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Supplemental Information

Functionally Distinct Gamma Range Activity Revealed by Stimulus Tuning in Human Visual Cortex

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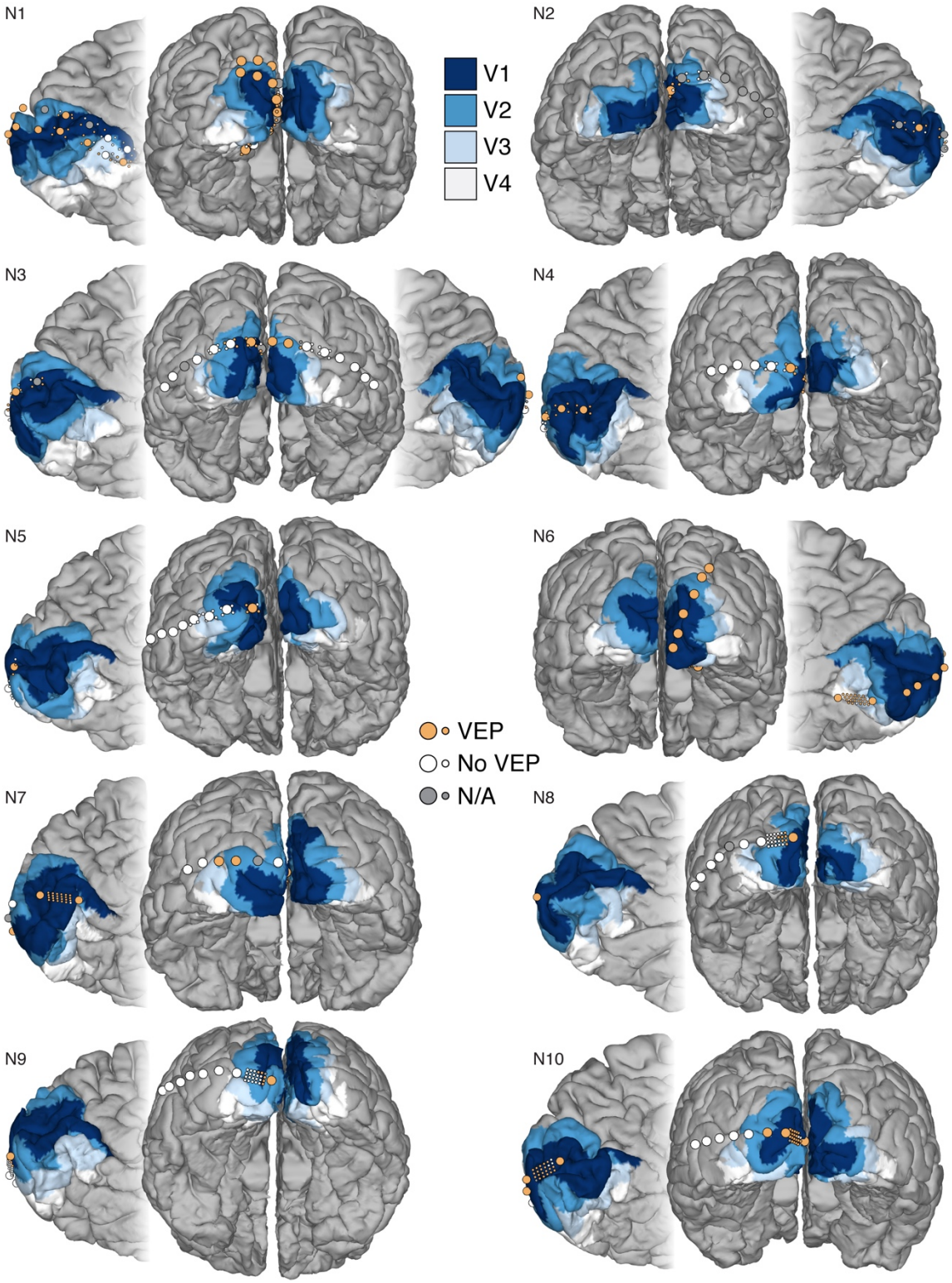

Figure S1. Single subject cortical surface and electrode array location. Related to Figure 1. Electrodes are color-coded in a similar fashion to Figure 1: orange indicates electrodes exhibiting a VEP, white indicates electrodes that did not. Additionally, gray indicates electrodes that were excluded from data analysis. The probabilistic atlas of areas V1, V2, V3 and V4 are mapped on each individual brain surface and shown as an overlay (see STAR Methods).

