Computation in spinal circuitry: lessons from behaving primates.

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Abstract:

Performing voluntary motor actions requires the translation of motor commands into a specific set of muscle activation. While it is assumed that this process is carried out via cooperative interactions between supraspinal and spinal neurons, the unique contribution of each of these areas to the process is still unknown. Many studies have focused on the neuronal representation of the motor command, mostly in the motor cortex. Nonetheless, to execute these commands there must be a mechanism that can translate this representation into a sustained drive to the spinal motoneurons (MNs). Here we review different candidate mechanisms for activating MNs and their possible role in voluntary movements. We discuss recent studies which directly estimate the contribution of segmental INs to the transmission of cortical command to MNs, both in terms of functional connectivity and as a computational link. Finally, we suggest a conceptual framework in which the cortical motor command is processed simultaneously via MNs and INs. In this model, the motor cortex provides a transient signal which is important for initiating new patterns of recruited muscles, whereas the INs translate this command into a sustained, amplified and muscle-based signal which is necessary to maintain ongoing muscle activity.

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