552.1

SITES OF MOTOR LEARNING IN THE VESIBULO-OCULAR REFLEX (VOR) PREDICTED BY A DYNAMICAL NETWORK MODEL. T.J. Sejnowski and S.G. Lisberger, The Salk Institute, La Jolla, CA 92037, and Department of Physiology, University of California, San Francisco, 94143.

A dynamical neural network model of the VOR and smooth pursuit eye movements was used to explore possible sites of plasticity of the VOR. The model had processing units that were nonlinear leaky integrators interconnected in a pattern based on the known anatomy of the VOR pathways. There were two vestibulo-motor pathways: a direct one through the brainstem and an indirect one through the cerebellar flocculus. The flocculus also received negative visual feedback related to image velocity and positive feedback related to output eye velocity. We used a gradient descent optimization procedure i) to adjust the parameters of the model so it achieved good tracking during VOR and smooth pursuit trials and ii) to determine how the network would reduce the amplitude of the VOR while maintaining excellent pursuit.

Reductions in the amplitude of the VOR in the model were achieved by decreasing the connection weights in the vestibular input to the brainstem. The connection weights in the vestibular input to the flocculus increased during the early stages of learning, as suggested by M. Ito, but decreased during the later stages, as demonstrated by F. Miles et al. Because gradient descent optimization allowed learning at all sites in the model, we conclude that the pattern of weight changes resulted from other factors, such as the anatomical structure of the network and the requirement for accurate dynamic tracking during visual and vestibular stimulation. Similar factors may determine the sites of local learning mechanisms in the VOR pathways in the brain. (Supported by DARPA through the Office of Naval Research and the Howard Hughes Medical Institute).