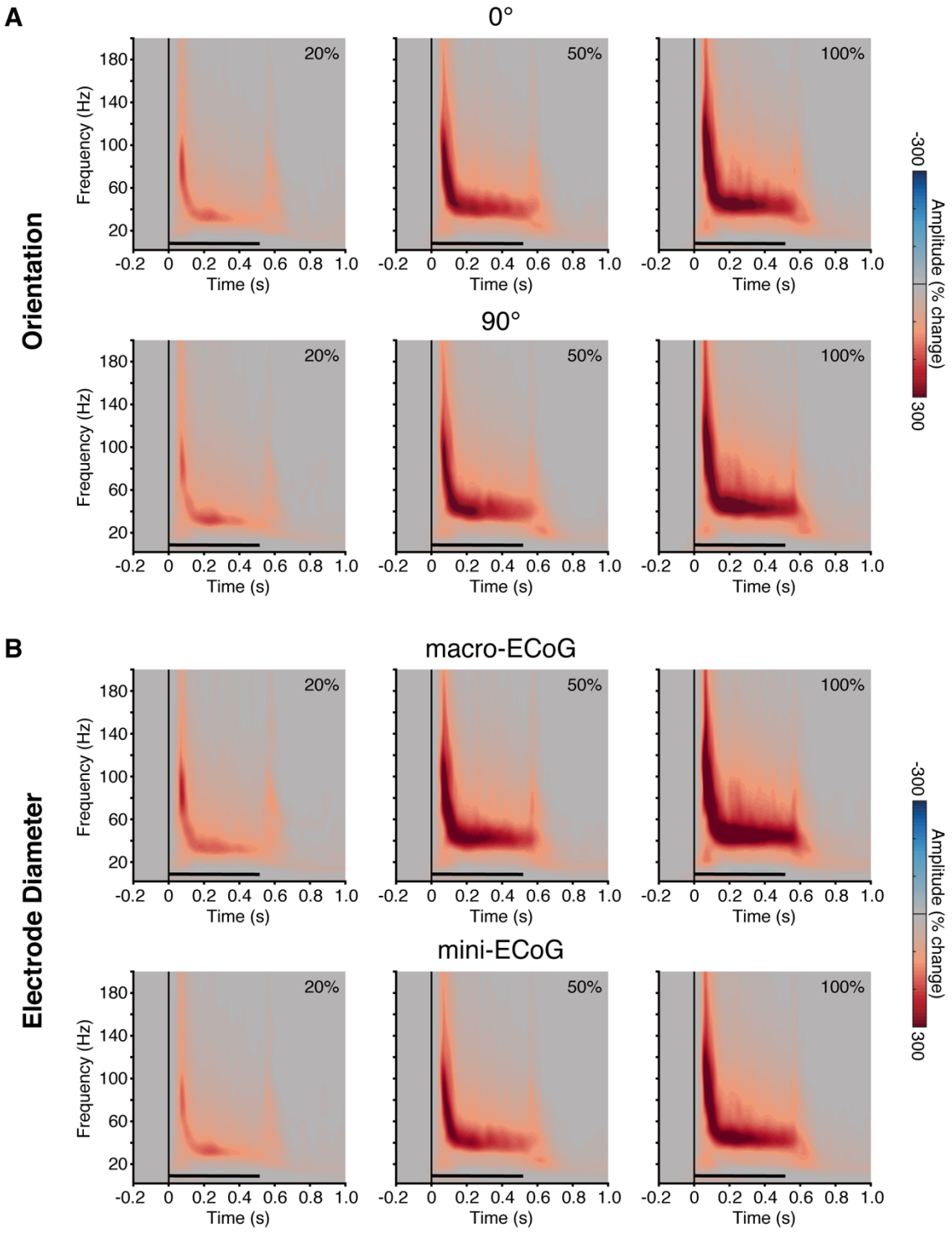

Figure S2. Influence of grating orientation and electrode size on spectral response. Related to Figure 2. Spectrograms show group average time-frequency responses for the 20%, 50% and 100% contrast levels. **A)** Spectrograms for the two grating orientations (0° and 90°). **B)** Spectrograms for the two electrode sizes (macro- and mini-ECoG). As is clear from both panels, the observed spectral responses show a striking similarity to Figure 2, supporting the combination of orientation and electrode diameter in data analyses.

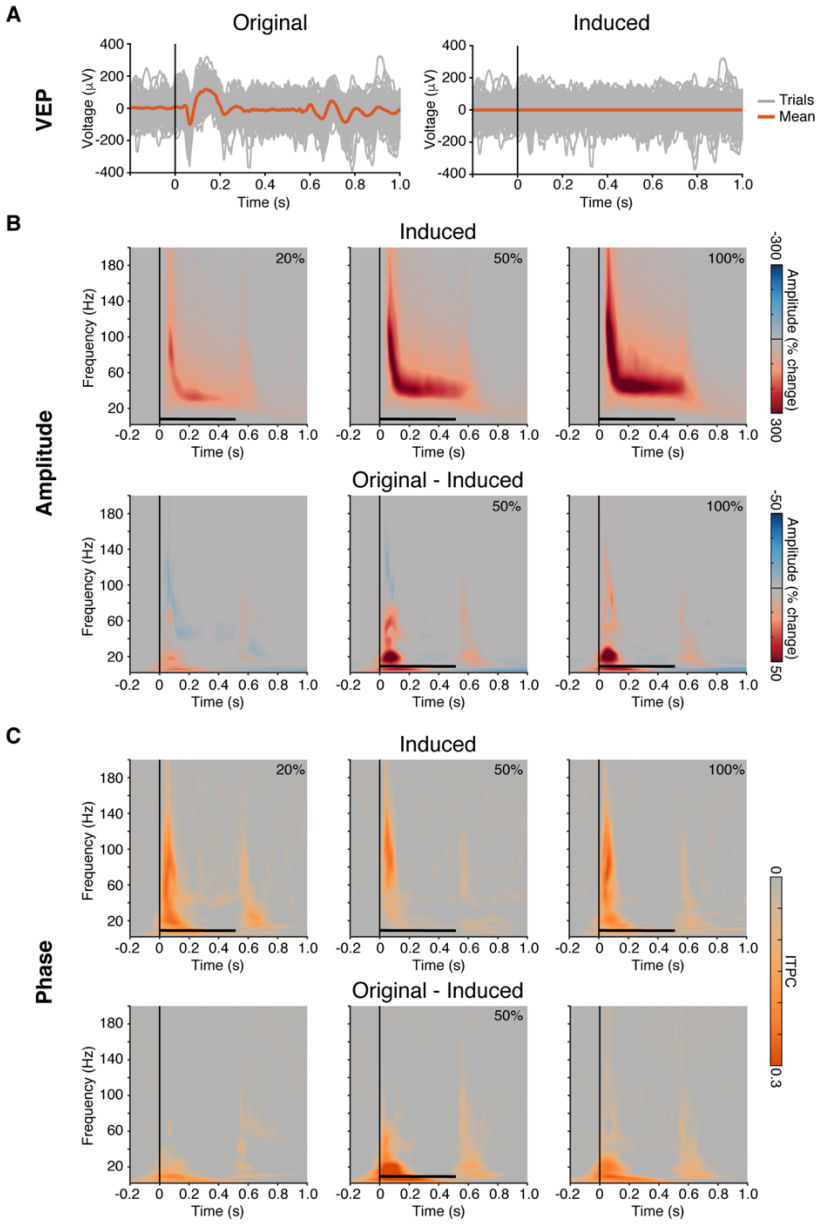

Figure S3. Influence of evoked components on spectral response. Related to Figure 2 and 3. **A)** Example of the separation between induced and evoked components: all trials recorded from one electrode (N7) are shown in gray and the average (capturing the VEP) is shown in orange (left). The average gets subtracted from each trial to obtain an induced signal (right). Spectral decomposition is then performed on the induced signal. **B)** Group mean spectrograms for the induced signal (upper) and the difference between the original signal (as reported in Figure 2) and the induced signal, reflecting the evoked components (lower). Spectrograms are for the 20%, 50% and 100% contrast levels. **C)** Same as B, for inter-trial phase clustering (ITPC). For both panels B and C, the induced spectral responses show a striking similarity to the original data reported in Figure 2 and Figure 3, respectively. These data suggest that evoked components of the VEP were not the main generators of the NBG or BBG features reported.

