

## Computations underlying decisions between multiple directions of motion

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While first theoretical attempts have been made to study possible decision making mechanisms underlying choices between multiple alternatives (e.g., [1][2]), most behavioral and neurophysiological studies have so far focused on choices between two alternatives. The available data sets from choice experiments between multiple alternatives are largely not quantitative enough to address the underlying computational mechanism. The 2AFC version of the random dot motion direction discrimination task has been very helpful in advancing our understanding of the neural and computational mechanisms underlying choices between two alternatives.

Here we present behavioral data from a new version of the random dot motion discrimination task. Subjects are presented with a random dot stimulus containing up to three coherent motion components with different directions. They are asked to pick the dominant direction of motion out of three alternatives. The viewing duration is controlled by the subjects (reaction time task). Response times (RTs) and the subject's choice are measured. The advantage of this task is that it provides the experimenter with full control over the sensory evidence provided for each of the alternatives. Thus, for example, situations with equal amounts of sensory evidence for each of the alternatives can be created at different levels and the behavioral (and, in the future, also neurophysiological) responses can be studied.

In the 2AFC version of the task both the behavioral as well as neurophysiological data recorded from the parietal cortex of monkeys performing the task could be explained by a computational model based on the idea of a race to threshold between two integrators accumulating the net sensory evidence for a particular choice [3]. Here we show that the behavioral data (probabilities of particular choices as well as RT distributions) from our new 3-choice task are quite well explained by a computational model assuming a race to threshold between three integrators, one for each alternative. Each integrator accumulates the net sensory evidence for a particular alternative. The net sensory evidences are calculated as linear combinations of the activities of three relevant pools of sensory neurons with a positive weight assigned to the pool providing evidence for a particular choice and negative weights assigned to the pools providing evidence against a particular choice. Overall, the model turns out to be consistent with Multialternative Decision Field Theory [1].

- [1] Roe RM, Busemeyer JR, Townsend JT (2001) Multialternative decision field theory: a dynamic connectionist model of decision making. *Psychol Rev* 108:370-392
- [2] Usher M, McClelland JL (2001) The time course of perceptual choice: the leaky, competing accumulator model. *Psychol Rev* 108:550-592
- [3] Ditterich J (2006) Stochastic models of decisions about motion direction: behavior and physiology. *Neural Netw* 19:981-1012