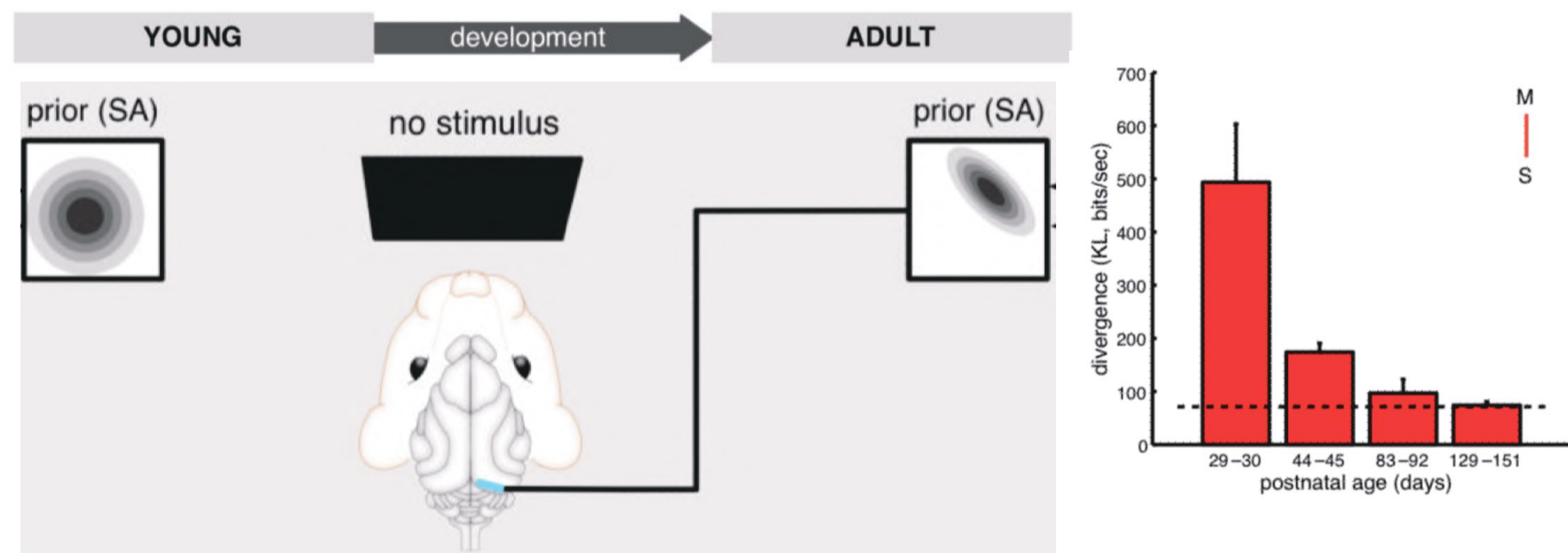# Learning spontaneously reactivatable prior distributions for causal inference

