Impact of Acute Action Observation on Flexor Carpi Radialis Corticospinal Excitability in Older Adults

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Background

Action Observation (AO) is a technique in which a participant views the movement of an actor. AO interventions target the central nervous system rather than muscle tissue directly, with the potential to increase neuromuscular responses such as corticospinal excitability. As strength loss is common in advanced age, AO has been explored as a means of leveraging the neuromuscular system for strength preservation in older adults.

Purpose

The purpose of this study was to investigate the acute effects action observation on corticospinal excitability of the wrist flexors in older adults.

Methods

Participants:

Fourteen older adults (5 men, 9 women, mean ± SD age = 73 ± 6 years; height = 1.67 ± 0.06 m; mass = 78.0 ± 24.1 kg; hand grip strength = 0.37 ± 0.12 kg/kg) participated in this study

Protocol:

Four sessions of AO: (1) observation of very strong, forceful contractions of the hand and wrist, (2) Observation of very weak, feeble contractions of the hand and wrist, and (3) a control condition with no action observation, as well as a familiarization visit to reduce the impact of learning effects. Throughout the 8-minute video observation, transcranial magnetic stimulation (TMS) was performed to assess motor evoked potentials (MEPs) of the nondominant flexor carpi radialis (FCR) as captured with surface electromyography.

Statiscal Analysis:

A two-way repeated measures (time [PRE, 2MIN, 4MIN, 6MIN, 8MIN] × condition [STRONG, WEAK, CONTROL]) ANOVA was used to examine mean differences in MEP amplitude for the FCR during 2-min intervals throughout action observation. If the sphericity assumption was violated, Greenhouse–Geisser corrections were applied. Partial eta-squared statistics (n_p^2) were used as a measure of the effect size for each ANOVA, with values of 0.01, 0.06, and 0.14 representing small, medium, and large effects, respectively.

Methods

Figure 1. TMS pulses were delivered to the motor cortex to determine corticospinal excitability of the Flexor Carpi Radialis at rest.

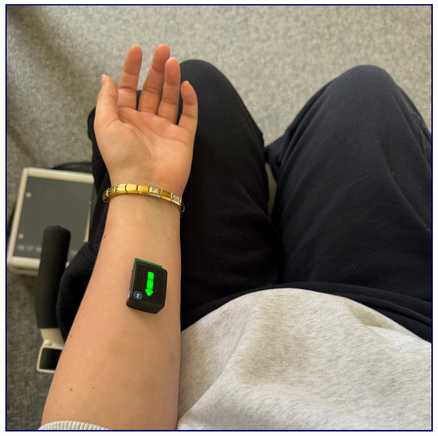

Figure 2. Electromyography (EMG) sensors placed Flexor Carpi Radialis

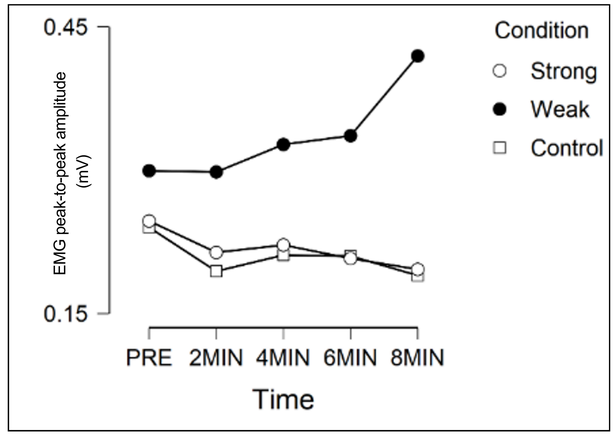

Figure 3. FCR MEP amplitude throughout action observation conditions. Data points represent means.

Results

Results from the Greenhouse–Geisser corrected repeated measures ANOVA indicated that there was not a significant time × condition interaction ($F=1.858$, $p=0.145$, $n_p^2=0.125$). The results further demonstrated that there was no main effect for time ($p=0.484$, $n_p^2=0.057$) or condition ($p=0.134$, $n_p^2= 0.156$). However, when examining effect sizes, there was a large effect for condition, with WEAK resulting in MEP amplitudes 17.4-53.3% greater than STRONG and 19.7-54.8% greater than CONTROL at all time points.

Conclusions

Observation of strong actions did not increase MEP amplitude of the FCR, but effect sizes indicated that observation of weak actions resulted in elevated MEP amplitudes throughout observation. We present two hypotheses to rationalize these findings. 1) This may be due to distinct differences in our participants' perceived abilities and the observed actions. Several participants indicated that they were much stronger than the actors in the videos. This perception may have heightened corticospinal excitability. 2) Observing weak, feeble actions of their peers may have resulted in heightened fear/anxiety, which may increase corticospinal excitability.

Practical Applications

While AO interventions have demonstrated enhanced corticospinal excitability, responses are likely perception- and state-dependent. Future interventions hoping to utilize AO for enhancement of the neuromuscular system should ensure the observed actions are aligned with the target outcome. This is particularly important if the ultimate outcome is strength enhancement.

References

di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: a neurophysiological study. Experimental brain research, 91(1), 176–180. https://doi.org/10.1007/BF00230027

Fadiga, L., Fogassi, L., Pavesi, G., & Rizzolatti, G. (1995). Motor facilitation during action observation: a magnetic stimulation study. Journal of neurophysiology, 73(6), 2608–2611. https://doi.org/10.1152/jn.1995.73.6.2608

Harmon, K. K., Girts, R. M., Pagan, J. I., Rodriguez, G., & Stock, M. S. (2022).The acute effects of action observation on muscle strength/weakness and corticospinal excitability in older adults. Experimental brain research, 240(6), 1801–1810. https://doi.org/10.1007/s00221-022-06370-2

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