

Supplementary materials for: High-level cognition during story listening is reflected in high-order dynamic correlations in neural activity patterns

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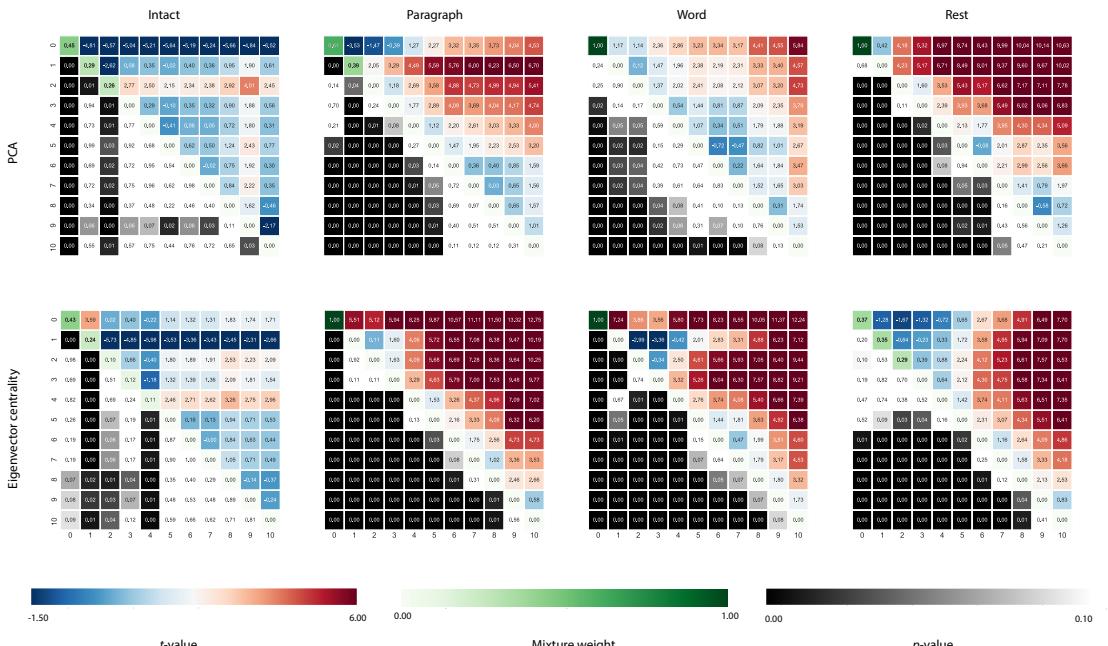
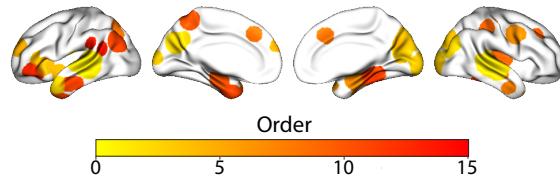
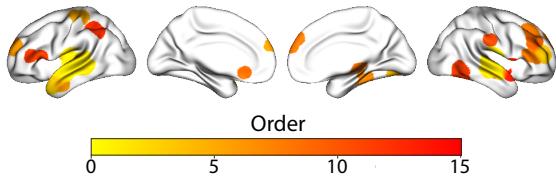


Figure S1: Heatmaps conveying statistical results comparing decoding accuracy for each order. For each condition (intact, paragraph scrambled, word scrambled, and rest) and for each reduction technique (PCA and eigenvector centrality), we compared the distribution of decoding accuracy for each order. The upper triangle of each heatmap conveys the results of t-tests, and the lower triangle conveys corresponding p-values. The diagonal is the results of the optimization of the phi parameter.



