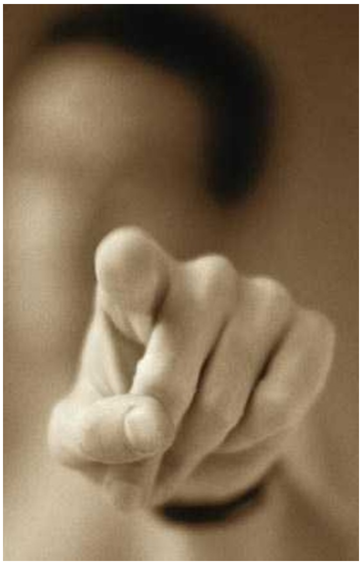
LEARNING

That'll teach you!



In the cerebellum, integration of information at the cellular and systems levels is assumed to be a prerequisite for the learning of motor tasks; however, these levels have not been investigated simultaneously. Now, by analyzing the relationship between Purkinje cell (PC) plasticity and motor learning in awake behaving monkeys, Medina and Lisberger link complex spikes with simple-spike plasticity and learning of a motor task.

One current hypothesis postulates that the interplay between the mossy fibre system (which evokes simple spikes in PCs) and the climbing fibre system (which evokes complex spikes in PCs) enables cerebellar learning through the spatial and temporal integration of these different electrical activities. The authors simultaneously examined complex-spike and simple-spike firing in individual PCs during and after learning of eye pursuit behaviour, to establish their causality. Simple spikes are sensitive to the direction of eye movement and will respond with changes in their firing rate. Complex spikes respond to visual inputs that signal a change in target motion. In the learning task, a visual target moved along a straight line before changing direction in either the on direction or the off direction of the recorded PC.

First, the authors investigated changes in simple-spike firing that occur as a result of learning the task and found that they were appropriate in time, size and direction to drive the learned eye movement. Next, they made the key step that linked complex-spike-driven plasticity to behavioural learning. Looking at the simple-spike responses in pairs of successive learning trials, they found that simple-spike firing was depressed on the second trial of a pair if and only if there had been a complex spike on the first trial of the pair. The timing of the depression of simple-spike firing corresponded with being caused by cellular plasticity driven by the complex spike and with causing behavioural learning.

This paper contributes fundamentally to our understanding of how incoming signals drive cellular plasticity and, subsequently, motor learning in the cerebellum.

Claudia Wiedemann

ORIGINAL RESEARCH PAPER Medina, J. F. & Lisberger, S. G. Links from complex spikes to local plasticity and motor learning in the cerebellum. *Nature Neurosci.* 21 Sep 2008 (doi:10.1038/nn.2197)