Achievable Brain Computer Communication through Short Intensive Motor Imagery Training despite Long Term Spinal Cord Injury

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A. Background:
Severely motor disabled individuals face challenges to move independently and control their environment. Various different assistive technologies exist, however the ideal solution would be to bypass any need for neuromuscular involvement and allow the individual to use goal directed thoughts to achieve their intentions through a computer interface. Brain-computer interface technology offers this potential [1]-[3]. BCIs utilize a number of self-directed neurophysiological processes such as the activation of sensorimotor cortex during motor imagery (MI). Concerns exist that prolonged inactivity of sensorimotor cortex will impact on the amount of training and accuracies achieved limiting the usefulness of this technology. Here we demonstrate that in two individuals with long term tetraplegia from spinal cord injury, good accuracy levels can be achieved through short intensive training periods.

B. Case Description:
Case 1: female, aged 60, with a C4 ASIA A traumatic spinal cord injury (SCI) sustained 35 years ago. Case 2: male, aged 42, with a C5 ASIA B traumatic SCI sustained 12 years ago. Both individuals initially took part in 10 training sessions over 3 months to familiarise with the technology and 4 months later took part in an intensive 2-3 sessions over 1 week. A binary class BCI (left vs. right hand MI) with three bipolar channels over the sensorimotor cortex (CP3-FC3, CPz-FCz, CP4-FC4 and a reference at AFPz) was used [3][4]. Experiments were conducted in the participant’s home environments.

C. Results of Investigations:
Both subjects had achieved accuracy levels in the range of normality [2] (60%-70%) during an initial 10 training sessions. After a short intensive training period both participants showed clear performance gains, achieving accuracy in the range 70%-88%.

D. Discussion:
Individuals who have sustained high level injuries to their spinal cord resulting in prolonged inactivation of sensorimotor regions can still achieve accuracies needed to control a BCI within a relatively short intensive training period.

E. References: