

Supplementary Table 1. Outcome variables and statistical comparisons between stimulation conditions for each assessed location. Median values and interquartile ranges (IQR; 25th and 75th percentiles) are shown for SNR (top), PLV to the stimulation (middle), and aperiodic exponent (bottom), across all conditions and locations. Statistical comparisons between conditions for each location were performed using the Wilcoxon signed-rank test.

Signal-to-noise ratio (SNR)

	Regular	Task	Irregular	Rest	Rest vs Regular	Rest vs Task	Rest vs Irregular	Irregular vs Regular	Irregular vs Task	Regular vs Task
	Median (IQR)				Z statistic (<i>p</i> -value)					
Hippocam (n = 60)	1.75 (1.25, 2.35)	2.16 (1.64, 2.86)	0.98 (0.91, 1.12)	0.96 (0.85, 1.04)	-6.61 (< 0.001)	-6.68 (< 0.001)	-1.86 (0.06)	-6.73 (< 0.001)	-6.72 (< 0.001)	-2.53 (0.01)
Insula (n = 22)	3.33 (2.38, 3.69)	3.70 (2.88, 5.16)	0.98 (0.90, 1.01)	1.05 (0.89, 1.12)	-4.11 (< 0.001)	-4.11 (< 0.001)	-1.18 (0.24)	-4.11 (< 0.001)	-4.11 (< 0.001)	-1.51 (0.13)
Temporal (n = 182)	1.46 (1.17, 2.64)	1.81 (1.38, 2.64)	0.99 (0.89, 1.10)	0.96 (0.88, 1.04)	-11.27 (< 0.001)	-11.64 (< 0.001)	-2.49 (0.01)	-10.71 (< 0.001)	-11.69 (< 0.001)	-4.42 (< 0.001)
Temporob (n = 67)	1.44 (1.10, 2.52)	1.98 (1.41, 2.92)	1.01 (0.93, 1.11)	0.97 (0.89, 1.06)	-6.71 (< 0.001)	-6.98 (< 0.001)	-2.48 (0.01)	-6.39 (< 0.001)	-7.06 (< 0.001)	-2.14 (0.03)
Frontal (n = 113)	1.39 (1.25, 1.87)	1.52 (1.18, 2.15)	0.96 (0.86, 1.05)	1.02 (0.89, 1.08)	-8.47 (< 0.001)	-8.28 (< 0.001)	-1.96 (0.05)	-8.94 (< 0.001)	-9.05 (< 0.001)	-3.45 (0.001)

Phase locking value (PLV) to the stimulation

	Regular	Task	Irregular	Rest	Rest vs Regular	Rest vs Task	Rest vs Irregular	Irregular vs Regular	Irregular vs Task	Regular vs Task
	Median (IQR)				Z statistic (<i>p</i> -value)					
Hippocam (n = 60)	0.21 (0.15, 0.27)	0.23 (0.19, 0.30)	0.14 (0.13, 0.15)	0.13 (0.12, 0.15)	-2.19 (0.03)	-5.97 (< 0.001)	-6.42 (< 0.001)	-6.61 (< 0.001)	-2.99 (0.003)	-6.46 (< 0.001)
Insula (n = 22)	0.28 (0.23, 0.40)	0.35 (0.26, 0.42)	0.14 (0.14, 0.14)	0.13 (0.10, 0.15)	-4.11 (< 0.001)	-4.11 (< 0.001)	-2.06 (0.04)	-4.11 (< 0.001)	-4.11 (< 0.001)	-1.22 (0.22)
Temporal (n = 182)	0.18 (0.15, 0.24)	0.20 (0.16, 0.24)	0.14 (0.13, 0.15)	0.14 (0.12, 0.15)	-10.92 (< 0.001)	-11.24 (< 0.001)	-2.43 (0.01)	-11.05 (< 0.001)	-11.61 (< 0.001)	-3.23 (0.001)
Temporob (n = 67)	0.18 (0.15, 0.25)	0.21 (0.17, 0.27)	0.14 (0.13, 0.15)	0.13 (0.12, 0.15)	-6.17 (< 0.001)	-6.76 (< 0.001)	-1.32 (0.18)	-6.53 (< 0.001)	-6.96 (< 0.001)	-1.72 (0.08)
Frontal (n = 113)	0.16 (0.15, 0.19)	0.17 (0.16, 0.20)	0.13 (0.13, 0.14)	0.14 (0.12, 0.16)	-6.14 (< 0.001)	-6.82 (< 0.001)	-1.51 (0.13)	-8.93 (< 0.001)	-8.97 (< 0.001)	-3.49 (< 0.001)

