

EEG Neurofeedback Training for Mental Health Issues of Prisoners

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Abstract

The EEG neurofeedback training is an upcoming intervention concerning many disorders such as Attention-Deficit/Hyperactivity Disorder, Schizophrenia and Depression as well. The main aim of this review was to study the efficacy of this intervention on a vulnerable population like prisoners. Papers for this review were selected from established databases like PubMed, ProQuest, and ScienceDirect among many. The use of neurofeedback in the forensic psychiatric setting did not show a healthy level of applicability as expected. The main reasons for this were the variations in the sample characteristics between the studies, along with the motivation of the prisoners as well. The prison setting also delayed and interfered with the training and could also be alluded to its apparent difficulty in the application of this treatment. There are a small number of studies with even smaller samples in a population that is difficult to engage. These conditions have led to inconclusive results in most cases. There is scope for improvement, and this is an upcoming area of research. Future directions are also discussed.

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1. Introduction

“It is said that no one truly knows a nation until one has been inside its jails. A nation should not be judged by how it treats its highest citizens, but its lowest ones.” Nelson Mandela (p. 115, 1994)

The Governments in the interest of public safety and upholding the laws of the land takes the responsibility of prosecuting and meting out punishments as well. In most cases, these are in the form of prison sentences that might vary from being a few years to a lifetime. More often than not, it is believed that by merely isolating the criminals from society, would in a way, take care of the circumstances that lead to the crime in the first place. There is not much done in the prisons in terms of rehabilitation and this has led to an increase in recidivism. The national average in India stands at 10.4% which is also likely to fluctuate between states and union territories (Yadav, 2014). There are attempts at rehabilitation, but these are not effective as these are often viewed as unnecessary by the officials themselves. Rehabilitation, at its core, must be a system to correct the wrongs committed by the criminals and give them the skills and treatment that will facilitate a smooth transition into the general community. The provision of passing qualifying exams in an attempt to educate them and setting up vocational training centres is a good step in the right direction. These vocations, however, tend to involve skills that might not sufficiently interest the prisoners.

The prison system also neglects to cater to the interests and well-being of the prisoners, especially when it comes to their mental health. Syed and Raghavan (2018) noticed a dismal trend when it came to studies in this area. They classify prisoners as a minority and have highlighted the prevalence of chronic mental illnesses like schizophrenia, depression and adjustment issues along with suicide risk as well. In terms of the level of intervention that was implemented within the prisons, it was found that yoga was useful when it came to dealing with anxiety and depression. However, the need for newer techniques was also emphasised, along with mental health clinics and trained professionals within the prison system itself. The current scenario in India usually involves a psychiatrist from a government hospital who visits prisons once a month. This scenario is mostly for medications and treatment for people with substance use disorders. Any emergencies in terms of mental health are usually referred directly to the corresponding hospital. The high rates of recidivism and mental health could be tackled adequately with the introduction of techniques such as neurofeedback training.

Neurofeedback training (NFT) is a technique which teaches clients to control their brain waves and in turn alter brain functioning. This training operates on the principle of operant conditioning and uses electroencephalography (EEG). The client is given feedback on their training in real-time, and this shows them the progress that they make as well. Based on the brain waves targeted, many protocols are available. These can also be tailor-made to precisely certain brain areas as well depending on the goal of the NFT. NFT has also been effective in the treatment of disorders such as attention-deficit/hyperactivity disorder, schizophrenia, drug addiction, depression, anxiety and even pain management. Each of these disorders tends to affect the brain and its waves differently, and the protocols are designed to counter these effects (Marzbani, Marateb, & Mansourian, 2016).

2. Objectives

The main objectives of this review article are to review papers on neurofeedback and their efficacy in dealing with mental illnesses and antisocial behaviour among the prisoners. This would establish a neurobiological technique such as NFT as a useful alternative for rehabilitation in prison systems along with the pre-existing mechanisms of vocational training and providing education as well.

3. Methods

A traditional literature review was done using keywords such as neurofeedback training, prisoners, antisocial behaviour, and mental health in prisons. Papers, as a result, were reviewed from PubMed, ScienceDirect, Elsevier and Taylor and Francis, among others. It included papers from journals such as Basic Clinical Neuroscience, International Journal of Forensic Mental Health, Indian Journal of Social Psychiatry and the Journal of Criminal Justice, among others.

