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J Neurophysiol 91:2389-, 2004. doi:10.1152/jn.00128.2004

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Welcome Theory

Experimental work in neurophysiology has always been accompanied by theoretical work. Neurophysiologists have grown up with the Hodgkin-Huxley equations, with models of motor function, and are accustomed to using differential equations and complex statistics to describe the properties of both stimuli and spike trains. The *Journal of Neurophysiology* has always published and continues to publish theoretical papers, experimental papers with models included, and exclusively experimental papers. That said, I have been surprised at the number of queries we receive concerning the potential suitability of theoretical papers for the Journal. Even more surprising was my realization that appropriately reviewing theory papers can be more of a challenge to the Journal than reviewing purely experimental papers. I hope the following comments will be helpful to authors and reviewers alike.

First and foremost, the *Journal of Neurophysiology* welcomes theoretical papers on any aspect of neurophysiology from ion channel biophysics to cognitive function and behavior. A theory paper is potentially suitable for the *Journal of Neurophysiology* if it seeks to illuminate some problem relevant to the physiology and function of the nervous system. In other words, if an experimental paper dealing with an issue would be, in principle, suitable for the *Journal of Neurophysiology*, so would, in principle, a theory paper on the same subject. Not suitable are papers that do not attempt to explain some aspect of the nervous system but might exploit strategies that come from neuroscience for studies of artificial intelligence, machine function etc., unless those studies come full circle and are used in understanding the physiology of the nervous system.

Just as the experimental studies we publish employ diverse methods from single channel recordings to functional magnetic resonance imaging (fMRI), so the theoretical studies we publish will vary dramatically in methods and kinds of employed models. Some may be detailed, quite realistic simulations of neuronal or synaptic function. Others may employ integrate-and-fire neurons to model large networks. Still others may explore analytic solutions to problems of oscillator function, synchronization, etc. Different kinds of modeling approaches are suitable for different questions, and this ensures that a variety of theoretical approaches will find their way into the pages of the *Journal of Neurophysiology*.

Papers of all sorts present challenges during the review process. One challenge posed by theory papers is that some reviewers forget that theoretical papers should allow the investigators and the field to go beyond what is known. The *Journal of Neurophysiology* will certainly publish papers that validate the adequacy or generality of an experimental conclusion, or for that matter demonstrate its lack of generality. Additionally, the *Journal of Neurophysiology* seeks papers that provide rigorous speculations about how physiological processes might work and that tell us in which circumstances we might expect

certain outcomes or consequences of known processes. These are papers that open up new lines of investigations and go beyond verifying what we already understand. These are papers that surprise, then lead us to say, "Of course, why didn't I think of that!" Some important theory papers will prove to be wrong but will have stimulated thinking in new directions. Some important theory papers will prove to be essentially correct but wrong in certain details. Insistence on not modeling until all parameters are measured is equivalent to saying that nothing can be learned from voltage-clamp measurements on neurons that are not perfect spheres.

Although we must expect many theory papers to be eventually superceded by subsequent experiments, it is the responsibility of reviewers and editors to ensure that they are not trivially wrong. We should expect that the calculations be correct, that simulations be properly conducted and described, that relevant parameter searches be done, and that the assumptions that are used in model construction should not fly in the face of known and significant physiological phenomena and processes. We should expect that the assumptions of a theory paper be explicit and reasonable given the state of knowledge in the field and the level of analysis of the paper. In other words, the paper should make sense. We should require that the paper address a problem that neurophysiologists find puzzling and important. Especially, we should expect that a theory paper meet the same basic criterion we use in evaluating an experimental paper: Have we learned something new from this work?

In 1986 Peter Getting gave a talk about his first attempts to model the *Tritonia* swim and escape circuits. At the time, Getting said something I have never forgotten. He said that after several years of building models and playing with them, he realized that he himself had gained immeasurable intuition into the interplay of voltage-dependent conductances in controlling cellular excitability and consequently network dynamics, but that he was less certain that he had learned much that he could communicate to others. Getting was also fond of saying about theory, "Garbage in, garbage out." These are the two traps we must avoid in publishing theory papers. We don't wish to publish the outcome of individuals rediscovering or translating for themselves what the field already knows, and we certainly don't wish to publish garbage. My request to all of you who review all papers, theoretical and experimental, is that you ask yourself the two questions I referred to above. 1) Does the paper make sense? 2) Did I learn something from it? I hope that you will demand that all of our papers make sense and teach us something, but that you allow our theory papers to stretch our collective imaginations and dream to new answers beyond what we already know.

Eve Marder, *Chief Editor*
Journal of Neurophysiology
June 2004, Volume 91