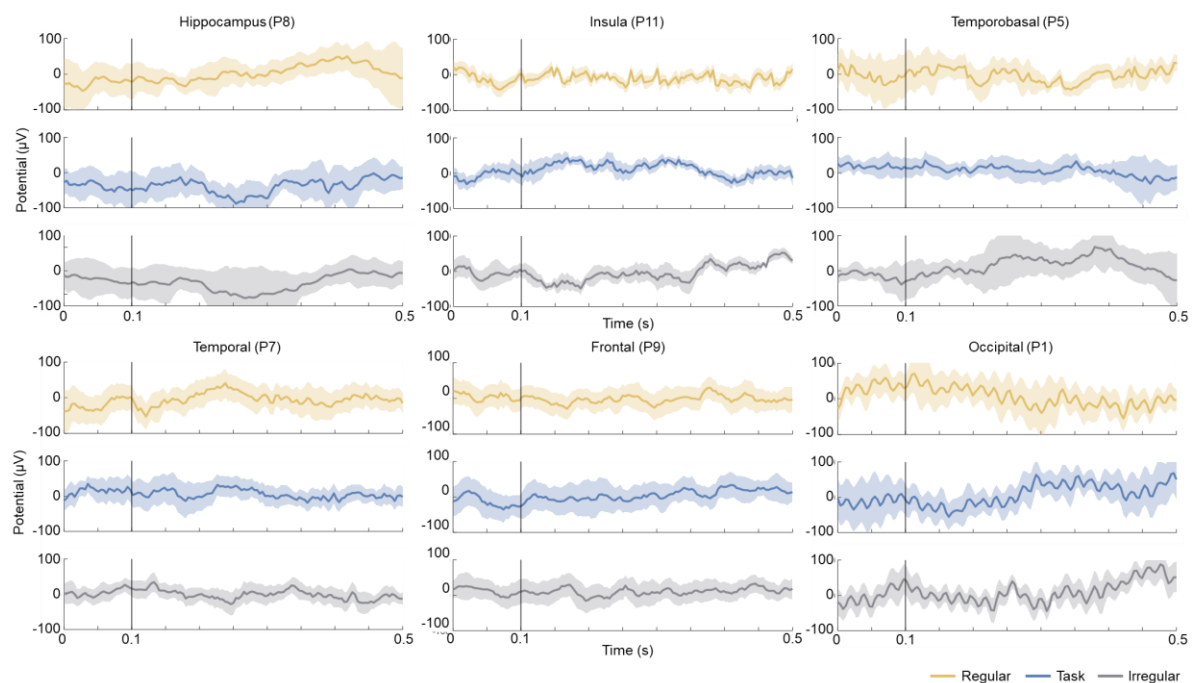
Aperiodic exponent

	Regular	Task	Irregular	Rest	Rest vs Regular	Rest vs Task	Rest vs Irregular	Irregular vs Regular	Irregular vs Task	Regular vs Task
	Median (IQR)				Z statistic (<i>p</i> -value)					
Hippocam (n = 60)	3.04 (2.32, 3.89)	3.23 (2.78, 4.05)	3.05 (2.38, 3.50)	3.98 (3.40, 4.55)	-3.55 (< 0.001)	-4.21 (< 0.001)	-3.41 (0.001)	-0.69 (0.49)	-2.85 (0.004)	-1.52 (0.13)
Insula (n = 22)	1.69 (0.69, 2.53)	2.35 (1.40, 2.62)	2.04 (1.15, 2.65)	1.98 (1.82, 2.27)	-2.10 (0.03)	-3.30 (0.001)	-2.86 (0.004)	-2.82 (0.005)	-2.37 (0.02)	-3.18 (0.001)
Temporal (n = 182)	3.21 (2.41, 3.55)	3.21 (2.61, 3.51)	3.09 (2.58, 3.43)	2.85 (2.32, 3.32)	-8.52 (< 0.001)	-6.73 (< 0.001)	-6.13 (< 0.001)	-0.59 (0.55)	-4.06 (< 0.001)	-1.28 (0.20)
Temporob (n = 67)	3.29 (2.21, 3.61)	2.98 (2.46, 3.50)	3.09 (2.46, 3.46)	2.75 (2.18, 3.39)	-3.23 (0.001)	-3.93 (< 0.001)	-2.80 (0.005)	-0.21 (0.84)	-0.70 (0.48)	-0.09 (0.92)
Frontal (n = 113)	2.37 (1.85, 2.89)	2.17 (1.98, 2.64)	2.27 (1.98, 2.55)	2.22 (1.90, 2.81)	-3.61 (< 0.001)	-0.01 (0.99)	-0.02 (0.99)	-3.83 (< 0.001)	-1.88 (0.06)	-3.55 (< 0.001)

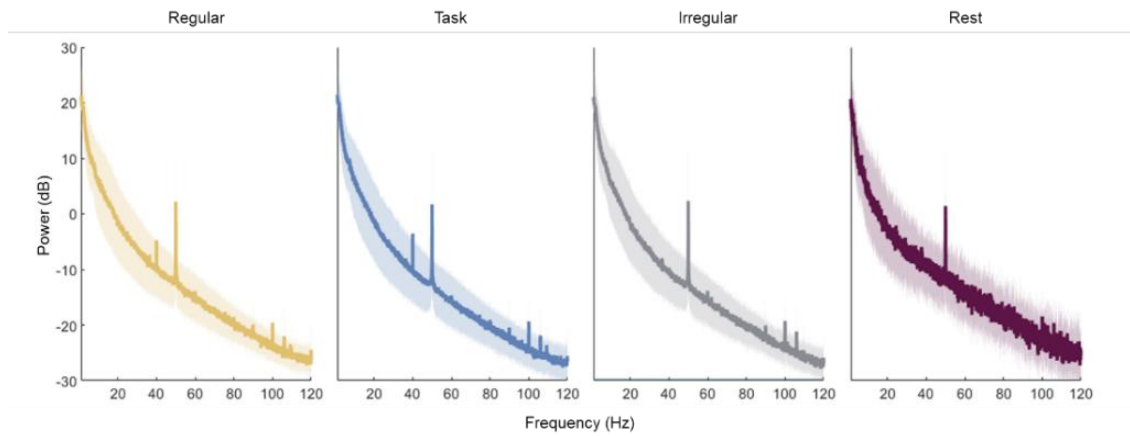
Supplementary Table 2. Demographic information, electrode locations, Medial Temporal Lobe Atrophy Score (MTA), and hippocampal integrity per patient.

Patient	Age	Gender	Electrode location	MTA	Hippocampal integrity
P1	24	F	1 depth electrode (6 contacts) in the right hippocampus 1 depth electrode (4 contacts) in the right posterior insula 1 depth electrode (4 contacts) in the right temporal operculum 1 subdural grid (8 x 4 contacts) over the right temporo-occipital cortex 1 subdural grid (2 x 5 contacts) over the right occipital cortex 2 subdural strips over the right temporal cortex 1 anterior strip (4 contacts) 1 basic strip (4 contacts)	2	Some atrophy of the right temporal lobe, including the right hippocampus. No hippocampal sclerosis.
P2	18	F	1 depth electrode (6 contacts) in the left hippocampus 1 subdural grid (4 x 4 contacts) over the left frontal apical cortex 1 subdural grid (2 x 6 contacts) over the left frontobasal cortex 1 subdural grid (4 x 4 contacts) over the left temporal cortex	2	Mesial temporal sclerosis left.
P3	40	M	1 subdural grid (4 x 4 contacts) over the right parietal cortex 1 subdural grid (2 x 6 contacts) over the right supplementary motor area	/	/
P4	42	M	1 depth electrode (8 contacts) in the left hippocampus 1 subdural grid (4 x 8 contacts) over the left temporal cortex 2 subdural strips over the left temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts)	0	Gliotic transformation in uncus of the parahippocampal gyrus left.
P5	47	F	1 depth electrode (8 contacts) in the right hippocampus 1 subdural strip (4 contacts) at the level of the right planum temporale (cf. cortical injury) 1 subdural grid (4 x 5 contacts) over the right temporal cortex 2 subdural strips over the right temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts)	0	Normal findings.
P6	22	F	1 depth electrode (8 contacts) in the right hippocampus 1 subdural grid (4 x 5 contacts) over the right temporal cortex 2 subdural strips over the right temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts) 1 subdural strip (6 contacts) over the right frontolaterobasal cortex 2 subdural strip over the left temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts) 1 subdural strip (6 contacts) over the left temporolateral cortex	0	Normal findings.
P7	48	M	1 depth electrode (8 contacts) in the right hippocampus 1 subdural strip (8 contacts) over the right frontolateral cortex 1 subdural grid (4 x 5 contacts) over the right temporal cortex 2 subdural strips over the right temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts) 1 subdural strip (6 contacts) over the left temporolateral cortex 2 subdural strips over the left temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts)	0	Incomplete hippocampal inversion left. Normal morphology of both hippocampi with no mesial temporal sclerosis.

