Table 1: Parameters of the network

N	300
$\mathrm{E}[W]$	0
$\mathrm{Std}[W]$	$1/\sqrt{N_e}$
μ_b	0.001
μ_a	0.001
Initial a	1
Initial b	0

1 Equations of the Network Model

We investigate a discrete-time, fully connected recurrent network model that includes homeostatic threshold and gain control by using the Kullback-Leibler divergence between a target distribution and neuronal output as a control measure. Standard parameters of the model are given in Table 1. Find the details of the model in the following sections.

1.1 Neuron Model

At discrete times t, each neuron i in our network is characterized by a single activity variable y_i^t. The next state is calculated by:

$$y_i^{t+1} = \sigma\left(x_i^t\right) \tag{1}$$

$$\sigma(x) = \frac{1}{1 + \exp(-a(x-b))} \tag{2}$$

$$x_i^t = x_{i,ee}^t + x_{i,eext}^t = \sum_j W_{ij} y_j^t + x_{i,eext}^t \tag{3}$$

$$\tag{4}$$

where W_{ij} is a connectivity matrix whose properties are described in the following section and $x_{i,eext}^t$ is an optional external input.

1.2 Recurrent Network Properties

W_{ij} is a fixed randomly generated matrix, whose entries were drawn from a normal distribution with mean and standard deviation given in Table 1. Autapses were prohibited, meaning that $W_{ii} = 0$. Note that we did not impose Dale's law onto the sign of our connections.

2 Activity Regulation in a Non-binary Recurrent Network