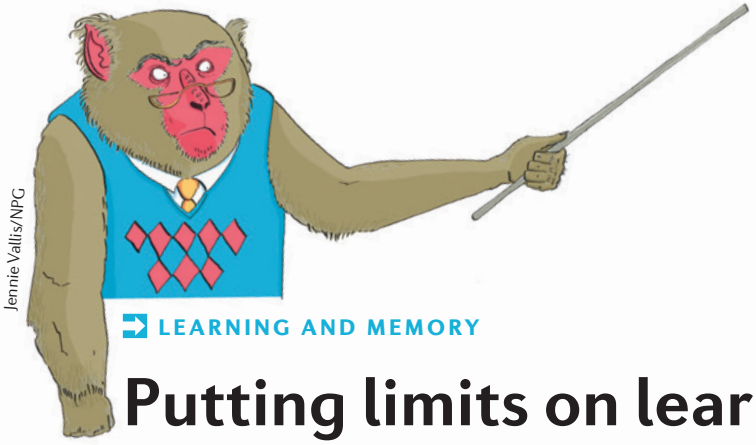
Nature Reviews Neuroscience | AOP, published online 10 September 2014; doi:10.1038/nrn3826



Jennie Vallis/NPG

LEARNING AND MEMORY

Putting limits on learning

Every time we learn a new skill, the efforts that we put into its practice are reflected by changes in the patterns of activity in the underlying networks of neurons. Nevertheless, it is usually easier to learn a new behaviour when it is similar to something that we can already do. In a new paper, Sadtler *et al.* now provide an explanation for this phenomenon by showing that the current properties of the neurons in a network restrict the new activity patterns that the network is capable of exhibiting.

> "the existing properties of a network place constraints on the types of new learning that can be achieved"

The authors designed a brain–computer interface learning paradigm in which two Rhesus macaques were trained to control the movement of a cursor on a computer screen by generating particular patterns of activity in the primary motor cortex. The activity of individual neurons was recorded using a multielectrode array, and the authors could determine the set of activity patterns that would be required to drive cursor movement (that is, the control space).

At the start of each training session, the authors identified existing activity patterns exhibited by neurons on the array (termed the intrinsic manifold) as the monkeys moved the cursor. Next, they examined the ability of the monkeys to learn to generate new patterns of activity, by changing the control space. This means the activity patterns that had previously moved the cursor continued to do so but now moved it with a different velocity. When the authors changed the control space so that it remained within the intrinsic manifold — that is, the animals only needed to recombine existing activity patterns in new ways — the monkeys were able to relearn to control the cursor. However, when the authors modified the control space so that it was outside the intrinsic manifold — that is, the animals needed to generate entirely new activity patterns to move the cursor — their ability to relearn to control the cursor was impaired.

These findings suggest that the existing properties of a network place constraints on the types of new learning that can be achieved, at least within a timescale of hours: it is easier to learn new patterns of activity (and thus the corresponding actions or thoughts) that are closely related to those already present than it is to learn new patterns of activity.

Katherine Whalley

ORIGINAL RESEARCH PAPER Sadtler, P. T. *et al.* Neural constraints on learning. *Nature* **512**, 423–426 (2014)
FURTHER READING Wolpert, D. M., Diedrichsen, J. & Flanagan, J. R. Principles of sensorimotor learning. *Nature Rev. Neurosci.* **12**, 739–751 (2011)