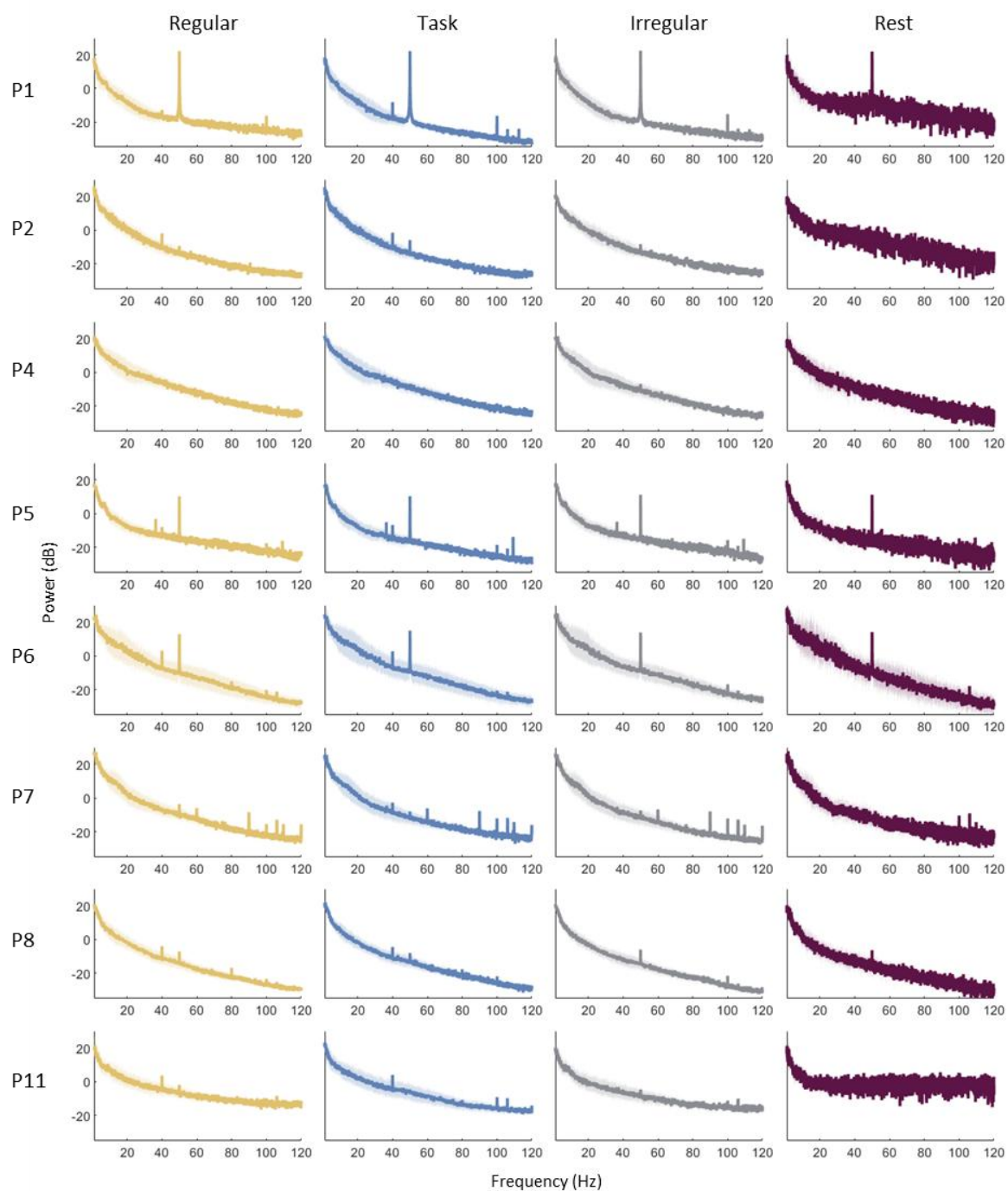
P8	15	M	1 depth electrode (8 contacts) in the left hippocampus 1 depth electrode (10 contacts) in the left insular region 1 subdural grid (4 x 5 contacts) over the left temporal cortex 2 subdural strips over the left temporobasal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts)	0	Impression of slightly smaller and plumper hippocampus left compared to right.
P9	20	M	1 depth electrode (4 contacts) at the level of the periventricular heterotopia right frontal 1 subdural strip (8 contacts) over the right frontopolar cortex 1 subdural strip (8 contacts) over the right frontolateral cortex 1 subdural strip (8 contacts) over the left frontopolar cortex 1 subdural strip (8 contacts) over the left frontolateral cortex	/	/
P10	14	F	1 depth electrode (4 contacts) in anterior flank of the right frontal focal cortical dysplasia 1 depth electrode (4 contacts) in posterior flank of the right frontal focal cortical dysplasia 1 subdural grid (4 x 5 contacts) in the right frontodorsal cortex	/	/
P11	40	F	1 depth electrode (8 contacts) in the left hippocampus 1 depth electrode (8 contacts) in the left insular region 1 subdural grid (4 x 5 contacts) over the left temporal cortex 1 subdural strip (4 contacts) over the left temporobasal cortex 2 subdural strips over the left orbitofrontal cortex 1 anterior strip (4 contacts) 1 posterior strip (4 contacts)	2	Partial atrophy of left hippocampus, without sclerosis or loss of structure.



