

# Reinforcement learning of 2-joint virtual arm reaching in detailed cortex simulation

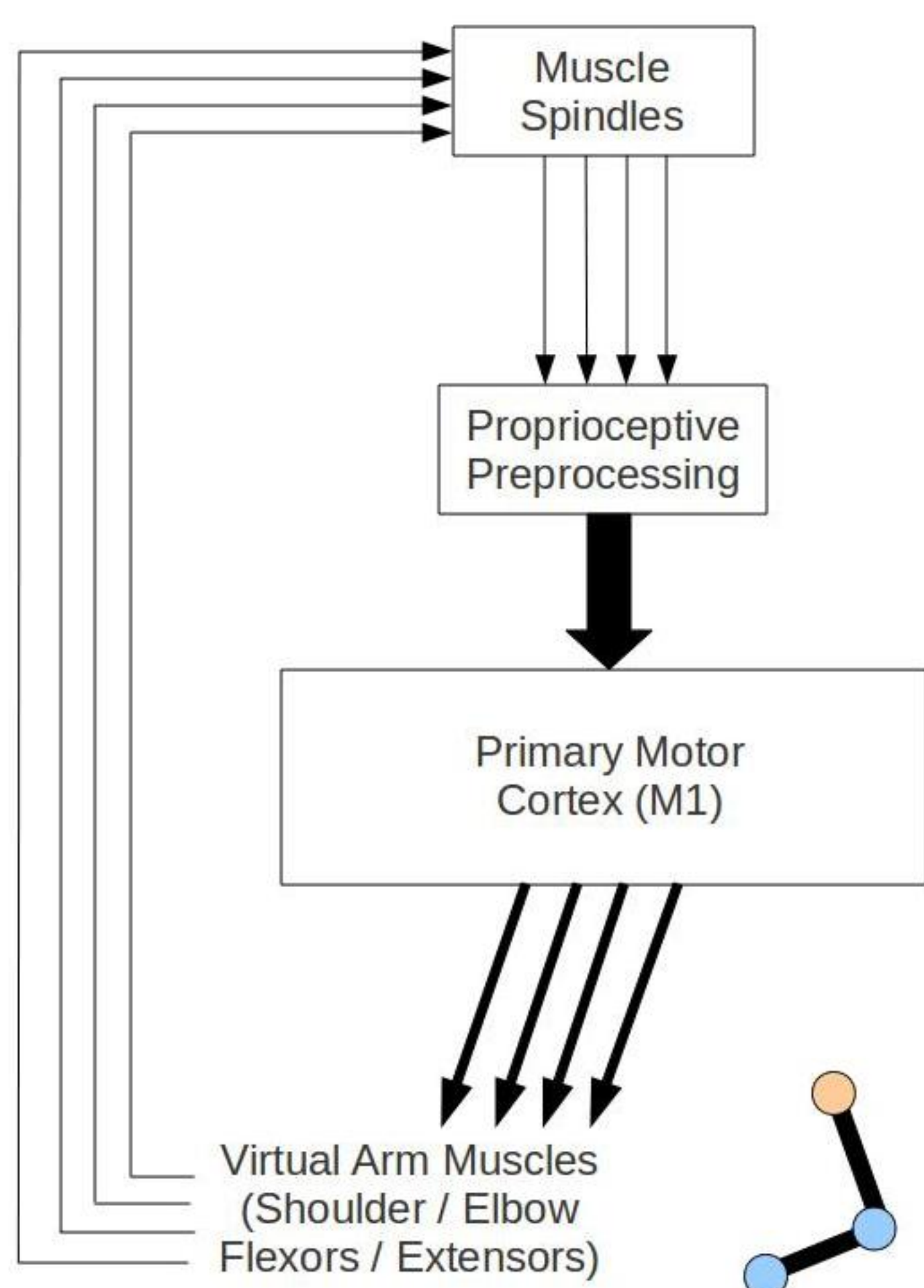
