Gait & Posture 81 (2020) 99–100

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Biofeedback-driven gaming to reduce muscle stretch reflexes

E. Flux [a], R.C. van 't Veld [b], M.M. van der Krogt [a], E.H.F. van Asseldonk [b]

[a] Amsterdam UMC, Vrije Universiteit Amsterdam- Department of Rehabilitation Medicine- Amsterdam Movement Sciences- de Boelelaan 1117- Amsterdam- The Netherlands, Amsterdam, Netherlands
[b] University of Twente, Department of Biomechanical Engineering- Enschede- The Netherlands, Enschede, Netherlands

1. Introduction

Exaggerated stretch reflexes (hyperreflexia) are present in many neurological impairments, such as spinal cord injury and children with cerebral palsy. Medication and surgery are often used to decrease hyperreflexia, but are invasive and often have limitations. A non-invasive method to decrease reflexes is operant-conditioning, in which participants are asked to reduce reflex response using biofeedback on the size of the reflex [1]. Mrachacz-Kersting et al. [2] were the first to show that healthy adults could successfully down-condition their stretch reflexes through visual biofeedback. Unfortunately, operant-conditioning protocols are time-intensive, which might cause patients to withdraw. Motivation can be increased by adding a gaming environment [3]. This study aims to: 1) replicate previous research to down-condition stretch reflexes; and 2) analyze if a gaming environment can be added to the conditioning.

2. Research question

Can healthy subjects down-condition plantarflexor muscle stretch reflexes using game-based biofeedback?

3. Methods

Six healthy adults (4 female, 24.2 y) participated in six baseline (B1-B6) and six conditioning sessions (C1-C6). Participants were seated with their foot connected to an ankle manipulator (Fig. 1A). Fast dorsiflexion perturbations, with 8° amplitude and 190°/s velocity, were applied to elicit stretch reflexes, while maintaining initial calf muscle length throughout the experiment. In all sessions, feedback was given on soleus background EMG levels to ensure stable conditions. In C1-C6, additional feedback was given on the short-latency component (M1) of the soleus stretch reflex, as measured using EMG. The first three participants, the replication group, received visual feedback conform the method of Mrachacz-Kersting et al. [2] via bar graphs (Fig. 1B). The second three participants, the gaming group, completed the same protocol, but visual feedback was provided using a custom-made interactive gaming environment (Fig. 1C). After C4-6, a within-session reflex reduction of around 15 %, compared to the average of B1-B6, was considered successful. These values are based on results of the stretch reflex study [2] and comparable H-reflex studies [1]. An Intrinsic Motivation Inventory [4] was used to assess interest-enjoyment and perceived competence.

4. Results

Participants from both groups could successfully reduce their reflexes compared to baseline average (Fig. 1D). The replication and gaming group respectively achieved a -14 % and -15 % within-session reflex reduction over sessions C4-6. Especially the gaming group reported high values on interest-enjoyment (8.5 vs 6.6), and perceived competence (8.5 vs 6.2).

5. Discussion

This study adds on to the validation of the operant-conditioning protocol to decrease stretch reflexes through reflex feedback. Furthermore, it shows that a gaming environment potentially improves engagement and competence, without interfering with the conditioning. This can potentially aid therapeutic applications, especially when considering children with cerebral palsy. Since this study is restricted to within-session effects, the effect on long-term changes should be further studied, as well as the applicability to patient populations.

https://doi.org/10.1016/j.gaitpost.2020.07.083

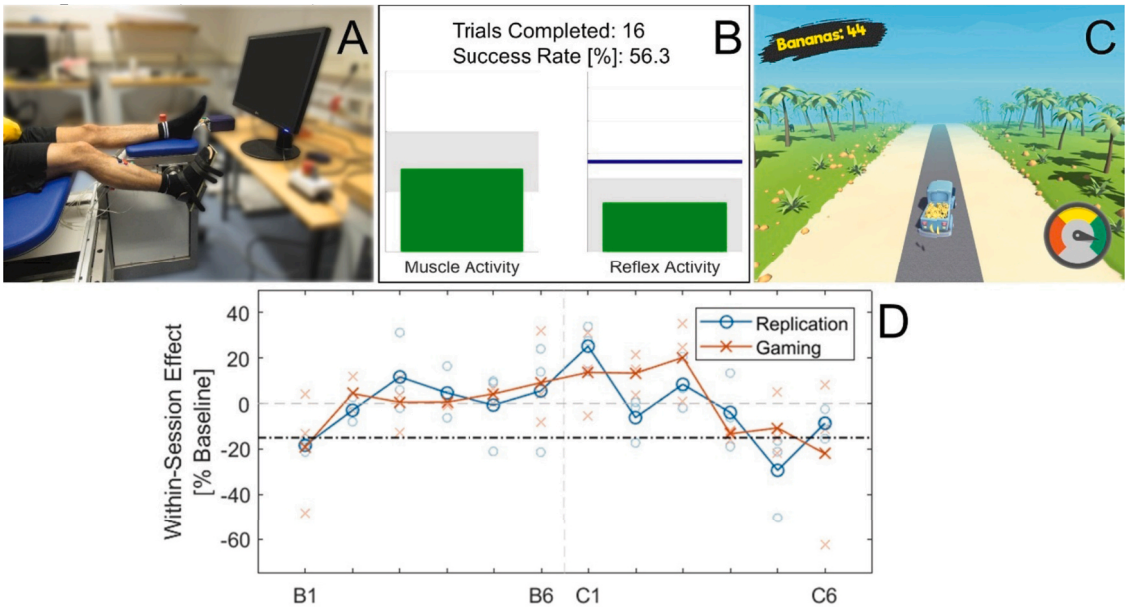

Fig. 1. XXX.

References

[1] Thompson, Front. Integr. Neurosci. 8 (2014) 1–25.
[2] Mrachacz-Kersting, J. Neurophysiol. 122–1 (2019) 435–446.
[3] Pereira, Neurol 29–9 (2014) 550–559.
[4] McAuley, Res. Q. Exerc. Sport 60–1 (1989) 48–58.