Supplementary Figure 1. Raw LFP traces at the beginning of stimulation. For each assessed brain region, the averaged activity across corresponding contacts is shown at the onset of stimulation for one example patient. Solid lines and shaded areas indicate mean $\pm$ standard deviation. The vertical gray line indicates the start of stimulation.

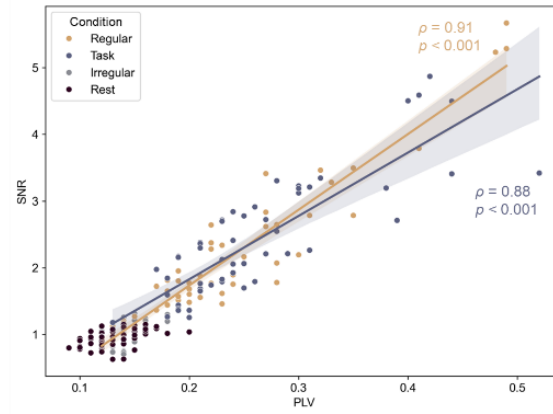


Supplementary Figure 2. Mean power spectra for all hippocampal contacts across patients. Power, averaged across all hippocampal contacts on a group level, is shown across the full spectrum for three stimulation conditions and a one-minute rest period before the first stimulation. Solid lines and shaded areas represent the mean $\pm$ SD. Note that five minutes of data were obtained for the stimulation conditions, and only one minute for the rest period.

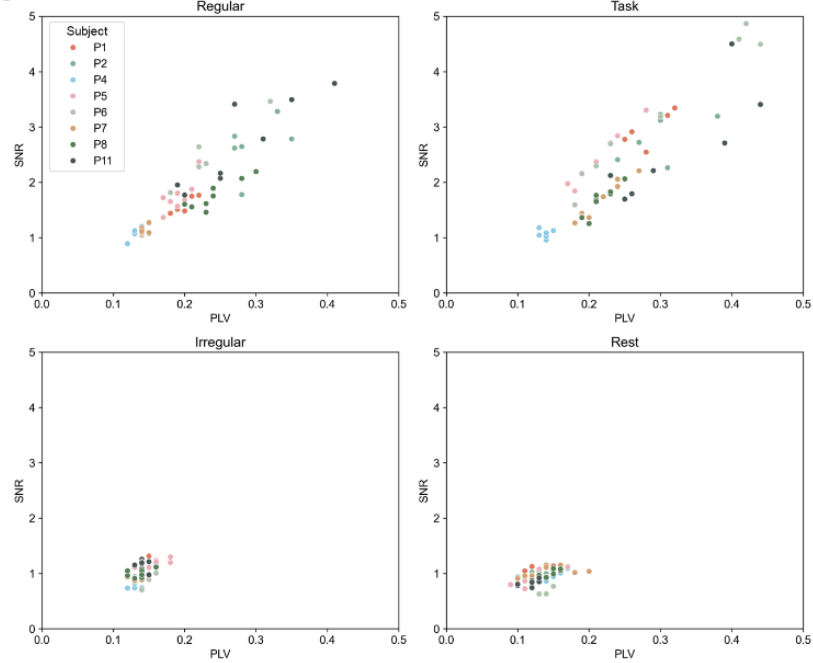


Supplementary Figure 3. Mean power spectra across hippocampal contacts for each patient. Power, averaged across all hippocampal contacts per patient, is shown across the full frequency spectrum for three stimulation conditions and a one-minute rest period before the first stimulation. Solid lines and shaded areas represent the mean $\pm$ SD. Note that five minutes of data were obtained for the stimulation conditions and only one minute for the rest period.