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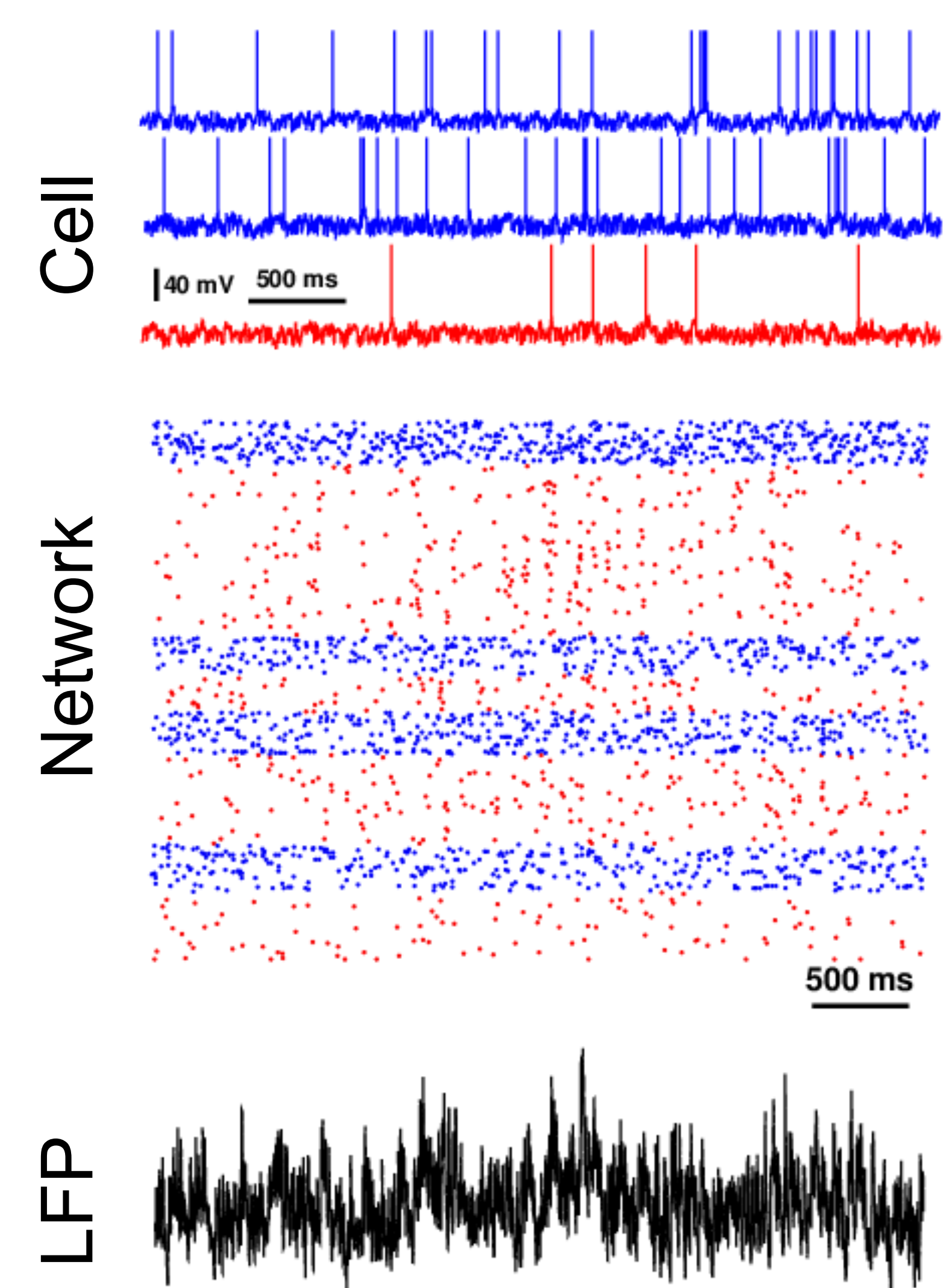
## Inside the Black Box

