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Factors that produce the functional coupling between hand and foot

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When human move their foot periodically, the neural activities in forearm muscles are modulated so as to correspond to the phase of the foot movement, which is termed “functional coupling”. It is considered that the coupling enhances the synchronized movements between the limbs. The purpose of this study was to examine the factors that produce the functional coupling. We investigated the four possible factors; 1) motor execution, 2) motor programming, 3) interference of afferent signal, and 4) attention to the afferent signal. To examine the contribution of these factors, we observed whether the functional coupling appeared in the following four conditions of foot movement; 1) voluntary movement, 2) imagined movement, 3) passive movement without attention, and 4) passive movement with attention. To evaluate the corticospinal neural activity, we measured the motor evoked potentials (MEP) from forearm muscles by transcranial magnetic stimulation. The MEPs were recorded in the movement phase of plantarflexion or dorsiflexion. The results indicated that in all conditions the MEP amplitudes in forearm muscles significantly modulated depending on the foot movement phase, that is, the functional coupling occurred. It is suggested that the “motor execution” and “attention to the afferent signal” would not be important to produce the functional coupling, because the functional coupling appeared in the motor imagery and passive movement without attention. In conclusion, the functional coupling would be generated in “motor programming” process and by “interference of afferent signal”.