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1:Neural Coding and Brain Computing Unit, Okinawa Institute of Science and Technology, Onna-son, Okinawa 9040495, Japan
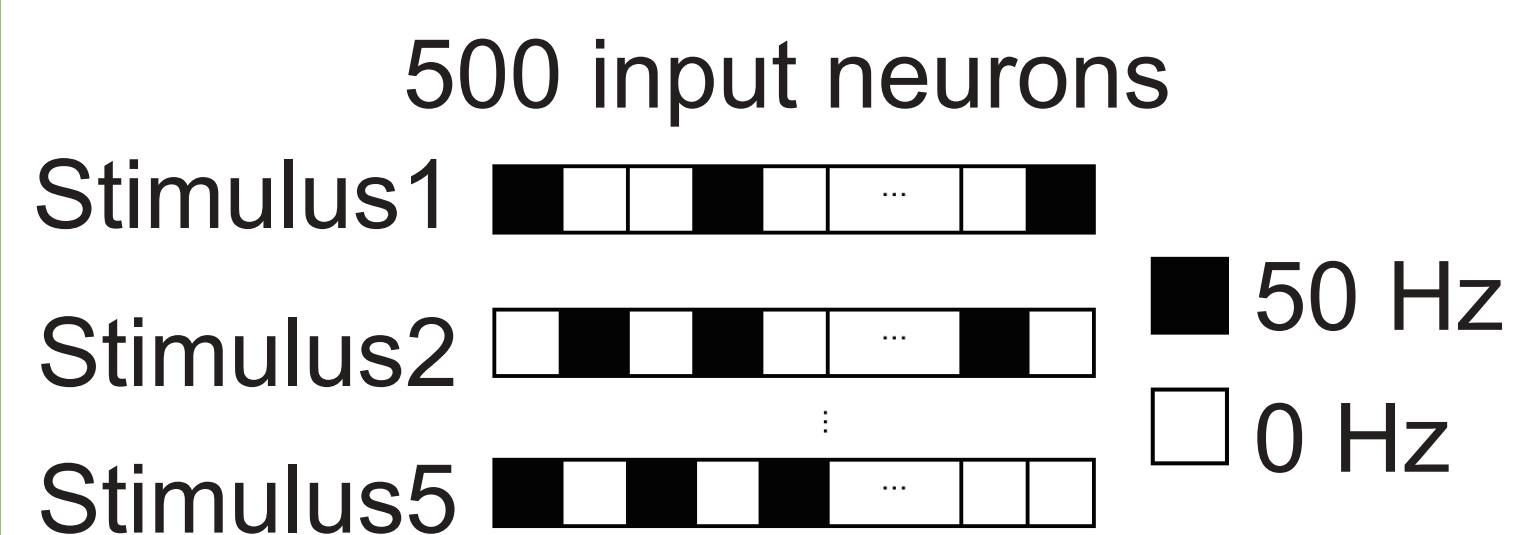
Background

Berkes et al. 2011 Science

Spontaneous activity = Prior distribution of environment?

Method

500 input neurons

Stimulus1 ■ 50 Hz
Stimulus2 □ 0 Hz
Stimulus5

Neural dynamics:

$$x_k(t) = \sum_{i=1}^{N} W_{ki} e_i^{ext}(t) + \sum_{j=1}^{K} (M_{kj} - G_{kj}) e_j^{net}(t)$$

Firing rate: $f = \dfrac{1}{1 + \exp(-\hat{\beta}(x - \hat{\theta}))}$

Adaptation parameters:

$$\tau_H \dot{H} = -H(t) \qquad \hat{\beta}(t) = g\beta/H(t)$$

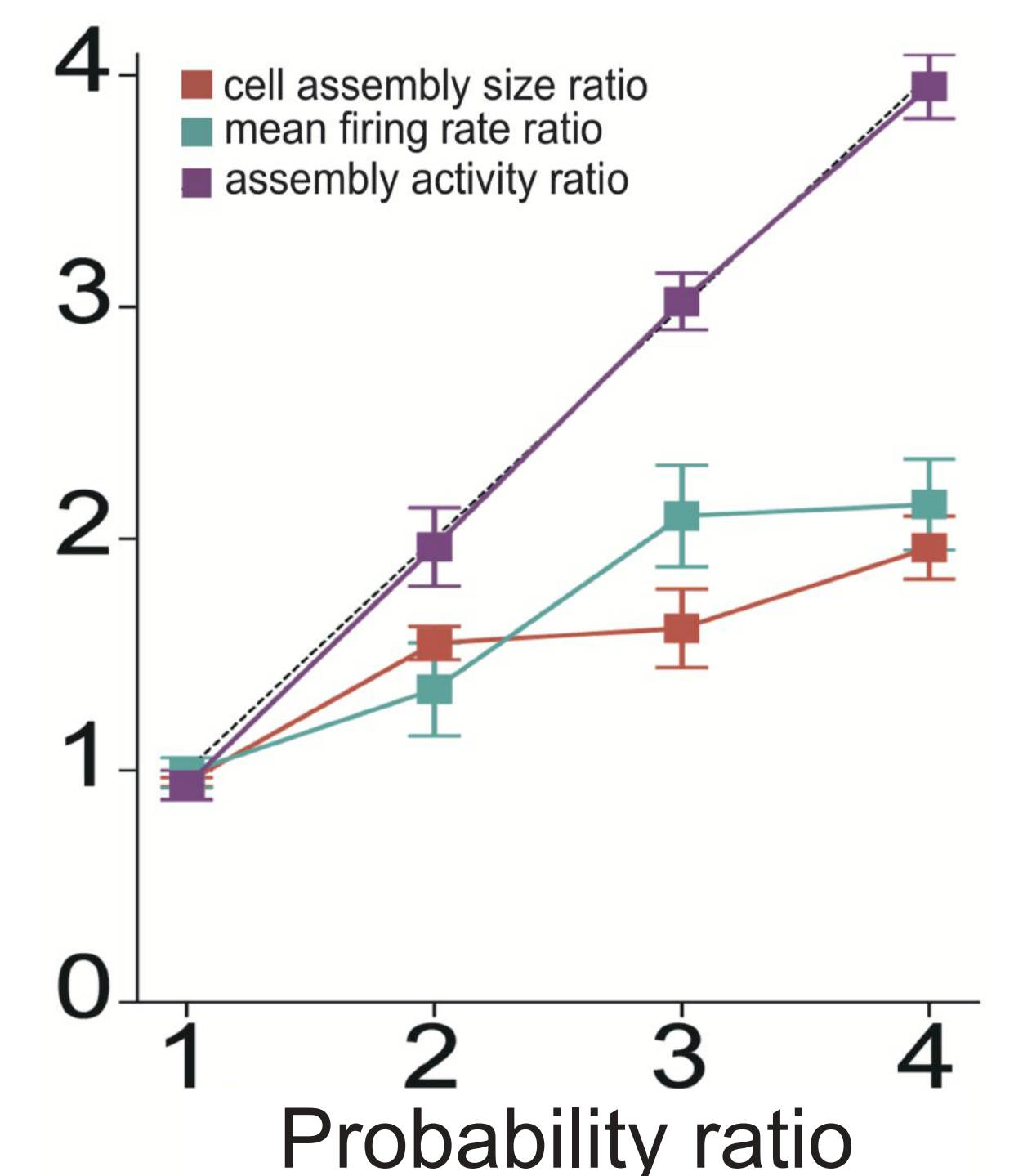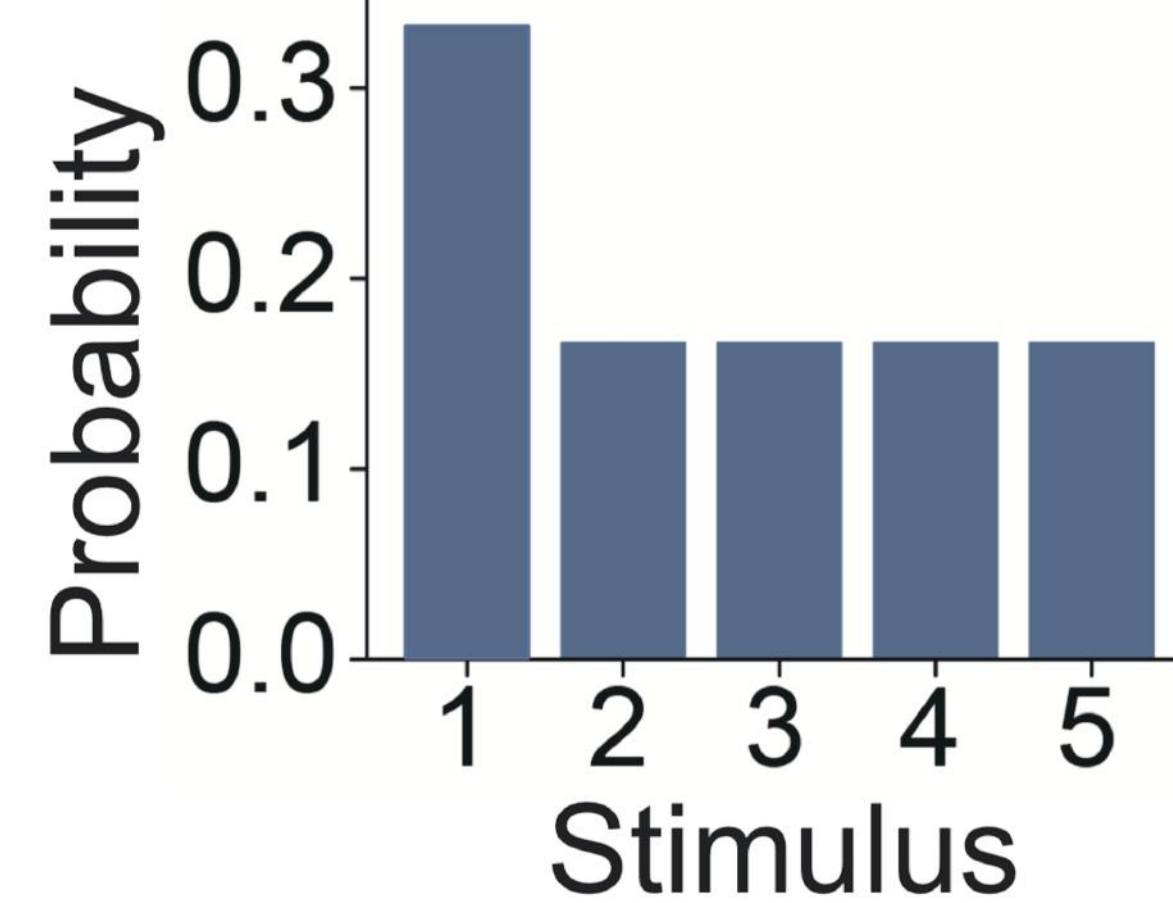$$H \leftarrow x \quad (if \ H < x) \qquad \hat{\theta}(t) = H(t)\theta$$

