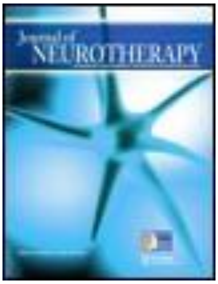


Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

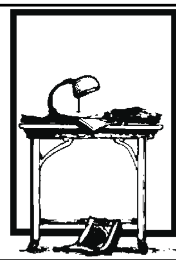
Plasticity and Neurotherapy

David L. Trudeau Editor MD Published online: 20 Oct 2008.

To cite this article: David L. Trudeau Editor MD (2001) Plasticity and Neurotherapy, Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience, 4:4, 1-3, DOI: 10.1300/J184v04n04_01

To link to this article: http://dx.doi.org/10.1300/J184v04n04_01

EDITORIALS



Plasticity and Neurotherapy

The inherent anatomic and functional plasticity of the brain is fundamental to brain wave biofeedback, and other forms of neurotherapy, such as audio-visual stimulation. Recent advances in our understanding of neuronal dendritic function have shed light on the crucial role dendrites play in the processing and integration of signals received by nerve cells. Advances in the study of the function of dendrites, at a detailed level that seemed technologically impossible a generation ago are reviewed in a special issue of *Science*, *27*, October 2000 (www.sciencemag.org).

Häusser, Spruston, and Stuart (2000) review advances in the dynamics of dendritic computation and its contribution to neuronal signal processing. The diverse range of dendritic forms and shapes, with their unique electrical and chemical properties, enables neurons to perform a number of specialized tasks, depending on the functional requirements of their particular location in the brain. These are reviewed through new models of neuronal computation based on new techniques of electrical and optical recording. These models include computational electrical compartments within dendritic trees of individual neurons, so that an individual neuron may have several compartments enabling a variety of local and long-range computational and signaling tasks. The complex dendritic structures can be viewed as the "neuron's brain." The models define the input-output relationships of neurons and the rules for induction of synaptic plasticity. Segev and London (2000) review new experimental approaches of dendritic modeling, emphasizing new and refined models that have been confirmed experimentally only years later. The nonlinearity of dendritic function is emphasized, as they process signals that are generated at the thousands of synapses on them. Kennedy (2000) reviews the postsynaptic density, a protein complex that receives and modulates incoming signals. She discusses recent findings concerning its structure, function, and regulation by neurotransmitters, as well as its auto regulation by feedback. Matus (2000) looks at the role of actin dynamics in dendritic spines and their role in synaptic plasticity that is thought to underlie adaptation, learning, and memory. "New developments in light microscopy allow changes in spine morphology to be directly visualized in living neurons and suggest that a common mechanism, based on dynamic actin filaments, is involved in both the formation of dendritic spines during development and their structural plasticity at mature synapses."

What emerges from these reviews is a fascinating look at the interplay of protein synthesis, signal summation and processing, and both neurotransmitter and anatomic plasticity that create computational bioprocessors within and between dendritic complexes. The role of electrophysiological rhythms in terms of enhancing inhibitions and excitations in the various kinds of dendritic complexes remains to be clearly elucidated. Neurotherapists believe that they are somehow influencing dendritic functions in ways that increase brain adaptability, possibly even increasing dendritic arborization and ease of signal processing for certain functions. Although it remains to be demonstrated that certain kinds of rhythmic entrainment or biofeedback training actually change dendritic function and structure, current models of dendritic plasticity are compatible with this hypothesis.

Will the day come when neurobiofeedback research can describe effects on dendritic function and architecture? Probably it will not, in any direct way for humans. However, as knowledge of dendrites grows we may be able to garner clues into the workings of the brain that can guide us to more meaningful experiments. What is important now is that neurotherapists continue to avail themselves of the latest information that pours forth regarding neuroscience.

David L. Trudeau, MD
Editor

REFERENCES

Häusser, M., Spruston, N., & Stuart, G. J. (2000). Diversity and dynamics of dendritic signaling. *Science*, *290*, 739-744.

Kennedy, M. B. (2000). Signal-processing machines at the postsynaptic density. *Science*, *290*, 750-754.

Matus, A. (2000). Actin-based plasticity in dendritic spines. *Science*, *290*, 754-758.

Segev, I., & London, M. (2000). Untangling dendrites with quantitative models. *Science*, *290*, 744-750.