

## **Cortical clusters formation underlying the neural coding of expectation**

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Understanding how brain circuits generate specific patterns of neural activity is one of the great challenges of modern neuroscience. Recent evidence shows that cortical activity is "metastable" – it can be characterized as a sequence of activity configurations, or 'states'. Such states constantly switch even when the variables encoded by them appear stationary. Importantly, the switching frequency can be modulated not only by external events, but also by a change in the internal state of the subject – such as a state of expectation. Metastability has been observed in the brain at rest, as well as during sensory processing and during the performance of cognitive tasks. Despite the importance of metastability, little is known on the neural circuits generating this pattern.

Through computational modeling with spiking neural networks, we recently identified a neural architecture capable of producing metastability and mediating both sensory processing and the effects of expectation. Such architecture features neurons organized in groups called clusters (neurons in the same cluster have strengthened synaptic connections compared to neurons in different clusters). Alas, little is known on how we can experimentally measure clustering in brain circuits and how clustering is affected by experience and learning. We propose a combination of experimental, analytical and modeling studies to detect cluster in cortical circuits and track their emergence and modulation by sensory experience.