Each component of the sensorimotor loop is itself a complex brain area

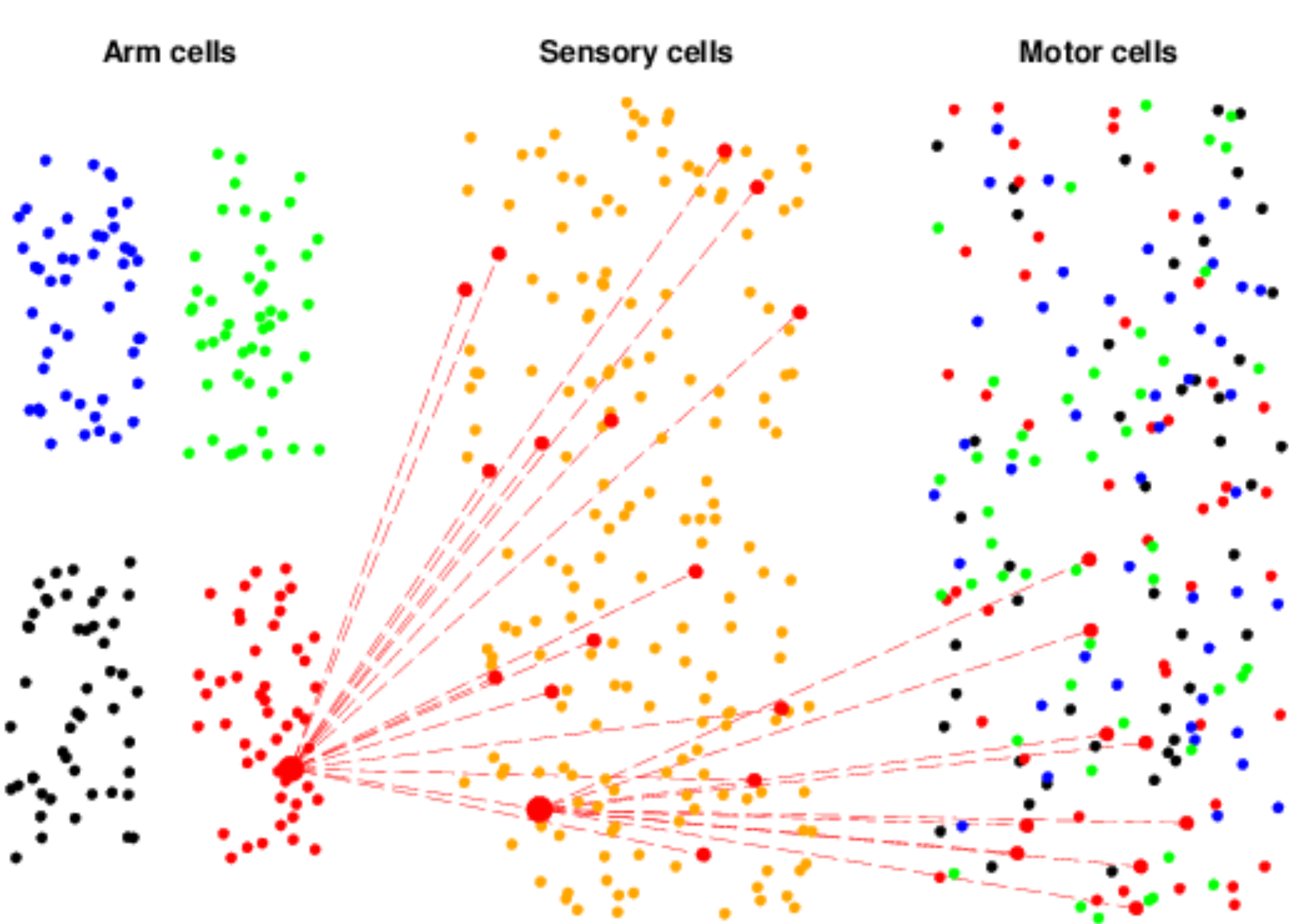


## Methods

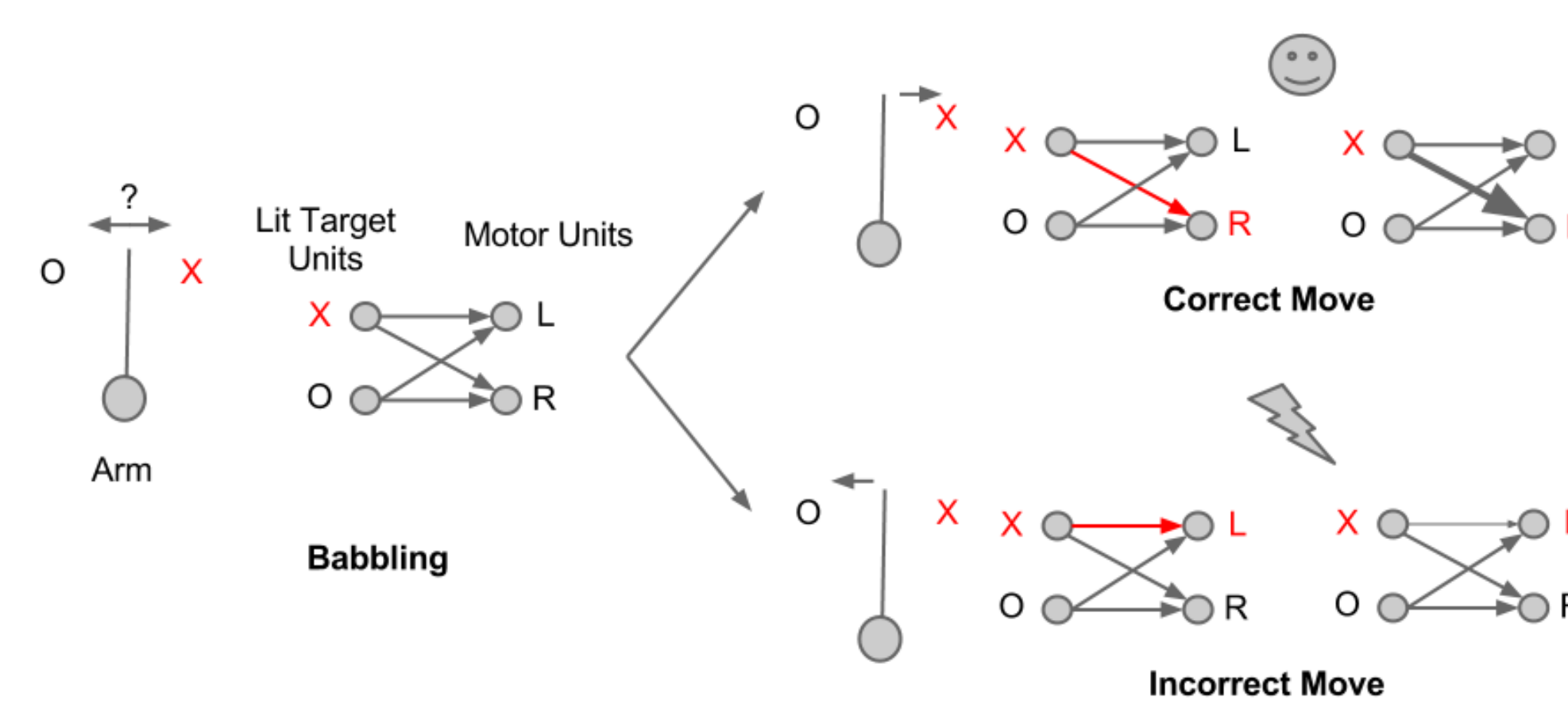
### Multiscale models of the brain



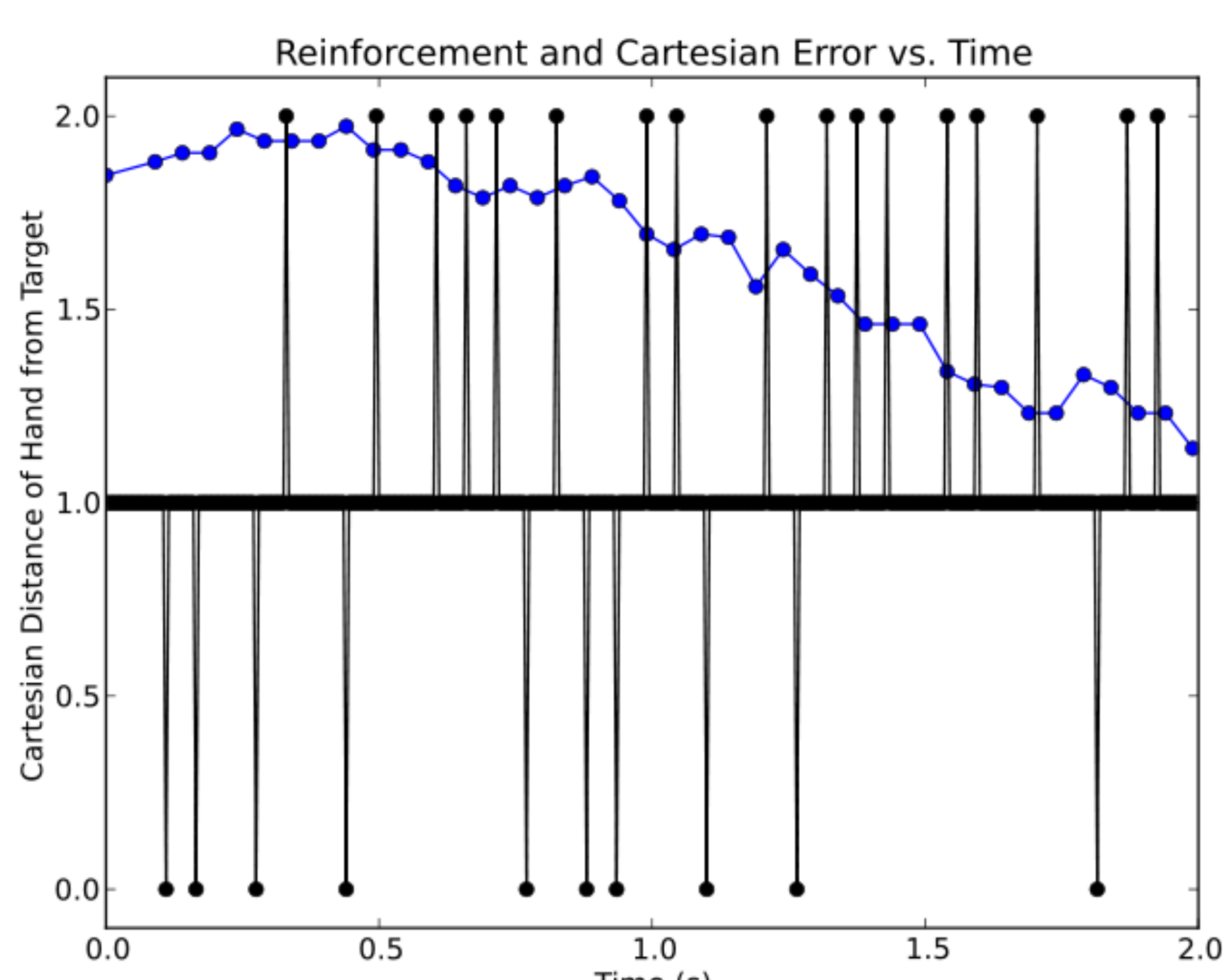
