Brain–Computer Interface Targeting Cognitive Functions after Spinal Cord Injury

Objective: In an attempt to widen the utility of computer-assisted devices and to increase independence among spinal cord injury (SCI) populations, brain–computer interface (BCI) technology has generated much interest. To date, most BCI studies in persons with SCI have revolved around motor-based activity and communication. The potential of BCI in neuropsychological facets of SCI has yet to be investigated.

Method: Eighteen patients who sustained a SCI (48% cervical; 44% thoracic; 52% residual tetraplegia) and 18 demographically matched normal controls participated in a BCI cube rotation and manipulation paradigm as part of a larger neuropsychological battery. None had severe cognitive or psychiatric impairments. Following a training session for individual differences in BCI mental rotation and manipulation, participants performed three attention/concentration trials using the BCI paradigm.

Results: Significant differences between groups were found for Oral Trail Making-A [F (1,34) = 6.72, p = .01]; Oral Trail Making-B [F (1,34) = 5.16, p = .030]; and BCI Total Mental Rotation and Manipulation Time [F (1,34) = 5.13, p = .030]. The BCI paradigm was well tolerated by participants across age ranges, educational/vocational backgrounds, and levels of injury. Participants reported enjoying the experience (79.2 ± 23.9 on 1-100 scale) and feeling competent (69.1 ± 28.4 on 1-100 scale) with the BCI technology.

Conclusion: This study suggests simulation technology and BCIs may be safely and successfully used with individuals undergoing inpatient SCI rehabilitation. Further, results indicate the BCI cube rotation and manipulation paradigm may offer an additional tool for assessment of visuospatial manipulation of virtual objects without motor demands.