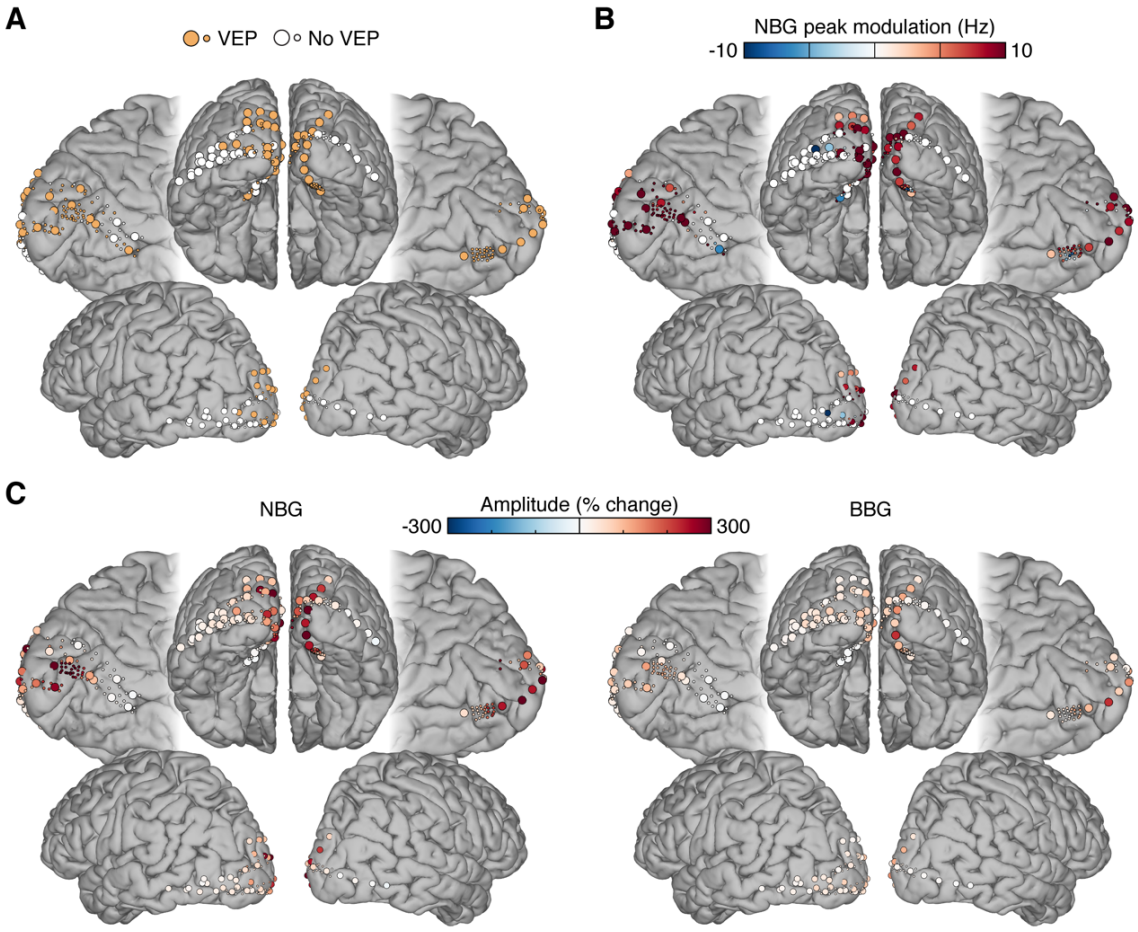

Figure S4. Influence of evoked components on the selection criterion. Related to Figure 1 and Figure 2. A) Same as Figure 1, repeated here to allow for an easier comparison with the other panels. The figure shows the occipital electrodes, colored according to the presence/absence of a visual evoked potential (VEP) which was used as a criterion to include electrodes in data analyses. As for Figure 1, the plot shows electrodes from subjects N1-N7 (as N8-10 did not perform the visual grating and object tasks). **B)** Magnitude of shift in NBG peak frequency. The contrast modulation of NBG peak frequency is represented at each electrode location (on the standard brain shown in Figure 1) and color coded according to the magnitude of frequency shift (by using the difference between the average peak frequency at 100% contrast versus 20% contrast). Note, three electrodes showed an apparent opposite modulation of the peak frequency: these electrodes did not display clear spectral increases in the lower contrast level causing a noisy estimate of the peak frequency in the NBG range. **C)** Average NBG (left) and BBG (right) amplitude (percent change in the 250-500 ms post-stimulus window) for all electrodes (VEP and non-VEP). Amplitude responses for both signals show a strikingly similar spatial distribution, being concentrated around the occipital pole, consistent with VEP data shown in A. NBG responses are higher in amplitude with respect to the BBG, confirming that the VEP criterion did not bias selection toward electrodes with larger BBG responses.

