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Direct brain recordings reveal continuous encoding of structure in random stimuli

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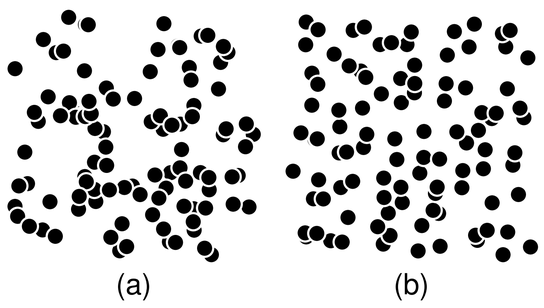
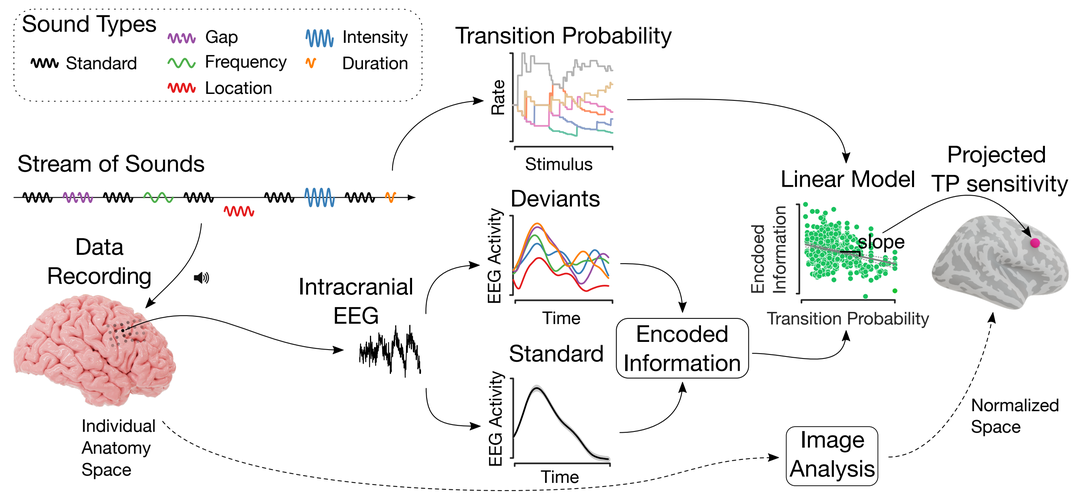
Which One is Random? (a) or (b)?



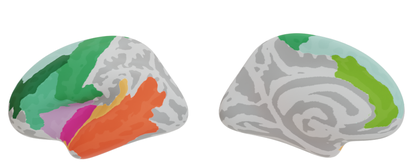
Perceptual models of the brain lets us see patterns were there are none.
While it is likely that these models draw on **statistical structures** in the sensory input, it remains elusive how and where this exactly takes place.

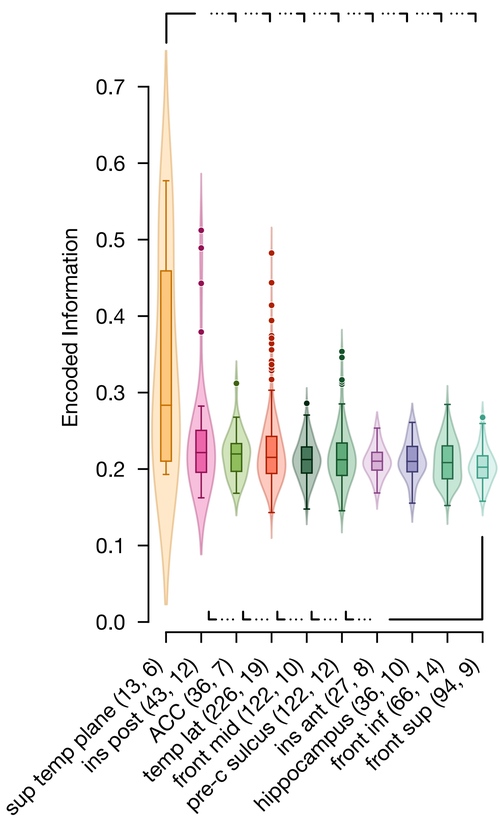
Analysis Overview



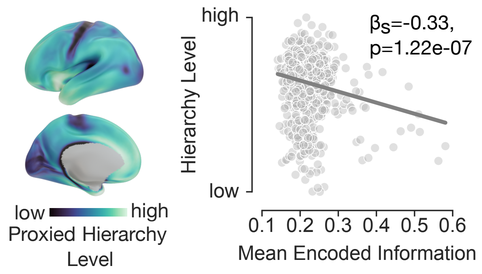
Deviance Detection

Encoded Information. Estimates the information content of deviant responses relative to a standard response. Lower values suggest similar, and higher values rather different responses. Based on Kolmogorov-complexity and high-frequency activity (HFA; 75 to 145 Hz) (1).