4. Results

4.1 Efficacy of Neurofeedback in Forensic Psychiatric Settings

Neurofeedback is increasingly being used to tackle many types of disorders in the clinical psychiatric setting from anxiety disorders to schizophrenia. However, there is no similar trend when it comes to its usage in forensic psychiatry. The presence of a co-morbidity may counteract with other treatments but would not be treated as a contraindication for NFT (Holtmann, Albrecht, & Brandeis, 2018). Moreover, it is the main reason why it is not frequently used in forensic settings. The forensic psychiatric population includes people who are not wholly responsible for their crimes. Part of the blame lies in the mental illness as well. Fielenbach, Donkers, Spreen and Bogaerts (2018) studied the effects of Neurofeedback on forensic psychiatric patients, about 19 of them with substance use disorder along with any other comorbidity as well. Primarily, in her protocol was to test the ability to reduce impulsivity and restore inhibitory controls within them through increasing SMR and reducing theta. To ascertain whether there was any change due to the NFT, the EEG magnitudes must have changed from the baseline by about 8%. At the face of it, although there were improvements in their impulsivity and craving due to increasing SMR, there were low respondents to the same. This was attributed to the low number of sessions along with the continued use of their prescriptions as well.

Neurofeedback has opened up the possibility of neurobiological approaches to the field of forensic psychiatry and correctional facilities. At present, it does not enjoy widespread attention from psychologists, primarily due to the overemphasis on psychosocial factors of antisocial behaviour and psychopathy. However, traditional forms of psychotherapy are plagued with

problems such as low compliance rates and in multicultural settings, lack of proper communication. This leaves the stage open for newer approaches such as neurofeedback. Neurofeedback therapy proved to be instrumental in dealing with cases of aggression and anti-social behaviour as a result of substance abuse (van Outsem, 2011). It was effective in reducing the craving as well as abstinence was also prolonged. In cases of domestic violence, which are precipitated by the fear of abandonment and pathological jealousy, neurofeedback was used to enhance flexible thinking and emotional response as well (van Outsem, 2011).

When it comes to prisoners, there is the aspect of criminal offending, recidivism, reoffending, aggression, violence, and along with disorder associated with the same like ADHD, schizophrenia, psychosis, cluster B personality disorders, psychopathy and substance use disorder. An important aspect when it comes to EEG-NFT is that there has to be actual learning for it to work. This is a criterion that takes prime importance when it comes to studies which employ this intervention. A review paper found that out of a total of 224 articles screened there were only ten that specifically looked at EEG and also included the details on the protocol used along with a specific criterion for EEG learning. Impulsivity and difficulties with inhibitory control did seem to improve, along with hostility and drug use. Recidivism could also be reduced if these symptoms are reduced as well. However, it was uncertain whether improvements in brain waves are always correlated with the behavioural measures utilised. The possibility of randomised control trials might help ascertain the effects of neurofeedback (Fielenbach, Donkers, Spreen, Visser & Bogaerts, 2018). The most interesting study of these 10 was one which looked to study the aspect of brain self-regulation in criminal psychopaths. It utilised slow cortical potentials demonstrated that the psychopaths were able to control brain excitability. There were reduced aggression, impulsivity and behavioural tendencies. There are few psychophysiological treatments as intervention, and neurofeedback continues to be the leading candidate for reducing psychopathic characteristics such as disinhibition, aggression and related behavioural approach tendencies. This was also reflected in self-report measures for physical aggression, although reactive aggression and aggression inhibition were not significant (Koncar et al., 2015).

4.2 Use of SMR and SCP training for Forensic Psychiatry and Substance Use Disorder

Fielenbach, Donkers, Spreen and Bogaerts (2017) explored the use of the sensorimotor rhythms protocol for reducing impulsivity and by extension, the use of substances among the forensic psychiatry population. Impulsivity has been associated with drug use and also a likely cause of it. The use of SMR protocols was expected to significantly reduce impulsivity and the level of craving that the participants experienced. This protocol was further evaluated along with theta waves. The substance use and psychiatric disorders in the forensic psychiatric population increase the likelihood of violence in the future. Hence, it is necessary to address the lack of inhibitory control in the population. According to the protocol, the SMR frequency was enhanced, while inhibiting the theta frequency. The Barratt Impulsivity Scale, along with a Go/No-Go reaction time task, was used to measure impulsivity. The population was male and had been undergoing treatment for their illness as well. Therefore, the neurofeedback sessions were accompanied by treatment as usual (TAU) in one grouping and just TAU in the other. However, this combination did not seem to be better in any sense (Fielenbach, Donkers, Spreen & Bogaerts, 2018).

In an attempt to isolate the effects of the neurofeedback, a clinical case series was done. The benefit of this is that individual differences can be strictly observed while still retaining the validity and stringent standards of an RCT. The control was done with a sham neurofeedback protocol. The theta/SMR protocol was used once again. While there was evidence that there was a decrease in the self-reported scores of impulsivity and craving, it could still not be attributed exclusively to the neurofeedback training. All connections to the intervention were purely speculative. However, there were no significant differences found in the study. This was especially concerning the two patients that underwent the real neurofeedback protocol. While one of them reported a reduction in their impulsivity and level of craving, this was present at baseline as well. The other patient, despite having undergone the same training, did not appear to have a similar reaction to the intervention. This was the result after a total of 8 sessions (Fielenbach, Donkers, Spreen, Smit, & Bogaerts, 2019). This raises several questions concerning whether the intervention can adequately be applied to this population. The type of externalising disorder, its severity, along with the treatment in progress, seems to be a confounding variable when it comes to testing the efficacy of this intervention.