### Modular Connectivity



### STDP-based Reinforcement Learning

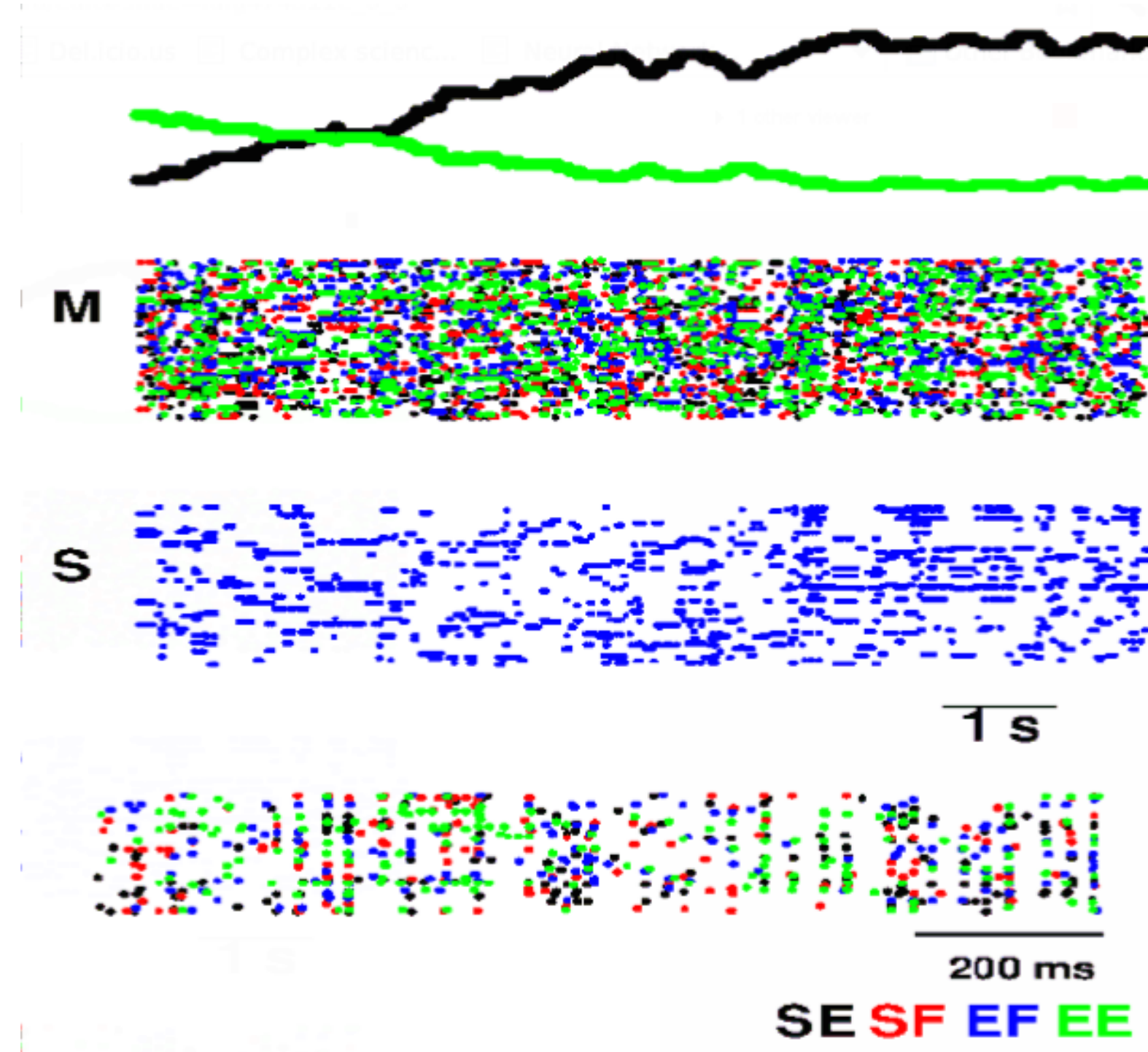


### Reinforcement learning with LTP/LTD

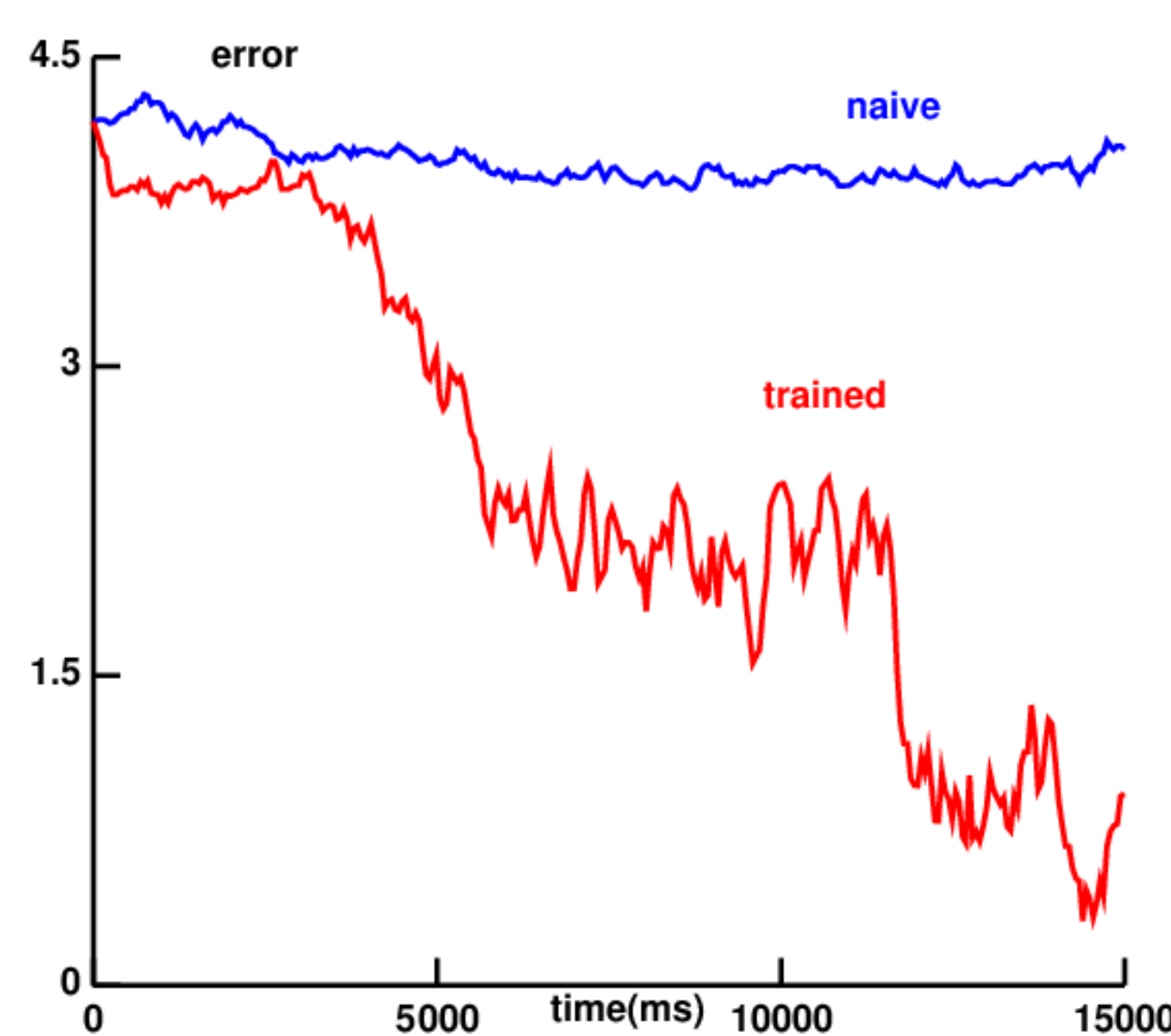


