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Unravelling the code of the brain

By *NLN*
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For more than fifty years, the neuroscience community is engaged in an intensive debate on how information is coded in the brain and transmitted reliably from one brain region to the next. Mutually exclusive coding systems have been proposed and are being energetically supported.

Scientists from Freiburg University were now able to demonstrate (forthcoming issue of *Nature Reviews Neuroscience*), that earlier studies were based on rather extreme propositions. Instead, it is possible that under certain conditions, both proposed codes can be simultaneously employed within the brain.

One of the unsolved puzzles of the brain is the question which code is being used when nerve cells communicate with each other. It has been known for more than a century that the basic unit of communication within the nervous system is the pulse-like fluctuation in voltage at the membrane of neurons. But there is still a hot ongoing debate on how these so-called action potentials are combined to form a code for the actual processing and transmission of information. Two forms of coding are popular candidates: one is based on the rate of action potentials (rate coding) and the other relies on the timing of their occurrences (temporal coding).

So far, the nature of the neural code has remained largely elusive to experimental brain research. Even the brains of insects are too complex for today's scientists to determine which code they use. Theoretical approaches, simulating brain processes by means of computer models, therefore play an important role within modern neuroscience and can address these and other questions.

Models presented in earlier studies suggested that only one of the two proposed codes could be employed at any time in neuronal networks. Depending on the way how neurons contact each other, either pulse rate or timings could be transmitted reliably. Arvind Kumar, Stefan Rotter and Ad Aertsen from the Bernstein Center Freiburg now propose that under certain conditions, both forms of coding can in fact be employed simultaneously. The Scientists then argue that earlier studies did not recognise the possible coexistence of both codes, because they represent two extremes of a continuum of biologically plausible conditions. In the article available online now, the scientists demonstrate that earlier findings can be reconciled into a larger conceptual framework of neural coding and transmission. In addition, their analysis of the required conditions shows that it is actually possible to use both codes simultaneously in one neuronal network (*Nature Reviews Neuroscience* 11, 615-627, September 2010). Thus, for the first time, conditions for this coexistence of different neural codes have been identified. This provides valuable clues what to analyse in future experiments when trying to identify the codes that are used by “real” brains.

Source [1]

Brain & Cognition

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[1] http://www.uni-freiburg.de/