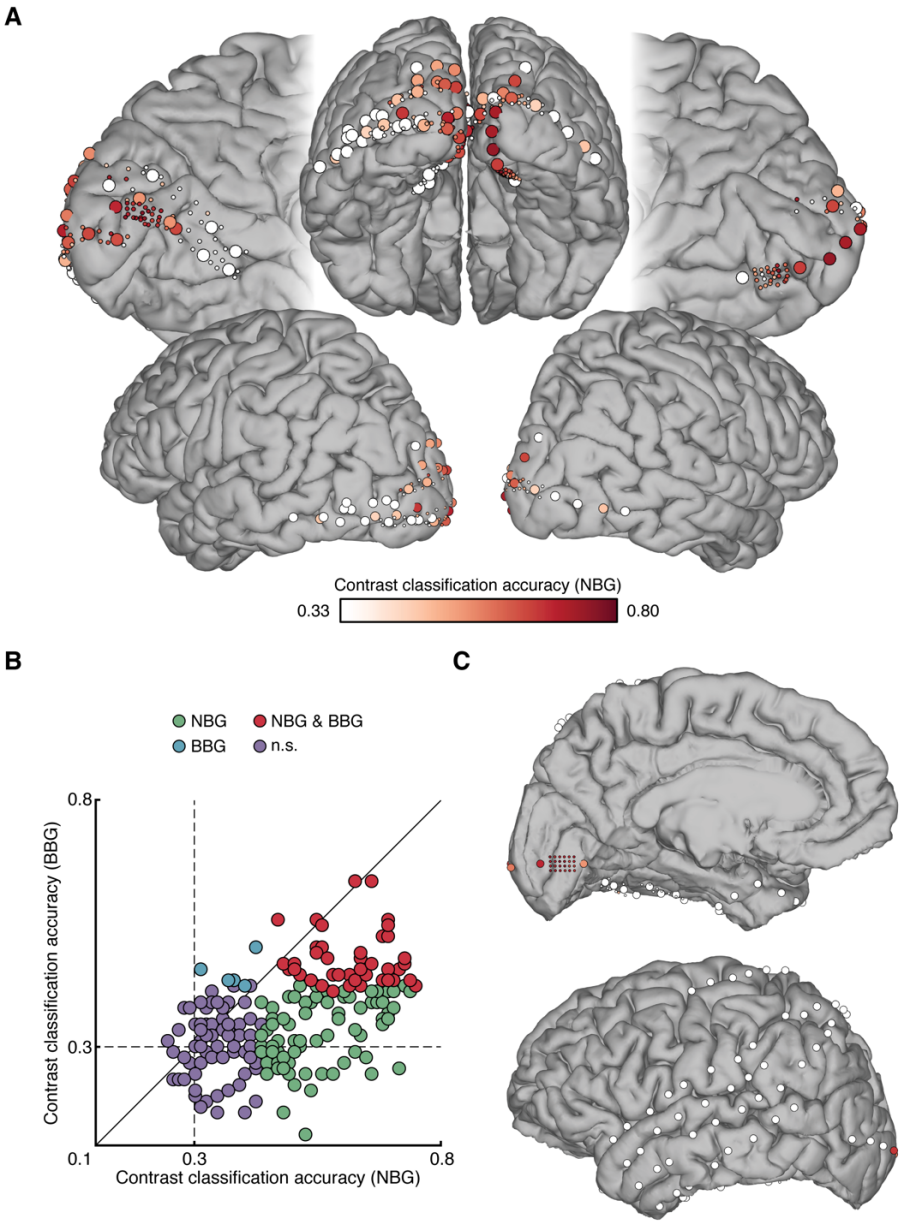

Figure S5. Classification of grating stimulus contrast. Related to Figure 1 and 2. A) Group data showing grating contrast level classification accuracy for each electrode (on the standard brain shown in Figure 1) based on a support vector machine (SVM) using averaged NBG amplitude (see Methods). Electrode locations with non-significant classification accuracy are shown in white. Note that all occipital electrodes were included in this analysis to assist in validating the VEP based selection of electrodes. There was an ~80% agreement between electrodes with above chance classification accuracy and those showing a VEP (see Figure 1 for a visual comparison). **B)** Scatter plot shows classification accuracy for the NBG-trained SVM plotted against the classification accuracy for the BBG-trained SVM for each electrode. Values are color coded according to the statistical significance of their classification accuracy (assessed with permutation testing, see Methods). **C)** Same as panel A for an individual subject (N7) showing that no electrode locations beyond the occipital lobe had above chance classification accuracy (using NBG; color map same as A).