The learning rule:

$$\Delta W_{ki} = \frac{\phi'}{\phi}[f - \phi(\sum_{i=1}^{N} W_{ki} e_i^{ext})]e_i^{ext}$$

All types of connections were trained with
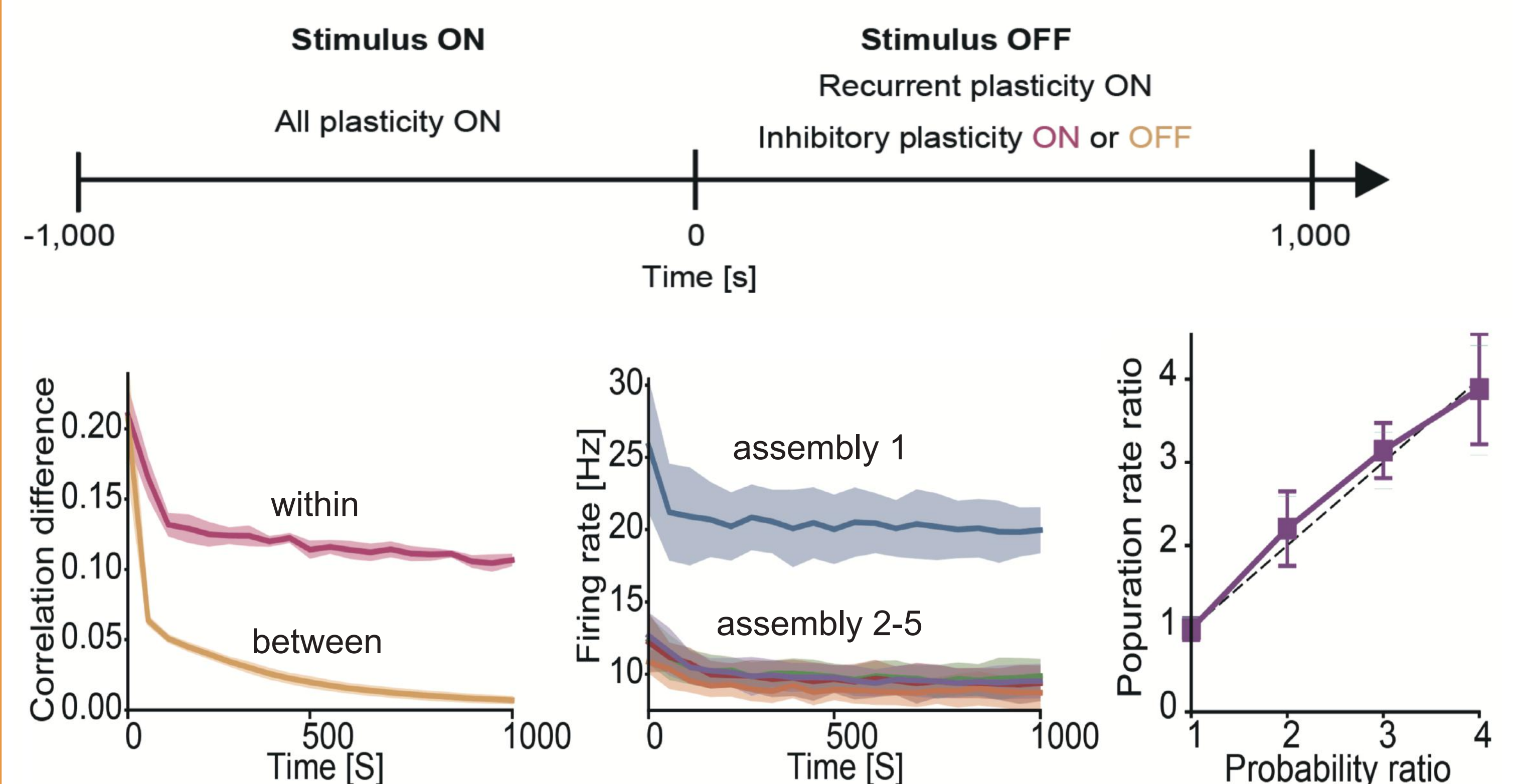the same learning rule.

