Guest Editorial

Special Issue: EEG and Addictions

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Salvatore Campanella[1]

Introduction

Drug Addiction remains one of the most serious public health concerns in our society because of the high prevalence of disability and death. About 35 million people worldwide are estimated to be affected by drug use disorder. Despite a large number of therapeutic approaches that have been proposed, the relapse rate remains high: around 70% to 90% within 1 year of treatment. This outlines the limitation of the current treatments proposed for addictive disorders (mainly psychotherapy and medication) and the urgent need to find effective add-on tools.

Over the past two decades, progress has been made by researchers in cognitive neurosciences regarding our understanding of addiction and the resultant cognitive and neuromodulation training programs. It has been highlighted that, although there are plenty of substances and behaviors that can lead to addiction (alcohol, tobacco, opiates, stimulants, gaming…) which are characterized by various pharmacological effects, all of them have in common an acutely rewarding aspect because of their impact on the dopaminergic system. A large amount of research in psychiatry has been carried out to identify the cognitive processes underlying the changes in drugs' saliency. In this view, the dual process model is usually mentioned in research: addicted patients present a default in the balance between a strengthened automatic system of impulsive habits (rewarding system) and a weakened executive process system (future-oriented processes, goal directed decisions). As regards the executive processes impaired in addiction, the inhibitory processes (ability to stop an ongoing behavior in favor of another), working memory (ability to maintain and manipulate a lot of information in the same time), and cognitive flexibility (ability to adapt quickly a response or our attention) have been identified as impaired. With regards to the reward system, an abnormal bottom-up system generating a "wanting" (craving) behavior and an automatic approach tendency has been described. Such deregulations can hamper the efficacy of conventional treatments, increasing the risk of relapse. Furthermore, a growing body of evidence designates the cognitive components set out in the dual process model as the best targets for treatment interventions and neurocognitive measures as valuable predictor of substance use disorders' (SUD) treatment outcomes. To be efficient, the cognitive therapy must also be personalized and individualized. Therefore, it has been suggested that a deep phenotyping of cognitive processes can lead to more well-matched cognitive and pharmacological approaches and as a result to better treatment outcomes. This is in line with the objective of a stratified medicine which is currently considered to be our best opportunity to address the large public health burden, and individual suffering associated with mental disorders. A more powerful evaluation of cognitive alterations is thus clearly needed, mainly to identify the best-suited cognitive mechanisms that should be rehabilitated by adapted cognitive training programs and/or neuromodulation tools.

Electroencephalogram (EEG) is an inexpensive and non-invasive method allowing the recording of spontaneous electrical brain activity from multiple electrodes placed over the scalp. Despite limited spatial resolution, EEG is a valuable clinical tool for diagnosis due to its excellent temporal resolution, making it a first-line method to exclude diagnoses of epilepsy, drug intoxication or sleep disorders in psychiatric patients. A derivative of the EEG technique includes event-related potentials (ERPs), referring to averaged EEG responses that are time-locked to the cognitive processing of stimuli. As cognitive complaints are a key factor of mental diseases, cognitive ERP deficits have been widely reported in various psychiatric disorders. Converging evidence shows that ERPs enrich our understanding of brain dysfunctions in sensory and cognitive systems in psychiatric patients, offering potential biomarkers to complement differential diagnosis, which is still mainly based on clinical evaluations. In the present Special Issue, several papers will illustrate how some *monitoring* EEG tools may be useful to identify the pathophysiological mechanisms indexing specific addictions (tobacco, gambling, caffeine, opioids, alcohol, etc), concerning the use of EEG abnormalities as potential predictors of illness course and outcome, but also at a therapeutic level, how non-invasive brain stimulation tools that utilize neuroelectric principles to modulate brain activity (such as transcranial direct current stimulation [tDCS]) can help in a better management of addicted patients. The main aim of such a Special Issue is therefore to illustrate how various EEG tools can actively contribute to the identification, the prediction of relapse, the evaluation of treatment outcomes, and the follow-up of addictive states.

[1]Laboratoire de Psychologie Médicale et d'Addictologie, ULB Neuroscience Institute, CHU Brugmann-Université Libre de Bruxelles (U.L.B.), Belgium

Corresponding Author:
Salvatore Campanella, Laboratoire de Psychologie Médicale et d'Addictologie, ULB Neuroscience Institute, CHU Brugmann-Université Libre de Bruxelles (U.L.B.), Belgium.
Email: Salvatore.CAMPANELLA@chu-brugmann.be