## Results

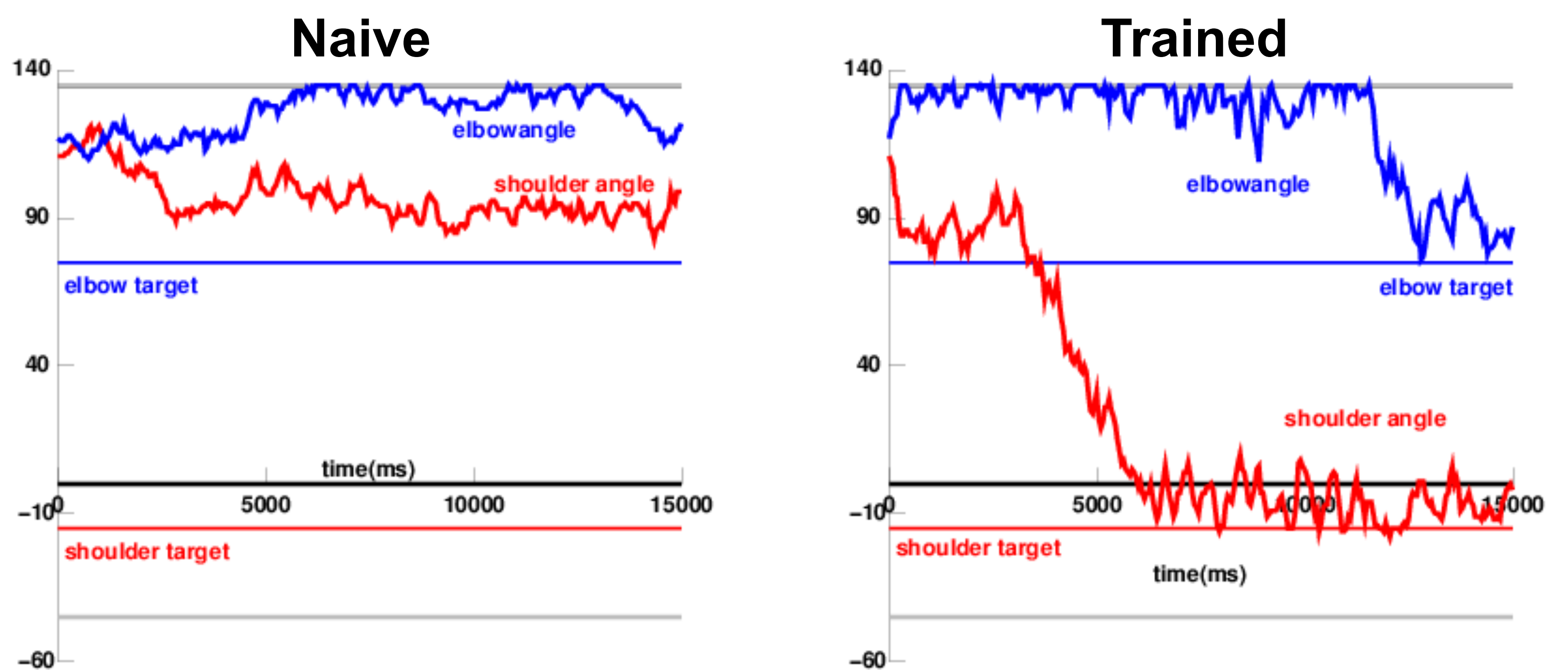
### Trained 2 DOF network: raster plot



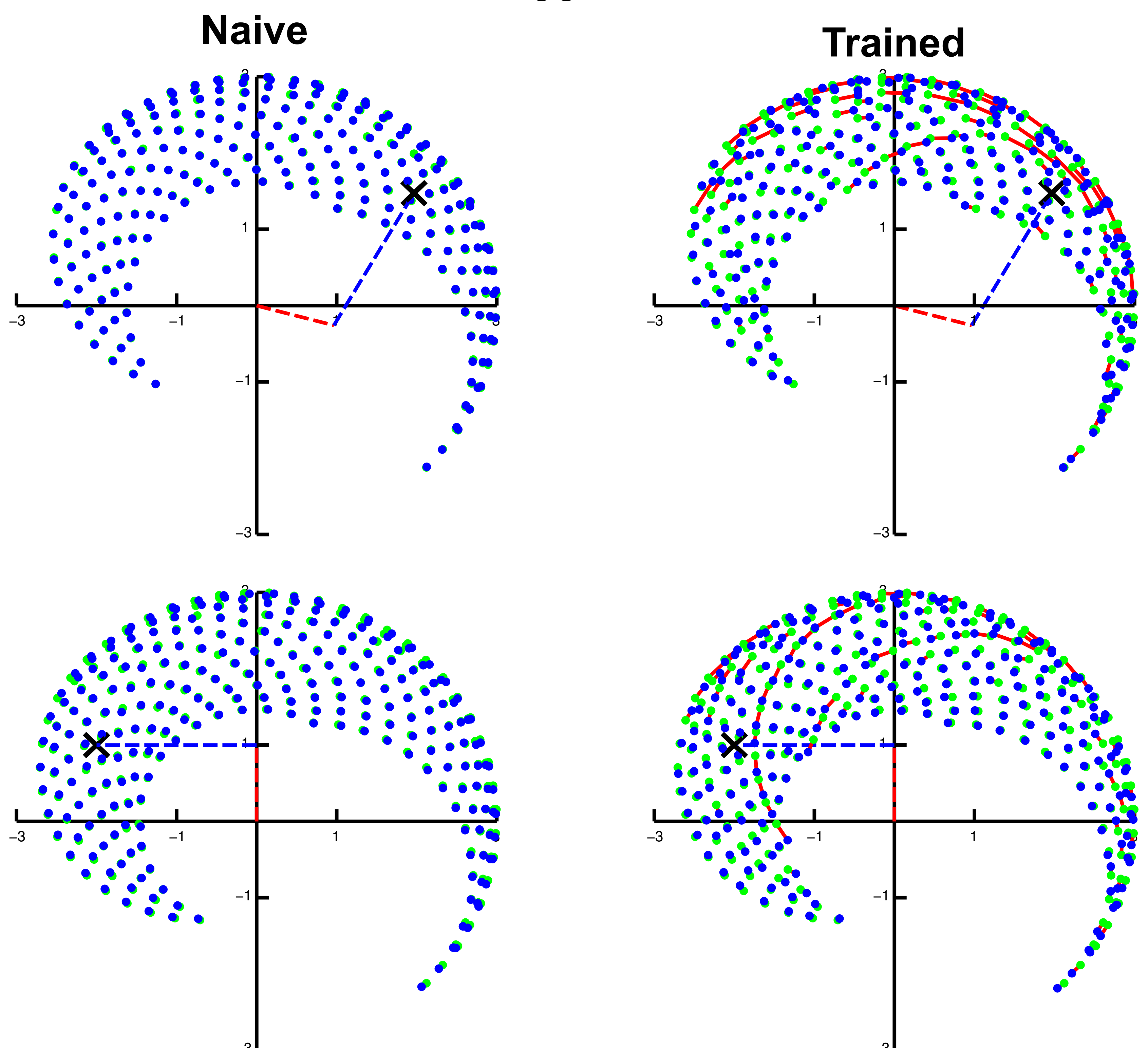
### 2 DOF network reaches target in plane



### Trained network reaches target: joints



### Vector field suggests an attractor



## Conclusions

1. A detailed spiking model of sensory and motor cortex utilizing STDP-based reinforcement learning can learn to control a (virtual) arm.
2. The trained network shows evidence of attractor dynamics.

### Thinking inside the box:

3. Multiscale modeling can begin to resolve the gap between large-scale control theory and small-scale measurements of LFPs and spike times.

**Abbrevs:** DOF: degrees of freedom; LTP long-term potentiation; LTD: long-term depression; LFP: local field potential; STDP: spike-timing dependent plasticity  
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