Online Proceedings

SESSION 1C

SENSORY INTEGRATION, LEARNING, AND MOTOR CONTROL IN ANIMAL AND HUMAN MODELS

Session Moderator: Horacio de la Iglesia, Biology
MGH 231
12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Does Cerebellar Variability Compensate for Variable Motor Commands?

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Mentor: Farrel Robinson, Biological Structure
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Normally, repeated voluntary movements to the same target are nearly identical to one another. If, however, the cerebellum is damaged, then repeated movements to the same targets have variable trajectories and end in different places. To investigate why cerebellar damage makes movements variable, we record in a rhesus monkey from the type of neurons in the cerebellum that we know most about, those that influence rapid eye movements (saccades). These neurons are in the medial nucleus of the cerebellum and send their axons to the saccade control center in the brainstem. The burst of action potentials fired by a single saccade-related cerebellar neuron can be long, short, fast, or slow. How do these variable signals from the cerebellum help create identical saccades? One commonly accepted idea is that the variability for each cerebellar neuron is not correlated with the variability of other cerebellar neurons. The uncorrelated variability of many cerebellar neurons produces a consistent summed signal that produces identical saccades. If this is true, then why are saccades variable when we damage the cerebellum? We propose an alternative hypothesis: the variability of saccade-related neurons is correlated. This correlation produces a variable summed output from the cerebellum for identical saccades. We think that the saccade-to-saccade variability of cerebellar output compensates for variability in the motor commands from the cerebral cortex. The signals from both the cerebellum and the cortex vary but their sum is consistent because they vary in opposite directions. Without cerebellar output, only the variable motor command from the cortex drives saccades. Variable commands make variable saccades. To test our proposal, we record from several cerebellar neurons simultaneously to measure how correlated their variability is. If our proposal is correct, then the variability of cerebellar neurons is not random. It serves a previously unsuspected function to create consistent saccades.