time. In such a condition, there is a large degree of uncertainty about whether the next symbol in the string will be a '0' or a '1'. But if we also know what a given presynaptic input is doing during the same period, this uncertainty will decrease. So, if the presynaptic input is strong, the probability of obtaining a '1' as postsynaptic output will increase. In the extreme case, a very strong input will always make the postsynaptic neuron fire, whereas a very weak input will have no effect. The authors developed a compression algorithm that allowed them to use their knowledge of the input to simplify the postsynaptic output string. So, for a very strong input, we can predict with confidence what the postsynaptic output will be, and therefore compress the string that we need to represent it. The SIE is a measurement of how many bits of information were saved by this compression.

By measuring SIE while altering the amplitude, kinetics and dendritic location of the presynaptic input, the authors obtained quantitative estimates of how information efficacy changed as a function of different synaptic properties. To make their model more realistic, they measured SIE in the presence of a high level of background synaptic activity, and used increasingly complex models of the postsynaptic neuron. Finally, London *et al.* measured SIE experimentally, and found that some predictions of their computational analysis could be confirmed in real neurons.

Critics of theoretical approaches might argue that this type of analysis is necessarily limited by our understanding of the cellular and biophysical characteristics of actual synapses and neurons. However, as the models incorporate more features of real cells, the insights that we will obtain from SIE as a measure of information efficacy should continue to increase. So, the quantitative nature of SIE provides us with a useful tool to answer the apparently simple question of what a single synapse tells the postsynaptic axon.

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References and links

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FURTHER READING Feng, Y. & Walsh, C. A. Protein–protein interaction, cytoskeletal regulation and neuronal migration. *Nature Rev. Neurosci.* **2**, 408–416 (2001) | Herz, J. & Beffert, U. Apolipoprotein E receptors: linking brain development and Alzheimer's disease. *Nature Rev. Neurosci.* **1**, 51–58 (2000)

IN BRIEF

ADDICTION

Covalent modification of proteins by cocaine.

Deng, S.-X. *et al. Proc. Natl Acad. Sci. USA* **99**, 3412–3416 (2002)

As the methyl ester group of cocaine is extremely labile, Deng *et al.* tested whether it could react with chemical groups on proteins, and found that cocaine reacts specifically with the amino group of lysine residues *in vitro*. Also, the plasma of rats and humans that were chronically exposed to the drug contained covalently modified proteins. This modification might explain the autoimmune effects of cocaine, and some of its long-term actions on the brain.

SENSORY SYSTEMS

A single olfactory receptor specifically binds a set of odorant molecules.

Gaillard, I. *et al. Eur. J. Neurosci.* **15**, 409–418 (2002)

Although a large family of olfactory receptors has been found, their ligands have not been identified. Gaillard *et al.* report on a calcium-imaging-based screening procedure that might assist in the identification of specific odorants. The authors validated this system by identifying the structural motifs of ligands that bind to the mouse olfactory receptor 912-93, and found that it was activated by aliphatic ketones. This system might help in the functional characterization of the olfactory receptors.

DEVELOPMENT

The bHLH transcription factors OLIG2 and OLIG1 couple neuronal and glial subtype specification.

Zhou, Q. & Anderson, D. J. *Cell* **109**, 61–73 (2002)

This and a related paper by Lu *et al.* in the same issue of *Cell* shed light on the function of Olig1 and Olig2 in cell specification in the spinal cord. In wild-type embryos, these transcription factors are expressed in a region that gives rise sequentially to motor neurons and oligodendrocytes. Zhou and Anderson generated *Olig1/2* double-mutant mice and found that both cell types were absent in these animals. Instead, the mutant progenitor cells gave rise to interneurons and then astrocytes, indicating that *Olig1/2* do not control the neuron–glia decision, but act to couple neuronal and glial specification.

SYNAPTIC PHYSIOLOGY

Evidence for two distinct processes in the final stages of neurotransmitter release as detected by binomial analysis in calcium and strontium solutions.

Searl, T. J. & Silinsky, E. M. *J. Physiol. (Lond.)* **539**, 693–705 (2002)

The authors analysed transmitter release at the frog neuromuscular junction in solutions that contained calcium or strontium. They found that the values of the quantal parameters n (the number of releasable quanta) and p (the release probability) depended on the divalent cation. Statistical analyses led them to suggest the existence of two different steps in the final stages of exocytosis. It will now be important to test whether these steps are subserved by specific presynaptic proteins.