5. Summary of Studies: Pros and Cons

Table 1. Pros and cons of studies

Authors	Pros	Cons
Caria, Sitaram, Veit, Begliomini, & Birbaumer (2010)	It used a new approach – real-time functional magnetic resonance imaging to assess the role of the insula in feedback.	Small sample used
Fielenbach, Donkers, Spreen, Smit, & Bogaerts (2019)	Utilised EEG neurofeedback in a single case experimental design to control impulsivity and craving	Improvements on behavioural reports were not attributable to neurofeedback intervention
Fielenbach, Donkers, Spreen, & Bogaerts (2017)	Development of an SMR neurofeedback protocol that is designed for forensic patients	The N-of-1 approach may help explain effects encountered to the protocol but loses generalisability
Fielenbach, Donkers, Spreen, & Bogaerts (2019)	Use of SMR and Theta protocols for craving and impulsivity. There were improvements in the self-reported measures for the same.	Only the craving improvements could be attributed to the neurofeedback training. N=19 means that there is a low scope for generalisability.
Fielenbach, Donkers, Spreen, & Bogaerts (2018)	Use of SMR/Theta Protocol to reduce craving and impulsivity in substance abuse disorders. A randomised control trial was used with the two groups being neurofeedback and treatment as usual.	There were changes in the level of craving with an increase in SMR activity on an individual level, but this was not found on the group level.

Shepard (2015)	Review paper showed that there were specific protocols like the Peniston Protocol, its Scott-Kaiser modification, and the QEEG that are more helpful. Of these, Scott-Kaiser modification has the highest rates of success.	This review affirms the use of neurofeedback therapy as a means of treatment, especially for substance use disorders, but does not clarify its use with forensic patients.
Konigar et al. (2015)	Psychopathic offenders can gain control of brain excitability in the Fronto-central region after intense brain regulation intervention using the SCP protocol.	Possibility of practice effects on the Flanker task that was used in the study. A small sample was used and there were not adequate control conditions.
Fielenbach, Donkers, Spreen, Visser, & Bogaerts (2017)	There is a possibility that Neurofeedback techniques can be applied to criminal offender populations.	Difficulty in assessing the modality of the neurofeedback to be used in most cases. Single case experimental designs more beneficial than double-blind, randomised controls

6. Conclusion and Future Directions

The effects of the neurofeedback intervention do not seem to lend itself to the natural adaptation to the forensic psychiatric population as expected despite having a high level of success otherwise in terms of higher rates of abstinence and lower levels of depression. This comparison is when treated with traditional forms of intervention, such as psychotherapy. This could also be attributed to the protocols used as they differ between researchers as well. The Peniston Protocol uses a form of alpha/theta training, while the articles reviewed focused on SMR instead (Shepard, 2015). There has been much evidence for the use of neurofeedback as an excellent alternative to traditional practices (Marzbani, Marateb, & Mansourian, 2016; van Outsem, 2011). However, this is not easily visible when it comes to the prison system and the forensic psychiatric population. Some of the significant issues in this population is the prevalence of impulsivity and substance use disorders. While many designs and protocols of the Neurofeedback therapy deal with similar issues such as aggression and substance use disorders, they did not show any significant difference pre- and post-intervention. More importantly, these were not restricted to the effects of the neurofeedback itself (Fielenbach, Donkers, Spreen, Smit, & Bogaerts, 2019; Fielenbach, Donkers, Spreen, Visser & Bogaerts, 2018). Other issues which came were the fact that the intervention did not seem exciting enough to keep the prisoners engaged. The number of sessions was also variable between the studies. Some of these were as short as eight and rarely went over 20. This was also attributed to the low level of compliance and motivation to participate in the study.

Along with this, the treatment that the participants were already undergoing did not stop either. This became a confound within the experiments. The criterion of EEG must be used; otherwise, any significant positive changes would be not attributed to the use of neurofeedback therapy. The use of behavioural measures meant that the results were susceptible to participant's bias. The future course of action can be directed towards increasing the number of sessions and utilising games or animations that are tailored to the population. This would also contribute to keeping the participants engaged in the intervention.

Furthermore, the use of neurofeedback means that the results are not readily visible, hence the improvements must be communicated between sessions to retain the participants. Finally, it has to be considered that the composition of the Forensic Psychiatric Population is varied and it might also lack the necessary training to learn neurofeedback itself (see Fielenbach, Donkers, Spreen, Smit, & Bogaerts, 2019; Caria, Sitaram, Veit, Gaber, Ruiz & Birbaumer, 2010). There were instances where the participants had to be directed to participate rather than stare blankly at the screen actively. The use of a sample that can be standardised to the extent that even the TAU is constant would help emphasise the intervention capability of the neurofeedback training.

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