Results

Tranined network shows structured spontaneous activity
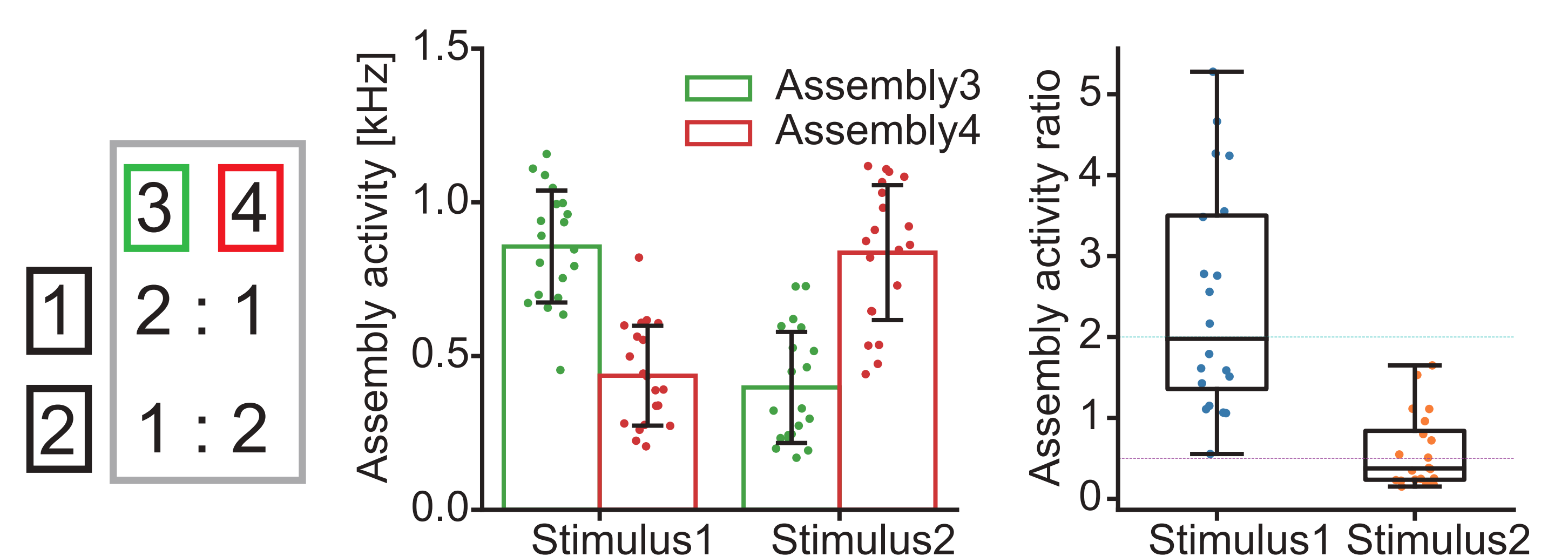

Cell assembly activities encode prior distribution of stimulus

During trainins, we controled the
probability that stimulus 1 appears.

