Metastable Cortical Dynamics Drive Anticipatory Neural Activity

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Submitter Luca Mazzucato

Affiliation State University of New York At Stony Brook

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Presentation Abstract Summary Sensory stimuli can be recognized faster when their delivery is expected, compared to when they are unexpected. When taste stimuli are preceded by an anticipatory cue (the same for all stimuli), neural activity in the gustatory cortex encodes stimulus-related information faster than in absence of the cue. However, the mechanism linking cue responses to faster encoding is unknown. Here, we elucidate this process using a biologically plausible model based on a recurrent network with clustered architecture. Slow fluctuations in this network generate state sequences as observed in experiment. The anticipatory cue accelerates transition rates between states, leading to faster onset of stimulus-coding states. Their shorter latency mediates the faster encoding due to expectation. This effect was confirmed in ensemble recordings from the gustatory cortex of alert rats. Anticipatory neural activity was unrelated to changes in selective neurons' firing rates and was absent in homogeneous networks, suggesting that a clustered architecture is necessary to mediate the expectation of stimuli in cortex. Our results demonstrate a novel mechanism for speeding up sensory coding in cortical circuits and provide a new framework to investigate sensory processing.

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Co-author Information

* Presenting Author

First Name	Last Name	Affiliation	E-mail
Luca *	Mazzucato *	State University of New York At Stony Brook	luca.mazzucato@stonybrook.edu
Giancarlo	La Camera	State University of New York At Stony Brook	giancarlo.lacamera@stonybrook.edu
Alfredo	Fontanini	State University of New York At Stony Brook	alfredo.fontanini@stonybrook.edu

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