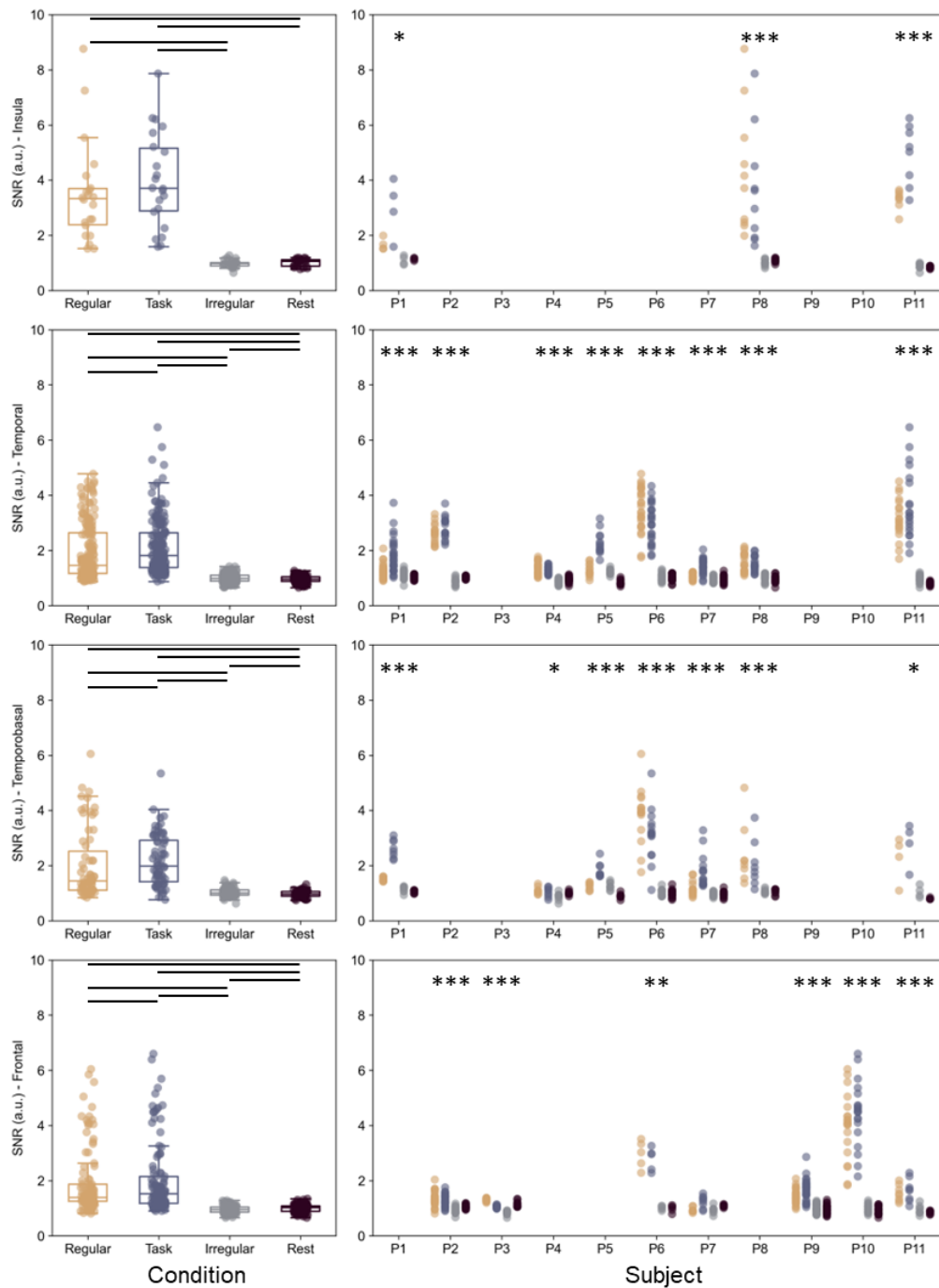
A



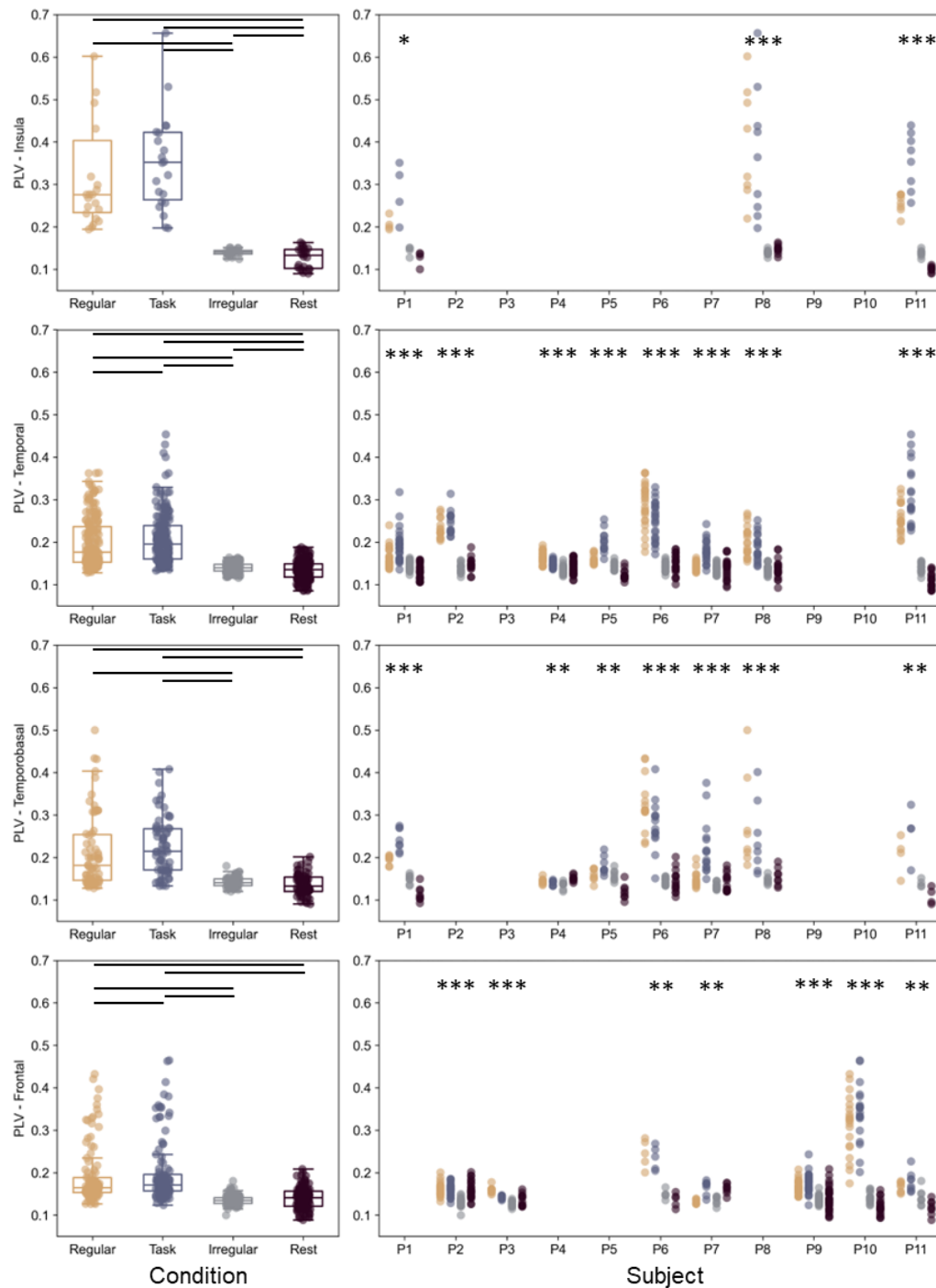
B



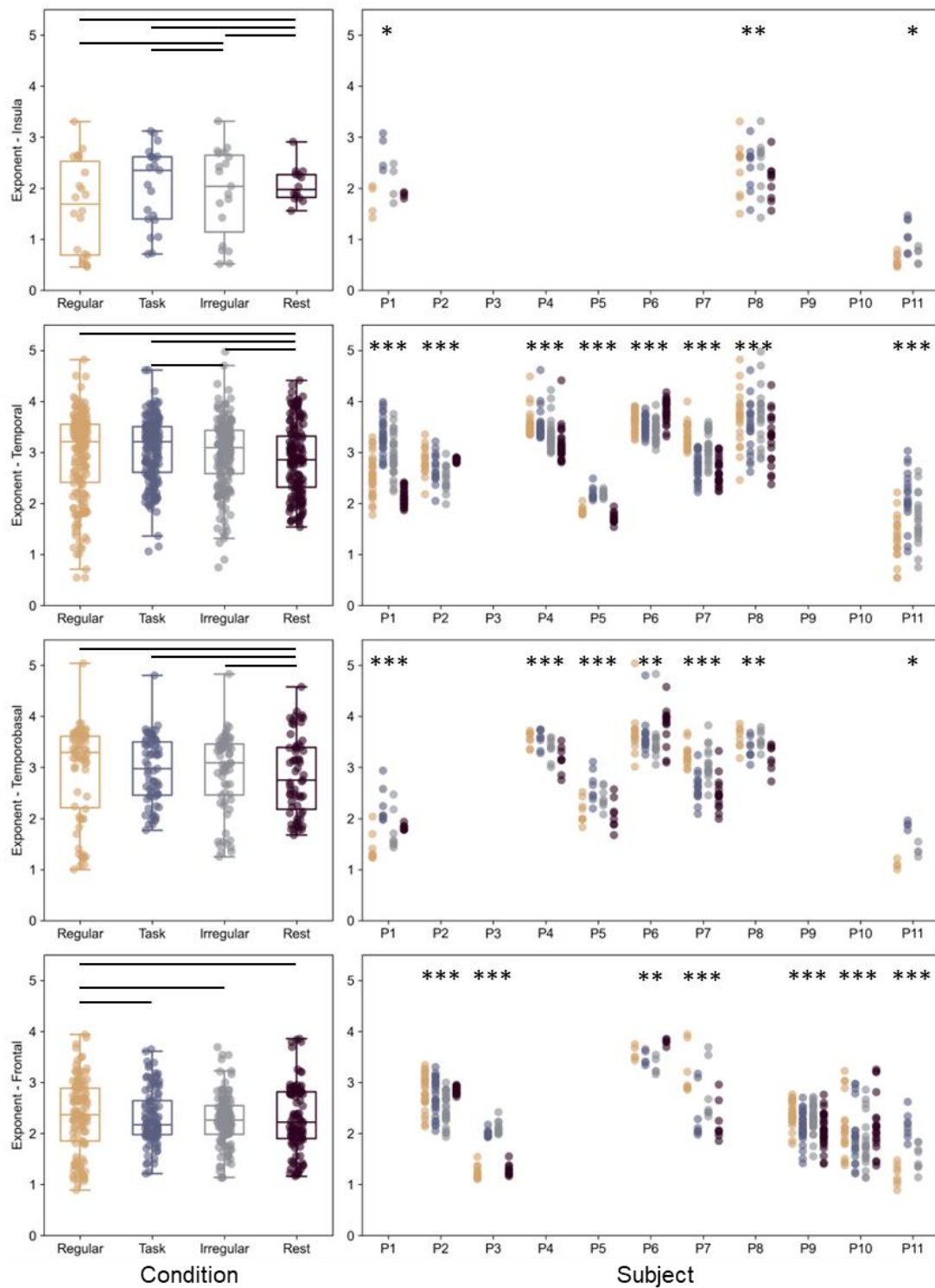
Supplementary Figure 4. Correlation between SNR and PLV. (A) Correlation plot showing SNR as a function of PLV to the stimulation for all hippocampal contacts across patients for each condition. A linear regression line shows a significant correlation ρ (Spearman's rank correlation analysis). Each circle represents one hippocampal contact. **(B)** Correlation plots shown separately for each condition and color-coded by patient. Each circle represents one hippocampal contact.



Supplementary Figure 5. SNR results for other brain regions. Signal-to-noise ratio (SNR) for each contact is shown at the group (left) and patient (right) level for other brain regions (insula, temporal, temporobasal, and frontal) for each condition. Each dot represents a single contact. Each row displays patients who had electrodes implanted in the corresponding region. Color convention: yellow – Regular, blue – Task, gray – Irregular, purple – Rest. Box plots: The central line on each box indicates the median, and the bottom and top edges indicate the lower (Q1, 25th percentile) and upper quartile (Q3, 75th percentile). The whiskers indicate the range from $Q1 - 1.5 \times IQR$ to $Q3 + 1.5 \times IQR$, where the inter-quartile range (IQR) is defined as $Q3 - Q1$. The horizontal black lines denote a statistically significant difference between conditions (Wilcoxon signed-rank test, $p < 0.05$). Asterisks indicate significant differences between conditions per patient (nonparametric Friedman test; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