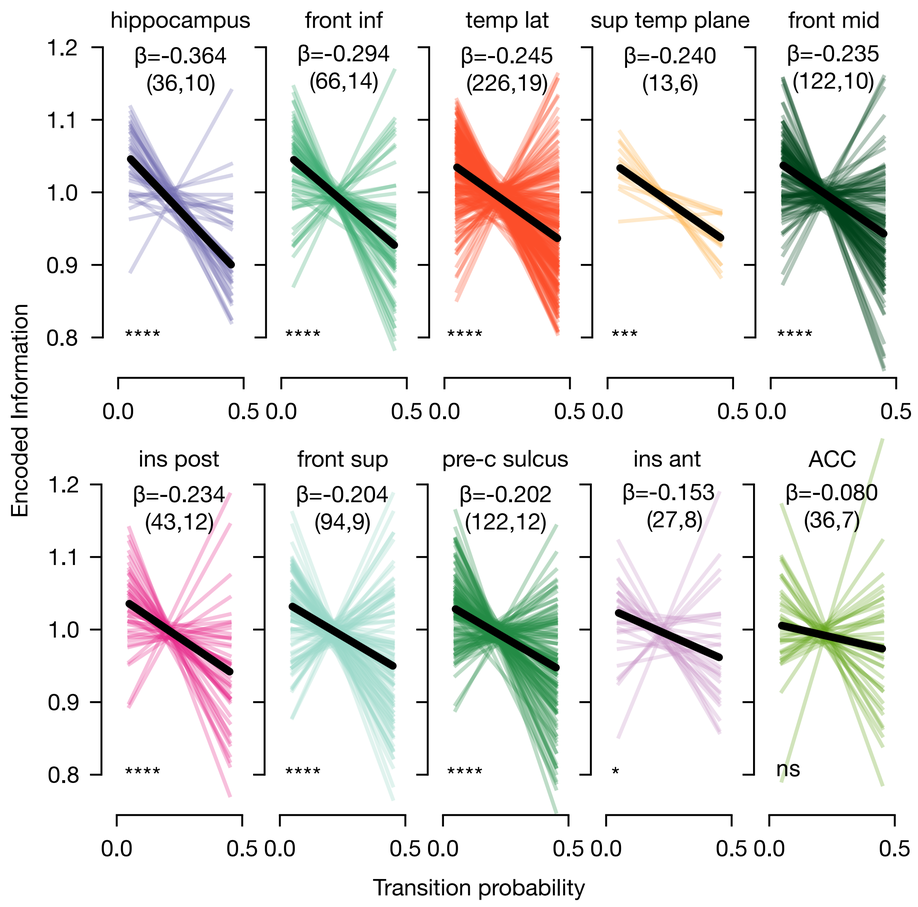




Results. Encoding of deviants was not strictly confined to specific areas, but distributed across multiple brain regions in a hierarchically organized manner, involving among our regions of interest (**ROIs**), the superior temporal plane and posterior insula.



Sensitivity to Transitional Probabilities



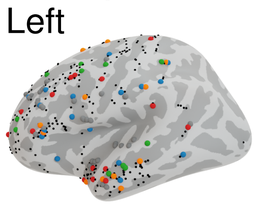
Results. 61.53 % of 785 channels from 22 subjects showed a significant *TP sensitivity*: These channels tended to increase the amount of encoded information for low TP and conversely decreased the encoded information for high TP (2).

Conclusion. While automatically assessing the deviance of events, the brain simultaneously identifies patterns by encoding conditional relations between events. This implicit process involves, in addition to the hippocampus, inferior frontal cortices, pure sensory areas, and other cortical regions.

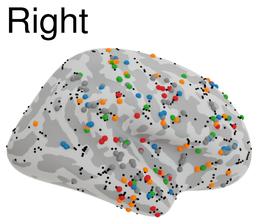
Other Frequencies

Deviant vs. Standard by channel:

Left

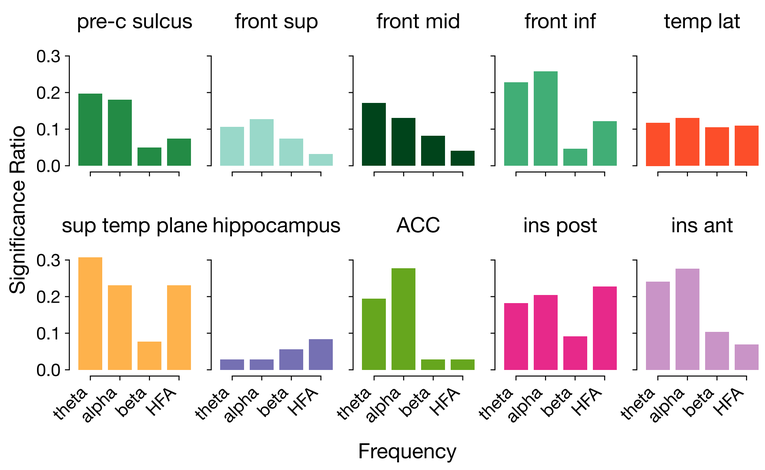


Right



theta alpha beta HFA
mixed n.s.

Channels with a significant t value relative to all channels per ROI.



References

1. J. Fuhrer, A. Blenkmann, T. Endestad, A.-K. Solbakk, and K. Glette, “Complexity-based encoded information quantification in neurophysiological recordings,” 2022.
2. J. Fuhrer, K. Glette, J. Ivanovic, P. G. Larsson, T. Bekinschtein, S. Kochen, R. T. Knight, J. Tørresen, A.-K. Solbakk, T. Endestad, and A. Blenkmann, “Direct brain recordings reveal continuous encoding of structure in random stimuli,” *bioRxiv*, 2021.

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