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Brain-Computer Interface Technology In ALS Patients: What Is The Reality In Brazil?

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ABSTRACT

Brain-computer interface technology has been a new communication option for individuals with Amyotrophic Lateral Sclerosis. However, due to the poor financial situation of a large part of the population, in Brazil, their access is hampered. Only patients selected for research or with reasonable purchasing power receive information and, consequently, can acquire new technologies. Although the country is still far from virtual reality there are reference centers in this area that generate the hope of changing this situation to positive results.

Keywords: brain-computer interface, Amyotrophic Lateral Sclerosis, communication.

Over the past decade, many laboratories have begun to explore brain-computer interface (BCI) technology as a radically new communication option for those with neuromuscular impairments that prevent them from using conventional augmentative communication methods (Ikegami, 2014). Although this technology is already implemented in many developed countries, unfortunately in Brazil, its access is hampered, mainly due to the lack of health information of professionals linked to the socio-economic level of the population.

Individuals with Amyotrophic Lateral Sclerosis (ALS) exhibits speech disorders since the early stages that decrease the communication rate and interfere in social participation. Options for patients who have lost the ability to communicate orally are limited. Communication devices are categorized into two segments: dedicated and undedicated. A dedicated device is strictly a communication device in that the only function it performs is speech generation. Undedicated devices, which are computer based, not only speak, but also feature all the functions of a regular computer, such as word processing, email, internet access, among other applications (Erlbeck, 2017). In our country, more primitive ways of attempting communication have been attempted, for example, affirmation or negation movements with the cervical region or movement of the eyes in models with letters or numbers.

Different researchers have generated a novel communication and control system that utilises the electrical activity of the brain as a signal that represents the messages or commands an individual sends to the outside world, without using the normal output pathways of the brain, such as peripheral nerves and muscles; instead, this is achieved through an artificial system that extracts, encodes and applies them, called a brain-computer interface (BCI). The central element in each BCI is a translation algorithm that converts electrophysiological input from the user into output that controls external devices. BCI operation depends on effective interaction between two adaptive controllers, the user who encodes his or her commands in the electrophysiological input provided to the BCI, and the BCI which recognizes the commands contained in the input and expresses them in device control (Li *et al*, 2011).

The electrophysiological activity for a BCI can be obtained by means of superficial or implanted electrodes, and may therefore be classified as invasive or non-invasive. Five types of brain signals have been explored for use with a BCI: visual evoked potentials, slow cortical potentials, cortical neuronal activity, beta and mu rhythms, and event-related potentials. The practical use of BCI technology depends on the development of appropriate applications, identification of appropriate user groups, and careful attention to the needs and desires of individual users. Controlling over mobile peripheral devices such as intelligent wheelchairs or nursing robots is a very important application of BCI technology in the future (Neto *et al*, 2017).

Another important issue is that although some programs already have free access on the internet, the acquisition of necessary instruments such as computers, electrodes, internet and qualified personnel for installation and orientation are difficult in Brazil, because of the poor financial situation of a large part of the population.

Despite partial success, communication has remained impossible for ALS patients suffering from complete motor paralysis but intact cognitive and emotional processing, a state called complete locked-in state (CLIS). Based on a motor learning theoretical context and on the failure of neuroelectric

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brain-computer interface (BCI) communication attempts in CLIS, researchers report BCI communication using functional near-infrared spectroscopy (fNIRS) and an implicit attentional processing procedure. Preliminar positive results could indicate the first step towards abolition of complete locked-in states, at least for ALS (Vansteensel *et al*, 2016).

As long as we are not advancing economically and scientifically, countless brain-machine research will be restricted to the smallest part of the population in Brazil. Of course there are centers of reference in this area, but only patients selected for research or with reasonable purchasing power receive information and, consequently, can acquire new technologies. We are still far from virtual reality.

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