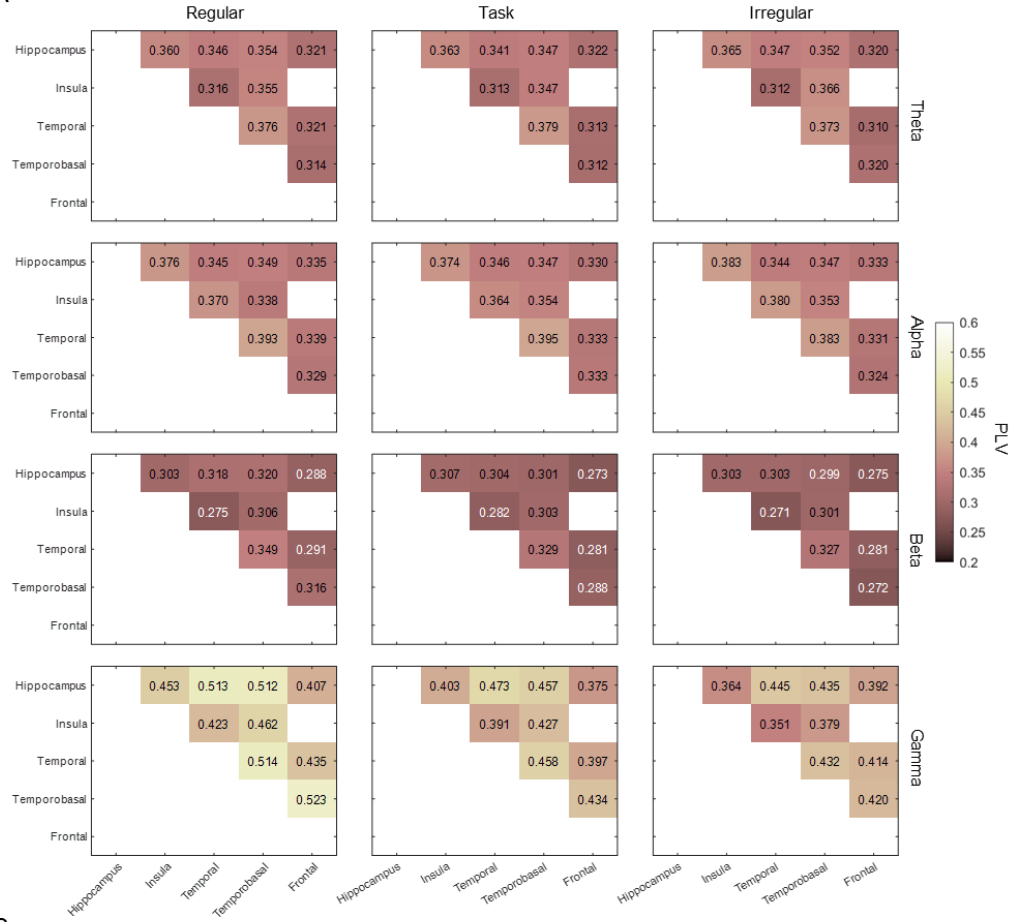


Supplementary Figure 6. PLV to the stimulation for other brain regions. Phase locking value (PLV) to the stimulation for each contact is shown at the group (left) and patient (right) level for other brain regions (insula, temporal, temporobasal, and frontal) for each condition. Each dot represents a single contact. Each row displays patients who had electrodes implanted in the corresponding region. Color convention: yellow – Regular, blue – Task, gray – Irregular, purple – Rest. Box plots follow the same convention as in Supplementary Figure 4: the central line indicates the median, box edges represent the 25th and 75th percentiles, and whiskers extend to $1.5 \times$ the interquartile range. The horizontal black lines denote a statistically significant difference between conditions (Wilcoxon signed-rank test, $p < 0.05$). Asterisks indicate significant differences between conditions per patient (nonparametric Friedman test; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

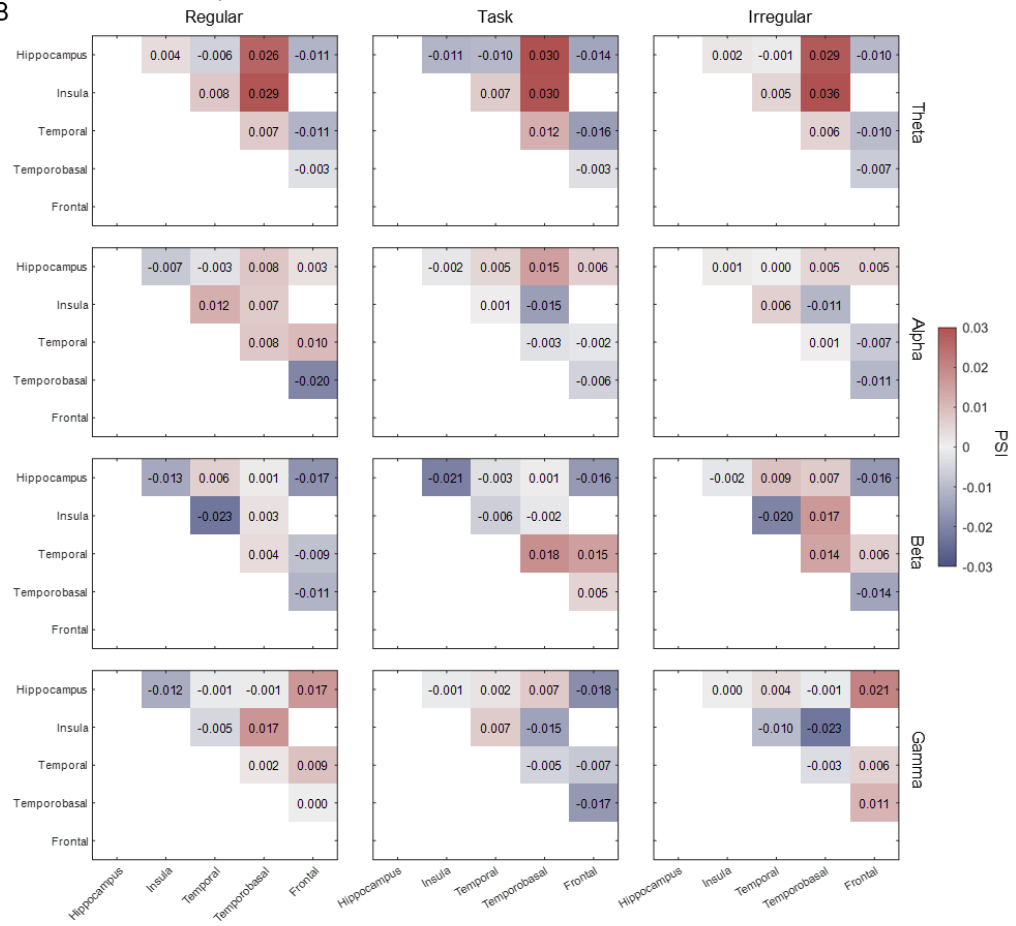


Supplementary Figure 7. Aperiodic exponent for other brain regions. Aperiodic exponent extracted from the gamma range (frequencies between 30 to 120 Hz) for each contact is shown at the group (left) and patient (right) level for other brain regions (insula, temporal, temporobasal, and frontal) for each condition. Each dot represents a single contact. Each row displays patients who had electrodes implanted in the corresponding region. Color convention: yellow – Regular, blue – Task, gray – Irregular, purple – Rest. Box plots follow the same convention as in Supplementary Figure 4: the central line indicates the median, box edges represent the 25th and 75th percentiles, and whiskers extend to $1.5 \times$ the interquartile range. The horizontal black lines denote a statistically significant difference between conditions (Wilcoxon signed-rank test, $p < 0.05$). Asterisks indicate significant differences between conditions per patient (nonparametric Friedman test; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