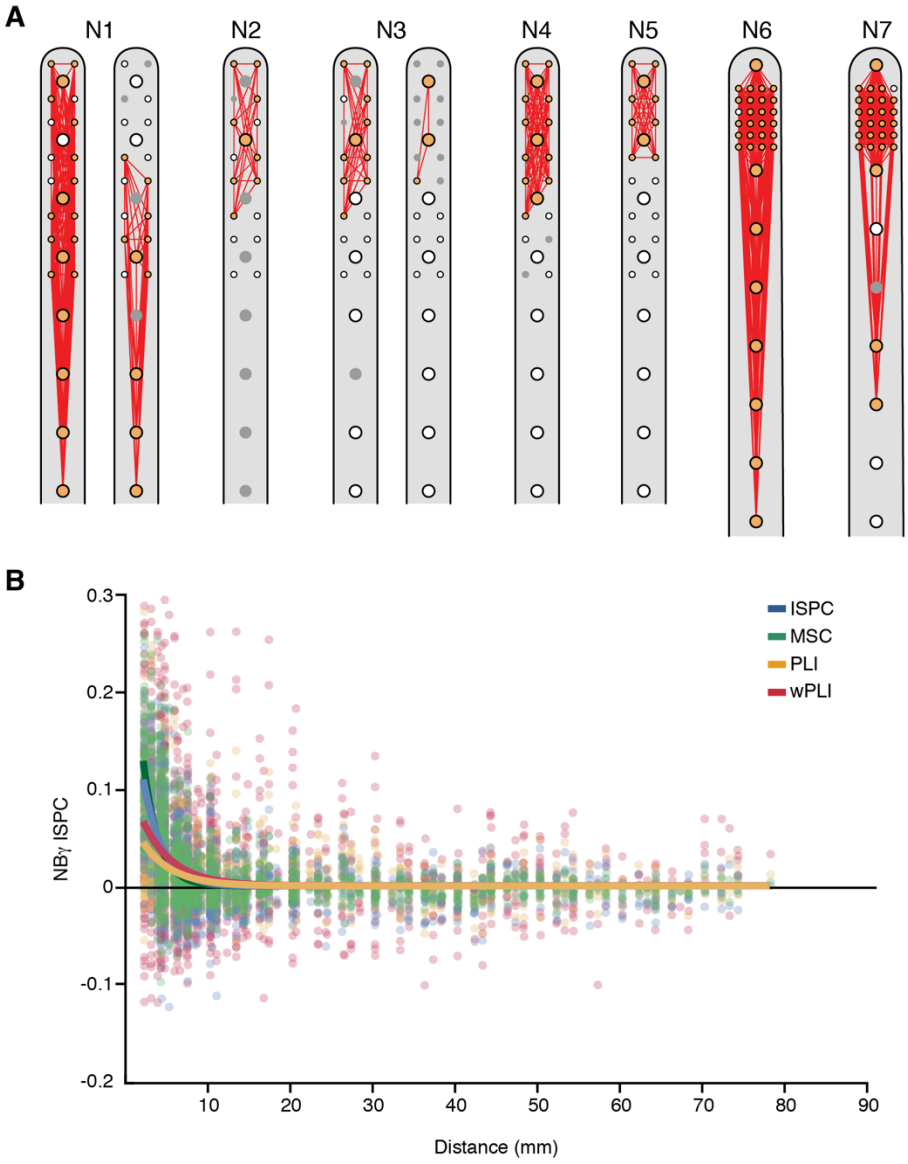

Figure S6. Electrode pairs and control metrics for NBG synchrony analysis. Related to Figure 3. A) Electrode array configurations for all subjects (N1-7), where red lines indicate all electrode pairs used in the phase-based synchrony analyses (electrode colors same as Figure S1). **B)** Scatter plot shows a comparison between the decay of NBG phase based synchrony over inter-electrode distance using different metrics (ISPC, inter-site phase clustering, MSC: mean squared coherence, PLI: phase lag index and wPLI: weighted phase lag index; see STAR Methods). Data is shown for the 20% contrast condition.

