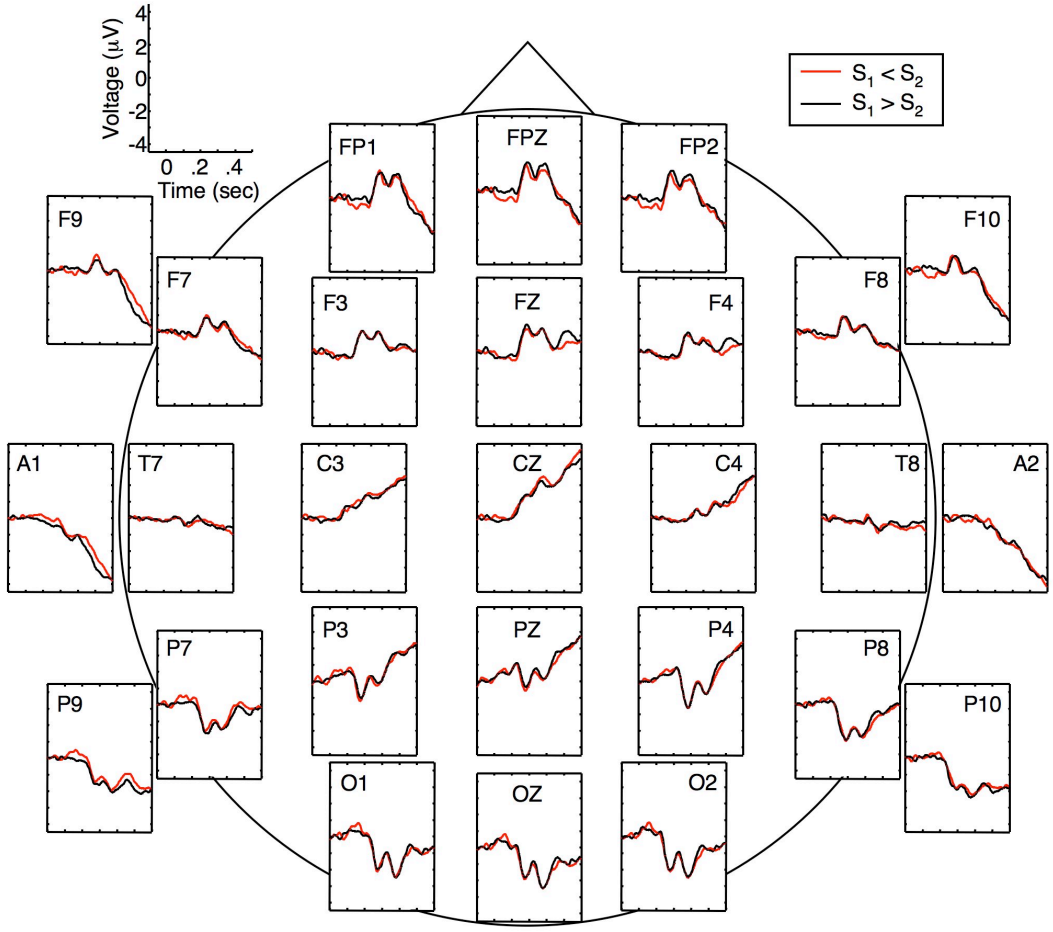
Supplementary Fig. 3. ERP results for high-frequency probes (higher than or identical to the mid-point). Plots are similar to those in Supplementary Fig. 2. Number of trials: 122.9±5.6, 122.1±5.6, 121.8±6.2.



Supplementary Fig. 4. Distribution of *P*-values at maximal temporal resolution. Each row represents 40 ms of data, at 4 ms intervals, starting at the time indicated on the left.



Supplementary Fig. 5. ERPs under different frequency order scenarios. Only *Lure* probes with vertical frequency below the mid-point are included. The red and black traces correspond to trials in which S_1 was lower or higher in frequency, respectively. No electrodes showed significant differences. Number of trials (red, black; mean+SD): 121.3±6.4, 120.8±4.5.



Supplementary Fig. 6. ERPs vs. frequency order for high-frequency *Lure* probes (above the mid-point). As with the low-frequency probes, no significant differences were detected. Number of trials: 122.7±6.5, 122.3±4.9.