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Wired for avalanches -- and learning

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The brain's neurons are coupled together into vast and complex networks called circuits. Yet despite their complexity, these circuits are capable of displaying striking examples of collective behavior such as the phenomenon known as "neuronal avalanches," brief bursts of activity in a group of interconnected neurons that set off a cascade of increasing excitation.

In a paper published in the American Institute of Physics' journal Chaos, an international team of researchers from China, Hong Kong, and Australia explores connections between neuronal avalanches and a model of learning – a rule for how neurons "choose" to connect among themselves in response to stimuli. The learning model, called spike time-dependent plasticity, is based on observations of real behavior in the brain.

The researchers' simulations reveal that the complex neuronal circuit obtained from the learning model would also be good at generating neuronal avalanches. This agreement between the model and a real, proven behavior of neurons suggests that the learning model is an accurate way to describe how the brain processes information.

The authors say their work could aid an understanding of how learning could lead to the formation of cortical structures in the brain, as well as why the resulting structures are so efficient at processing large amounts of information. "While [the finding] is entirely consistent with existing neurophysiology, our work is the first to provide this concrete link" between this particular learning rule and neuronal avalanches, says co-

author Michael Small of the University of Western Australia. "It provides a simple, and therefore perhaps surprising, explanation for how a system as complex as the cortex can generate such striking collective behavior."

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