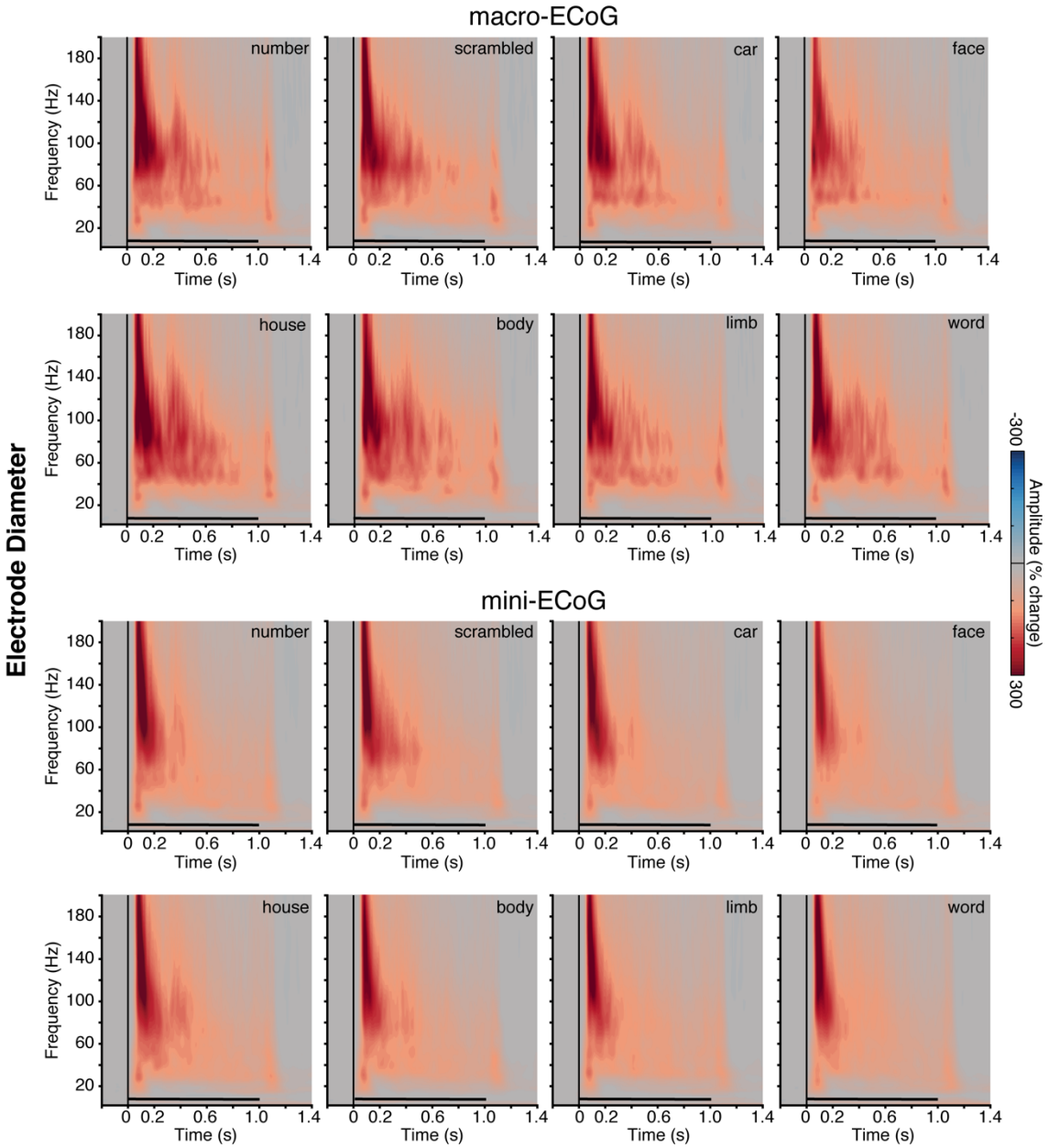

Figure S7. Influence of electrode size on spectral response in Experiment 2. Related to Figure 4. Spectrograms show group average time-frequency responses for the natural image categories in experiment 2. Spectrograms for the two electrode sizes (macro- and mini-ECoG) display similar responses to those reported in Figure 4, where electrode size was collapsed in data analyses. Macro-ECoG responses show some qualitative differences, with a longer duration BBG response, however they remain highly distinct from responses observed for Experiment 1.

# Subj	Sex	Age	Exp	Elec Array Configuration		# Elecs in OC						% OC Elecs in V1/V2		# Elecs with VEP in OC						% VEP Elecs in V1/V2	
				LH	RH	TOT	V1	V2	V3	V4	N/A	In V1/ V2	Out V1/V2	TOT	V1	V2	V3	V4	N/A	In V1/ V2	Out V1/V2
1	M	32	1	Ax2	-	44	20	12	9	3	-	73	27	29	15	9	3	2	-	83	17
2	M	44	1	-	A	16	10	5	1	-	-	94	6	9	8	1	-	-	-	100	-
3	M	54	1-2	A	A	36	10	6	4	-	16	44	56	13	9	3	1	-	-	92	8
4	M	20	1-2	A	-	22	11	6	1	1	3	77	23	14	11	3	-	-	-	100	-
5	M	47	1-2-3	A	-	24	5	6	6	3	4	46	54	10	5	5	-	-	-	100	-
6	F	37	1-2	-	B	32	3	6	15	7	1	28	72	31	3	6	14	7	1	29	71
7	M	25	1-2	B	-	31	26	3	1	-	1	94	6	27	25	2	-	-	-	100	-
8	M	53	3	B	-	31	1	15	1	-	14	52	48	8	1	7	-	-	-	100	-
9	F	19	3	B	-	31	6	18	1	-	6	77	23	6	2	4	-	-	-	100	-
10	F	41	3-4	B	-	31	25	2	1	-	3	87	13	23	22	1	-	-	-	100	-
						298	117	79	40	14	48			**170**	101	41	18	9	1		

Table S1. Subject and Electrode Information. Related to STAR Methods: Experimental Model and Subject Details. For each subject (#Subj 1-10, in bold) demographic and experimental information is reported in the following order: Sex (Male/Female), Age at time of experiment (years), the Experiments that were performed (Exp 1 = visual grating task, 2 = visual category task, 3 = visual color task, 4 = visual color/grayscale object task), Electrode Array Configuration (A or B) and the hemisphere on which it was placed (Left/Right). The electrode count in the region of interest (#Elecs in Occipital Cortex; OC) is subdivided by the total count (TOT) and the count within visual regions (V1,V2,V3,V4, see STAR Methods) and those not assigned to those regions (N/A). The percentage of occipital electrodes in V1/V2 (% OC Elecs in V1/V2) versus the percentage of electrodes outside V1/V2 (with respect to the total count) is reported. Lastly, the electrode count in occipital cortex of electrodes displaying a visual evoked potential (VEP, i.e. the electrodes that were used in all analyses, unless otherwise specified) is reported. The total count is subdivided by each visual region (V1, V2, V3, V4 & not assigned) as well as the percentage of VEP electrodes within and outside of V1/V2.