A

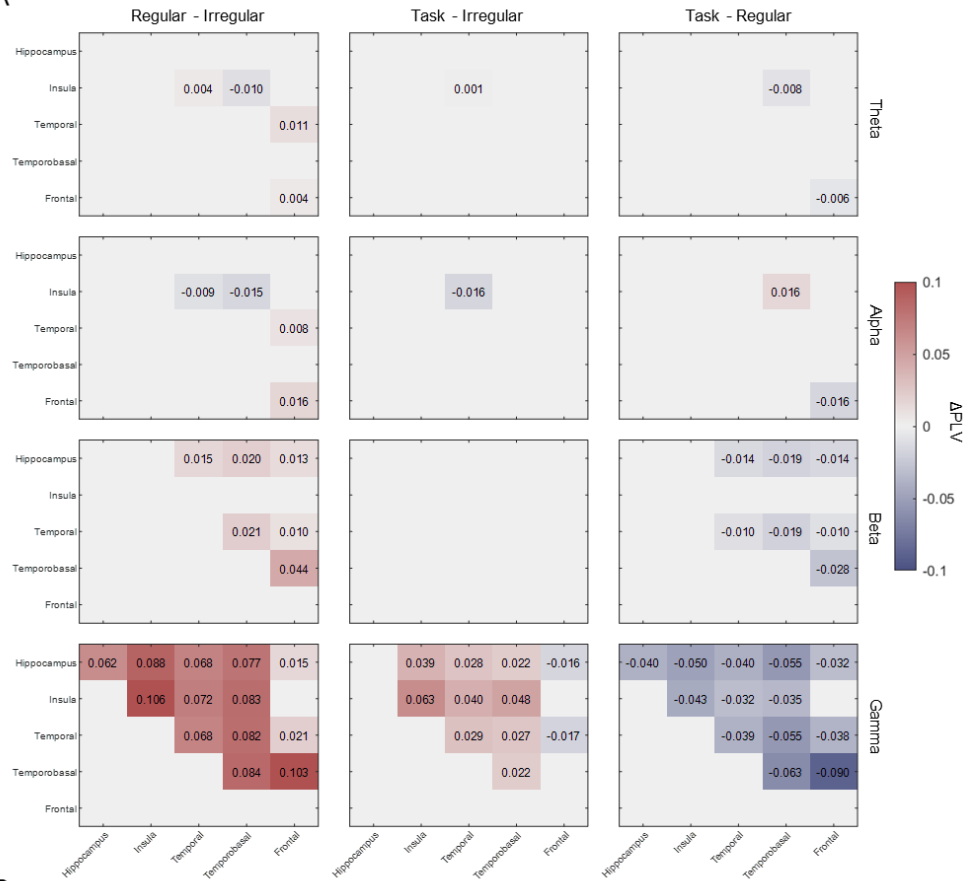


B

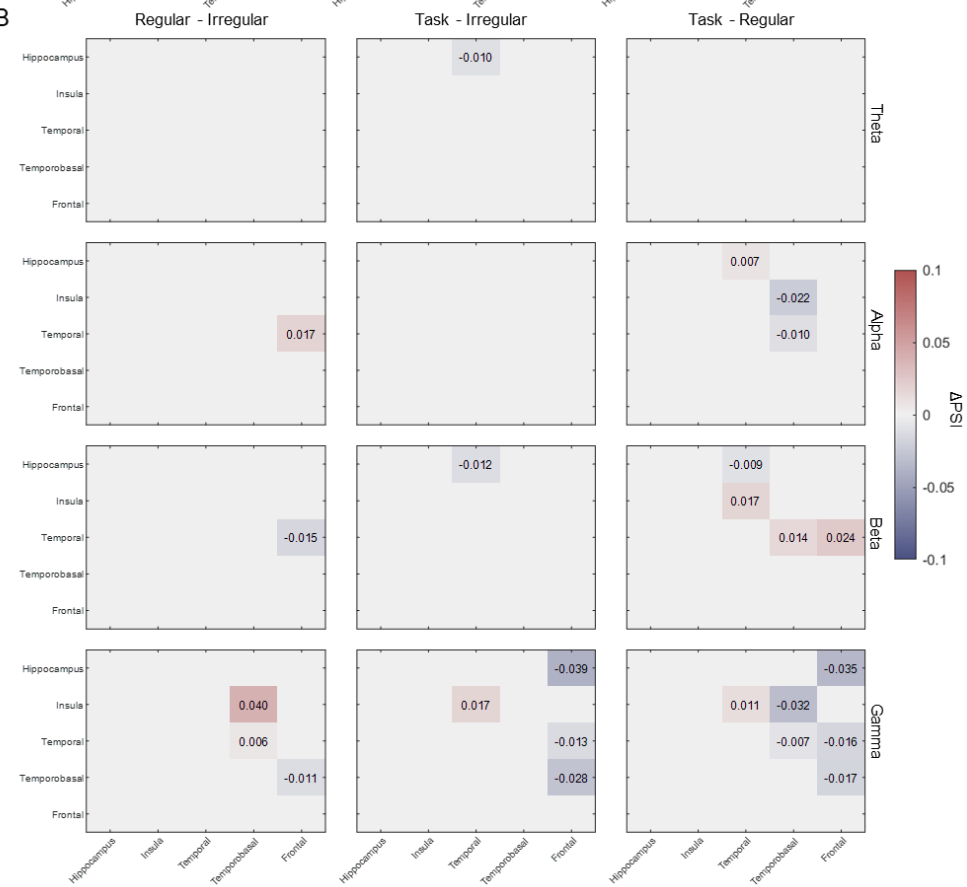


Supplementary Figure 8. Mean PLV and PSI for significant contact pairs for each stimulation conditions and frequency bands. For each patient, PLV (**A**) and phase-slope index (PSI; **B**) were estimated between all contact pairs during five minutes of stimulation for each condition and frequency band (theta, alpha, beta, and gamma around the stimulation frequency). Only contact pairs showing significant interaction in all three stimulation conditions were retained and averaged across patients and assessed regions.

A



B



Supplementary Figure 9. Mean differences in PLV and PSI between stimulation conditions across frequency bands. Only contact pairs that showed significant interaction in all three stimulation conditions were retained and averaged across patients and assessed regions. Mean differences in PLV (**A**) and PSI (**B**) were calculated for each frequency band and region pair between stimulation conditions. Only statistically significant differences are shown (linear mixed effects model with FDR correction for multiple comparisons; $p < 0.05$).



Supplementary Figure 10. Mean PLV and PSI between all region pairs across stimulation conditions and frequency bands. For each patient, PLV (A) and PSI (B) were estimated between all contact pairs over a five-minute stimulation period for different frequency bands (theta, alpha, beta, and gamma around the stimulation frequency). Values exceeding the significance threshold were retained, and contact pairs showing significant interaction across all conditions were aggregated by assessed regions. Box plots

follow the same convention as in Supplementary Fig. 4, with the central line indicating the median and the box indicating IQR. The dot indicates the mean value. Color convention: yellow – Regular, blue – Task, gray – Irregular. Positive PSI values indicate information flow from the hippocampus to the regions of interest and negative PSI values indicate a reversed flow.