

The arms and legs work better when used together: amplification of rhythmic activity-dependent suppression of soleus Hoffmann reflexes.

Greg Pearcey

Abstract:

Arm cycling causes suppression of soleus (SOL) Hoffmann (H-) reflex amplitudes that outlasts the activity period. Arm cycling presumably activates propriospinal networks that modulate group Ia presynaptic inhibition. These interlimb pathways are thought to relate to the control of quadrupedal locomotion, allowing for smooth and coordinated movement of the arms and legs. In a recent experiment, we examined whether the number of active limb pairs affects the amount and duration of activity-dependent plasticity of the SOL H-reflex. On separate days, twelve participants completed 4 randomly ordered 30 minute experimental sessions: 1) quiet sitting (CTRL); 2) arm cycling (ARM); 3) leg cycling (LEG); and, 4) arm and leg cycling (A&L) on an instrumented ergometer. H-reflex and M-wave amplitudes in the SOL were evoked via electrical stimulation of the tibial nerve at the popliteal fossa. M and H-reflex recruitment curves were recorded while the participants sat quietly prior to, 10 and 20 minutes into, immediately after, and at 2.5, 5, 7.5, 10, 15, 20, 25, and 30 minutes after the experimental session. Normalized maximal H-reflexes were unchanged in CTRL but were suppressed by ~30, 45 and 50% for the ARM, LEG and A&L conditions, respectively. Suppression of maximal H-reflexes outlasted activity duration for ARM (≤ 2.5 mins), LEG (≤ 5 mins), and A&L (≥ 30 mins) conditions. The non-linear duration of suppression of reflexes in the A&L condition was greater than the algebraic summation of effects in ARM and LEG. This non-linear summation suggests that using the arms and legs simultaneously—as in normal locomotor synergies—causes amplification of networks responsible for the suppression of soleus H-reflexes. This enhanced activity of spinal networks may have important implications for the implementation of locomotor training for targeted rehabilitation.