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To the editors of *Nature Neuroscience*:

We have enclosed our manuscript entitled *High-order cognition is supported by information-rich but compressible brain activity patterns* to be considered for publication as an *Article*. Our manuscript uses dimensionality reduction algorithms and pattern classifiers to explore how informative and compressible (in the information theory senses of those words) brain activity patterns are, under different cognitive circumstances.

We developed a computational framework for evaluating our two measures of interest (informativeness and compressibility), and we applied the framework to a public fMRI dataset. In the dataset's experiment, participants either listened to an auditory recording of a story, listened to temporally scrambled recordings of the story (randomizing the orders of paragraphs or words), or underwent a resting state scan. Each condition is designed to engage cognitive processing and engagement at different depths. For example, listening to the intact story leads participants to mentally engage with the narrative, and to deeply process and connect narrative events in a way that leads to a rich understanding of the story. Listening to temporally scrambled versions of the story might lead to understanding individual paragraphs or words. However, individual moments in the temporally scrambled stories lack contextual elements that enable participants to gain a deeper understanding. Across conditions, we found that both informativeness and compressibility of the brain patterns changed systematically with the cognitive "richness" of the stimulus across the different experimental conditions. We also traced out the brain networks associated with these changes. We found that networks traditionally associated with higher-level cognitive functions tended to exhibit more information-rich brain patterns than networks traditionally associated with lower-level cognitive functions.

Taken together, our work provides new insights into the fundamental "rules" describing how our brains respond to and represent specific stimuli and cognitive processes. We connect our findings about how the informativeness and compressibility of brain activity change across experimental conditions with prior work on task-dependent changes in functional connectivity (i.e., full-brain correlations). Our work helps to clarify how the "neural code" might be structured, and how the neural code might vary across tasks and brain areas. We expect that our work will be of interest to a broad audience including neuroscientists, cognitive psychologists and cognitive scientists, and others.

Thank you for considering our manuscript, and I hope you will find it suitable for publication in *Nature Neuroscience*.

Sincerely,

Jeremy R. Manning