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TACTILE FEEDBACK RESTORATION USING SENSORY SUBSTITUTION IN CHRONIC PARAPLEGIC PATIENTS

Objectives: Spinal Cord Injury (SCI) induces bidirectional loss of communication between the brain and the body. In the last decade Brain Machine Interfaces (BMI) have been proposed as a potential solution to restore motor functions in SCI patients. Here, we demonstrate a new paradigm for reproducing somatosensory feedback from lower limbs in paraplegic patients by remapping missing tactile sensations from the leg/foot onto the patients' forearms.

Methods: We developed a portable tactile display – called the tactile shirt – to reproduce the missing haptic feedback from the legs on patients' forearms through simple detachable vibrators. The feedback represented the rolling of the feet on the floor and was generated by a 3D avatar in an immersive virtual environment. EEG

signals were recorded to track cortical changes throughout the experiments. The setup was tested with eight chronic SCI patients.

Results: Relying on the tactile feedback only, patients could perceive the position of the leg in space. We observed functional cortical plasticity following few minutes in our setup. Psychophysical and neural data showed patients assimilated the 3D avatar as an extension of their own sensorial body. Tactile feedback was found to be essential as the observation of the 3D avatar alone did not elicit such an effect. This effect was paralleled with neurological improvement in the sensory area under patients' lesion area.

Conclusions: We propose use of rich sensory feedback in future development of neuroprosthetics with BMI for SCI patients. Patients can rely on this feedback to improve their motor control, as sensory feedback is known to be essential for locomotion control loop. Additionally we observed that patients brain representation of their body changed which has potential rehabilitative effect on patients' sensory functions.