2.4

Motor Unit Synchronization Measured by Cross-Correlation is Not Increased With Strength Training of a Hand Muscle

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It is commonly believed that motor unit synchronization in a hand muscle increases as a result of strength training, although this has never been assessed directly. The purpose of the study was to use cross-correlation to directly quantify the strength of motor unit synchronization before and after 4 weeks of strength training the first dorsal interosseous muscle. Four young subjects performed a training protocol 3 times/week consisting of 6 sets of 10 maximal isometric index finger abductions. Motor unit activity was recorded with pairs of intramuscular electrodes in the first dorsal interosseous muscle before (n=42 pairs) and after (n=41 pairs) the 4-week training protocol. The training intervention resulted in a 27% (51.0 ± 10.0 N to 64.9 ± 17.0 N, P = 0.007) increase in maximal index finger abduction force, whereas there was a 20% (common input strength index; 0.77 ± 0.41 pulses/s to 0.61 ± 0.38 pulses/s, P = 0.03) reduction in motor unit synchronization following 4 weeks of strength training. Furthermore, there was no association between the change in strength and the change in synchronization in individual subjects after training. These cross-correlation data suggest that increases in strength following 4 weeks of training a hand muscle are not accompanied by increases in motor unit synchronization.

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2.5

Reference Frames for Visuomotor Transformation: Evidence from Spontaneous Movements without Directional Feedback

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Many studies using a range of paradigms have sought to clarify the principles underlying visuomotor transformation. In two experiments, we investigated the “rules” of this transformation with a joystick-controlled computer-based aiming task in which no vision of the limb or feedback concerning movement direction was provided. Several factors were varied, including the orientation of head, trunk and limb. Any stable relationship between the direction of each target relative to the start position, and that of the ensuing limb motion, should reveal something of the underlying rules of visuomotor transformation. In the first experiment, 36 subjects either faced the display with the controlling limb aligned in the sagittal plane, or viewed the display over the left shoulder with the controlling limb extended to the right. Analysis centred on directional error, using circular statistics. Initial spontaneous movements for all but one subject suggest the spontaneous use of an intrinsic reference frame corresponding to a “visuomotor compatibility” principle. A second experiment explored the small deviations from this principle by having right-handed subjects use a joystick in nine positions from extreme left (across the body) to extreme right (right arm fully extended), but in which the y axis was always parallel to the vertical on the display and the sagittal axis. Direction errors show a strong tendency for spontaneous motions to employ a reference frame based on the “virtual” line of sight to the unseen limb, independent of its location. Together, these experiments provide strong support for the operation of a visuomotor compatibility principle in which virtual line of sight is a critical reference.