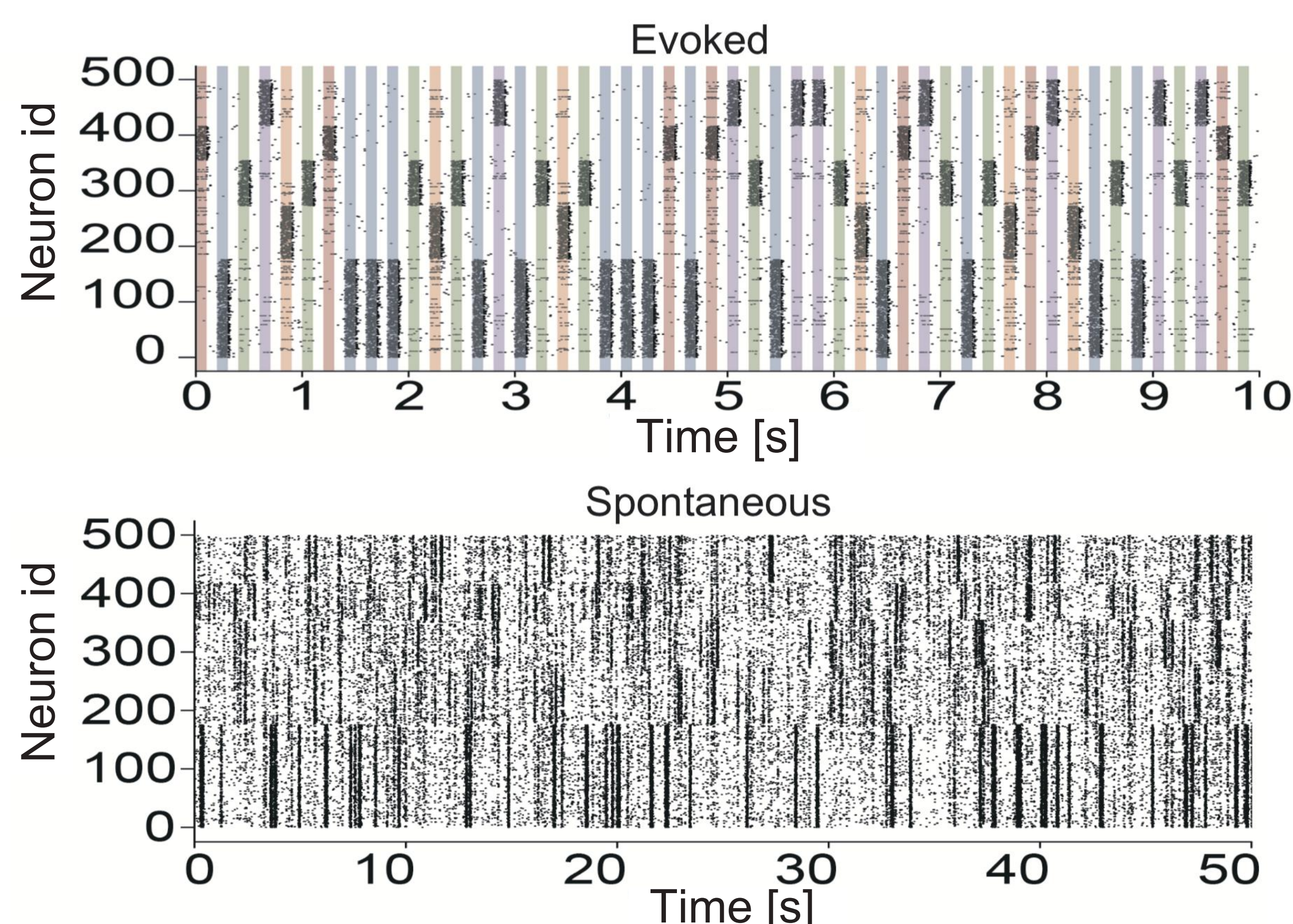## Stability of assembly structures and the prior distribution

Stimulus ON
All plasticity ON

Stimulus OFF
Recurrent plasticity ON
Inhibitory plasticity ON or OFF

Learning of conditional probability structures

Performance comparison with real experimental data

The prior probability of the direction was
either neutral (50:50) or domonated one
of the directions (80:20)

Data was taken from Hanks et al. 2011 J. Neurosci.