



Correspondence

Handedness and potential implications for neurorehabilitation in multiple sclerosis



To the Editor

We read with interest the paper by Jonsdottir et al. (2019) on the results of a trial to verify the feasibility and efficacy of a serious virtual reality-based game approach to supervised upper limb rehabilitation of the more affected arm in people with multiple sclerosis (MS) with moderate to severe disability (median expanded disability status scale score: 7), and the cross-over effect to the non-treated arm. Jonsdottir et al. found that this intervention improved dexterity and arm function, mainly in the treated arm, but with some positive effects in the non-treated arm. In half of the sample, the treated arm was the dominant arm, and in the other half the non-dominant arm was treated. Our comments are focused on suggesting future directions for this important line of research as it may relate to patients in earlier stages of MS even without clinically significant upper limb weakness, and the relevant implications of handedness.

Based on the neural reserve hypothesis, individuals vary in their capacity to tolerate neuropathologic damage, however the neural mechanisms underlying this capacity are not yet fully understood (Getz, 2011). Differences in the resilience of pre-existing neural networks may contribute to differing neural capacities such that an individual with more efficient neural networks could have a higher capacity for tolerating injury. With respect to handedness, it can be postulated that the neural networks responsible for controlling the more dexterous dominant hand have a greater reserve capacity due to use-dependent plasticity in comparison with the networks associated with the non-dominant hand. This is consistent with findings from several neurologic disorders with typically asymmetric involvement of upper extremities. For instance, it has been shown that patients with non-dominant-side onset Parkinson's disease had more motor deficits compared to those with dominant-side onset disease despite similar magnitudes of dopamine reductions on dopamine transporter imaging (Ham et al., 2015). Furthermore, patients with non-dominant hands affected by stroke were found to have more motor impairment post-

stroke in comparison to those with onset involving the dominant hand (Harris and Eng, 2006). It has also been shown in patients with MS or clinically isolated syndrome that the assessment of finger tapping performance with the non-dominant hand was associated with an overall higher sensitivity for detecting demyelinating lesions in the central nervous system compared to the dominant hand (Shirani et al., 2017), a finding that may propose a lower "reserve capacity" in the motor networks responsible for controlling the non-dominant side. We therefore suggest studies to examine the effect of virtual reality-based game approach using the non-dominant hand in patients in early stage of MS who might have minimal or no obvious dysfunction in upper extremities in an attempt to increase the reserve capacity of the brain hemisphere and relevant neural networks responsible for controlling the non-dominant side, and potentially increasing the threshold for symptom manifestation related to MS.

Upper extremity dysfunction may ultimately be present in up to 80% of patients with MS (Kraft et al., 2014). Impairments of manual fine motor skills can have a significant negative impact on the quality of life in these patients. Further research efforts are needed to investigate targeted patient engagement interventions to promote neuroplasticity and neurorehabilitation in the upper extremities of people with MS. We again commend the authors on their effort in completing this trial.

Declaration of Competing Interest

The authors disclose no conflicts of interests related to this work.

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Commentary on: Jonsdottir J, Perini G, Ascolese A, Bowman T, Montesano A, Lawo M, Bertoni R. Unilateral arm rehabilitation for persons with multiple sclerosis using serious games in a virtual reality approach: Bilateral treatment effect? *Mult Scler Relat Disord* 2019 Jul 20;35:76–82. doi: 10.1016/j.msard.2019.07.010.

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