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**Title**

Neurofeedback for central neuropathic pain: understanding successful neuromodulation in able-bodied and spinal cord injury participants

**Abstract**

Central neuropathic pain (CNP) is a debilitating problem prevalent in 53% of the spinal cord injury (SCI) population. Electroencephalogram (EEG)-based neurofeedback (ENF) is a process where individuals self-modulate brain activity (neuromodulation) using mental strategies (MS) to control a computer display of real-time EEG feedback. Preliminary research suggests that ENF has potential to reduce CNP after SCI. This exploratory study examined individuals’ MS used for ENF neuromodulation.

Twelve SCI patients with CNP (4 female; mean age 50) and twenty-six able-bodied participants (13 female; mean age 30.69) engaged in ENF on eight and four visits respectively. Each visit comprised of six five-minute ENF sessions; no neuromodulation guidance was given. Semi-structured interviews were conducted at the end of each visit examining participants’ MS and perceived neuromodulation performance, which was compared to actual-performance using frequency-spectrum analysis of their EEG activity. Interviews were analysed using thematic framework analysis. MS of patient and able-bodied participants were compared.

Common MS were found, although none were consistent within and across participant groups. Trait of MS was associated with neuromodulation success. Unsuccessful participants reported they could not differentiate between successful and unsuccessful strategies; interview analysis revealed this was due to a non-optimal method of displaying EEG activity that overloads attentional resources.

The results indicate that MS are a mediator, where MS are used to invoke specific mental processes (trait of MS) needed for ENF neuromodulation. The computer display of EEG activity may benefit from modifications by simplifying the on-screen information to facilitate learning ENF neuromodulation.