Order 1	Order 2	Order 3	Order 4	Order 5
speech sts auditory voice superior temporal sounds stg auditory cortex heschl temporal	sts voice temporal sulcus sounds speech comprehension tom network superior temporal person	v1 early visual cuneus visual cortex visual blind occipital vision sighted primary visual	anterior insula insula stop signal stop anterior unpleasant insular cortex response response inhibition vlpfc	visual occipital cuneus ofc cortex ofc visual cortex visual field orbitofrontal angular extrastriate
Order 6	Order 7	Order 8	Order 9	Order 10
temporal lobe lobe amygdala putamen lingual categories pole insula disease ad temporal pole	hippocampus hippocampal memory encoding lobe mtl temporal lobe mtl medial temporal anterior hippocampus encoding amygdala	recognition temporal lobes fusiform gyrus fusiform face anterior temporal face ffa fusiform ffa temporal lobe categories	monitoring anterior insula conflict insula anterior frontal cortex medial frontal insula anterior error insular	insular intensity posterior insular cortex secondary somatosensory tactile discriminative insula sii primary secondary
Order 11	Order 12	Order 13	Order 14	Order 15
hippocampal hippocampus memory anterior hippocampus episodic amygdala medial temporal retrieval parahippocampal mtl	retrosplenial temporal pole navigation face recognition anterior temporal pole recognize angular angular gyrus cuneus	parahippocampal cortex objects parahippocampal place episodic memory episodic locations memories medial temporal autobiographical	ba ba 44 extrastrate pleasant faces fusiform face object viewing	index finger contralateral finger motor task hand s1 sensorimotor cortex primary somatosensory m1 ipsilateral

Figure S2: Top 10 terms associated with the endpoints of the strongest correlations for the intact experimental condition. Each color corresponds to orders 1-15 of inter-subject functional correlations. The inflated brain plots display the locations of the endpoints of the 10 strongest (absolute value) correlations at each order, projected onto the cortical surface (Combrisson et al., 2019). The lists of terms on the right display the top 10 Neurosynth terms (Rubin et al., 2017) decoded from the corresponding brain maps for each order for the intact condition.

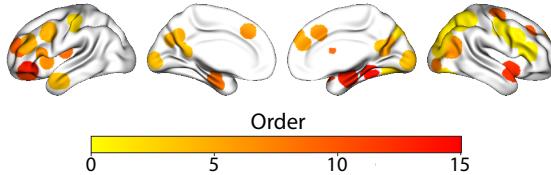


Order 1	Order 2	Order 3	Order 4	Order 5
auditory sounds speech auditory cortex superior temporal stg voice heschl pitch heschl gyrus	sounds auditory speech superior temporal voice auditory cortex planum spoken sts	sounds auditory superior temporal pitch superior temporal planum auditory cortex stg temporale planum temporela	decision task visual stimulus recruited word pairs regardless respectively generally stimulus classic character	occipital inferior occipital dlpfc visual thalamic lateral occipital cortex dlpfc extrastriate dorsomedial dorsolateral prefrontal
Order 6	Order 7	Order 8	Order 9	Order 10
putamen music vocal mind tom tom auditory stimuli heard theory of mind mind tone	inferior frontal lobe mtl medial temporal frontal gyrus parahippocampal cortex semantic mtl dorsolateral prefrontal lateral prefrontal concepts	face recognition verb face frontal gyrus ffa inferior frontal fusiform face recognition verbs face ffa	nucleus accumbens accumbens subgenual ventral striatum prediction dorsomedial perfrontal prediction error outcome dorsomedial ventral premotor	prefrontal dorsolateral prefrontal precuneus posterior prefrontal cortex cortex precuneus dorsomedial dorsolateral medial precuneus posteral cingulate
Order 11	Order 12	Order 13	Order 14	Order 15
2 somatosensory touch somatosensory cortex parietal junction tactile pain junction 1 somatosensory somatosensory s1	orthographic reading chinese visual word form word word occipitotemporal written words	inferior parietal decision ips choice sulcus ips anterior intraparietal maintenance intraparietal intraparietal sulcus decision making	anterior superior speech auditory listening spoken frontal operculum temporal gyrus superior temporal thalamic sounds	sts temporal sulcus sulcus sts mental states dorsomedial dorsomedial prefrontal speaker medial superior temporal superior

Figure S3: Top 10 terms associated with the endpoints of the strongest correlations for the paragraph scrambled condition. Each color corresponds to orders 1-15 of inter-subject functional correlations for the paragraph scrambled condition. The inflated brain plots display the locations of the endpoints of the 10 strongest (absolute value) correlations at each order, projected onto the cortical surface (Combrisson et al., 2019). The lists of terms on the right display the top 10 Neurosynth terms (Rubin et al., 2017) decoded from the corresponding brain maps for each order.



