

 NEURAL CODING

## Predictive power

Recording from populations (ensembles) of neurons is a popular approach for researchers aiming to understand neural coding. But how well does neuronal ensemble activity predict the activity of individual neurons? Truccolo *et al.* show that previous spiking activity in small, randomly sampled neuronal ensembles can predict the future spiking activity of individual neurons with substantial accuracy.

The authors analysed recordings from ensembles consisting of tens to hundreds of neurons sampled from the motor, parietal and premotor cortices of four monkeys carrying out a sensorimotor task. In addition, they analysed motor cortex recordings from two humans participating in trials of neural prosthetics.

A spiking-history model was used to estimate the probability that a given neuron would spike at a particular time point, based on the previous 100 ms of spiking of an ensemble in the same cortical area as the neuron. Using ROC (receiver operating characteristic) curve analysis the authors then assessed the predictive power of their model. They found that the spiking history of a neuronal ensemble could be used to predict an individual neuron's spiking with reasonable accuracy — that is, with median predictive power values of 0.3 to 0.5 on a scale in which 0 indicates no predictive power (chance prediction) and 1 indicates perfect prediction.

The authors also tested models that used the spiking history of neuronal ensembles in one cortical area to

predict the spiking of neurons in a different (but anatomically connected) area. Such inter-areal predictive power was substantial, indicating that even distant neurons can predict spiking, perhaps through long-range polysynaptic projections.

The demonstration of the ability to predict the spiking of individual neurons from relatively small and randomly sampled neuronal ensembles indicates that strong collective dynamics underlie single neuron spiking. It also complements previous studies that have shown that such small ensemble recordings can predict behavioural events such as arm movements. Future work may therefore concentrate on establishing links between these collective dynamics and specific behaviours, which might aid the development of neural prosthetics and neural monitoring of disorders such as epilepsy.

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**ORIGINAL RESEARCH PAPER** Truccolo, W., Hochberg, L. R. & Donoghue, J. P. Collective dynamics in human and monkey sensorimotor cortex: predicting single neuron spikes. *Nature Neurosci.* 6 Dec 2009 (doi:10.1038/nrn.2455)