BMC Neuroscience

BioMed Central

Poster presentation

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The encoding of alternatives in multiple-choice decision-making

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from Eighteenth Annual Computational Neuroscience Meeting: CNS*2009
Berlin, Germany. 18–23 July 2009

Published: 13 July 2009

BMC Neuroscience 2009, **10**(Suppl 1):P166 doi:10.1186/1471-2202-10-S1-P166

This abstract is available from: http://www.biomedcentral.com/1471-2202/10/S1/P166

During the last decades, research on binary decision-making elucidated some of the basic neural mechanisms underlying the decision-making process. However, most real life decisions involve the need to select between not two but several alternatives. Decision-making with multiple alternatives recently received increasing attention in experimental as well as modeling studies.

Here, we present a minimal biophysically realistic spiking neuron model for decision-making with multiple alternatives. Our model accounts for all relevant aspects of recent experimental data of a random-dot motion discrimination task [1], on both the cellular and behavioral level. Our specific objective was to construct a network model where all network parameters and inputs are independent of the number of possible alternatives. Thereby, we avoid the use of extra top-down regulation mechanisms to adapt the network to the choice number. Our network is an extension of Wang's [2] binary decision-making model, which is based on attractor dynamics and winner-take-all competition of two selective populations of neurons (pools), each representing one choice alternative. Instead of a continuous representation, as recently suggested by Furman and Wang [3], we increased the number of discrete selective neural populations encoding the alternatives and introduced an enhanced connectivity between neighboring pools.

Previously, networks with discrete populations have been adjusted to exhibit winner-take-all competition for one particular set of choice alternatives [2] or memory states [4]. In our study, we analyzed how the network's competition regimes for the different numbers of alternatives could be brought into accord. In this context, the relative number of neurons encoding one choice alternative turned out to be a critical factor. We explored the effects of size of these neural populations and found that increasing the number of neurons encoding each choice alternative is positively, linearly related to the network's capacity of choice-number-independent decision-making. As a result, our model successfully simulates all experimental paradigms tested by Churchland et al. [1], without the need of any number-of-choice dependent external top-down regulation mechanism. Moreover, our results suggest a physiological advantage of a pooled, multi-neuron representation of choice alternatives.

References

1. Churchland AK, Kiani R, Shadlen MN: **Decision-making with multiple alternatives.** *Nat Neurosci* 2008, **11:**693-702.
2. Wang XJ: **Probabilistic decision making by slow reverberation in cortical circuits.** *Neuron* 2002, **36:**955-968.
3. Furman M, Wang XJ: **Similarity effect and optimal control of multiple-choice decision making.** *Neuron* 2008, **60:**1153-1168.
4. Brunel N, Wang XJ: **Effects of neuromodulation in a cortical network model of object working memory dominated by recurrent inhibition.** *J Comput Neurosci* 2001, **11:**63-85.