Figure S4: Top 10 terms associated with the endpoints of the strongest correlations for the word scrambled condition. Each color corresponds to orders 1-15 of inter-subject functional correlations for the word scrambled condition. The inflated brain plots display the locations of the endpoints of the 10 strongest (absolute value) correlations at each order, projected onto the cortical surface (Combrisson et al., 2019). The lists of terms on the right display the top 10 Neurosynth terms (Rubin et al., 2017) decoded from the corresponding brain maps for each order.



Order 1	Order 2	Order 3	Order 4	Order 5
parietal calculation ips intraparietal superior parietal tasks subtraction task action numbers	visual occipital v1 extrastriate motion sighted visual cortex object occipital cortex visual field	network expectancy task ica additional networks load memory load spl parietal	autobiographical anterior temporal default network autobiographic default real scene mental retrosplenial dmn	dorsolateral dorsolateral prefrontal cognitive dlpfc memory load tasks working working memory lateral prefrontal load
Order 6	Order 7	Order 8	Order 9	Order 10
dorsomedial medial dorsomedial prefrontal cortex mpfc medial prefrontal mpfc memories temporal pole pole recollection	anterior insula insula frontal cortex anterior monitoring insular insula anterior picture error conflict	occipital precuneus precuneus posterior visual cortex precuneus parietal ipl occipital cortex superior parietal motion	posterior insula amygdala hippocampus accumbens nucleus accumbens amygdala anterior hippocampus hippocampus hippocampal monetary sii	person face ffa fusiform face dorsolateral prefrontal ffa production categories theory mind tpj speech
Order 11	Order 12	Order 13	Order 14	Order 15
1 somatosensory hippocampal hippocampus somatosensory cortex tactile s1 amygdala hippocampus somatosensory touch sensory	orthographic reading chinese visual word form word form word occipitotemporal written word	olfactory amygdala taste insula disgust ratings amygdala response painful food posterior insula	amygdala response amygdala hippocampus amygdala responses retrosplenial episodic retrieval amygdala hippocampus emotional stimuli fearful	nucleus accumbens monetary incentive prediction error accumbens incentive striatum reinforcement monetary ventral striatum prediction

Figure S5: Top 10 terms associated with the endpoints of the strongest correlations for the rest condition. Each color corresponds to orders 1-15 of inter-subject functional correlations for the rest condition. The inflated brain plots display the locations of the endpoints of the 10 strongest (absolute value) correlations at each order, projected onto the cortical surface (Combrisson et al., 2019). The lists of terms on the right display the top 10 Neurosynth terms (Rubin et al., 2017) decoded from the corresponding brain maps for each order.

Supplemental references

- Combrisson, E., Vallat, R., O'Reilly, C., Jas, M., Pascarella, A., I Saive, A., Thiery, T., Meunier, D., Altukhov, D., Lajnef, T., Ruby, P., Guillot, A., and Jerbi, K. (2019). Visbrain: a multi-purpose GPU-accelerated open-source suite for multimodal brain data visualization. *Frontiers in Neuroinformatics*, 13(14):1–14.
- Rubin, T. N., Kyoejo, O., Gorgolewski, K. J., Jones, M. N., Poldrack, R. A., and Yarkoni, T. (2017). Decoding brain activity using a large-scale probabilistic functional-anatomical atlas of human cognition. *PLoS Computational Biology*, 13(10):e1005649.