Journal of Neuroinfectious Diseases
ISSN: 2314-7326



Review Article Open Access

# Applications Based on Brain-Computer Interfaces for Training and Rehabilitation of Kids with Neurodevelopmental Disorders

**George Drigas***

*George Drigas, Department of Medical Physics and Neurology, Iran*

## Abstract

The purpose of this article is to discover a paradigm shift on Brain Computer Interface (BCI) research, as nicely as on intervention pleasant practices for coaching and rehabilitation of college students with neurodevelopmental disorders. Recent research point out that BCI gadgets have superb influence on students' interest capabilities and working reminiscence as properly as on different skills, such as visuospatial, social, resourceful and emotional abilities. BCI functions goal to emulate humans' Genius and tackle the splendid perception for every student's neurodevelopmental disorders. Studies carried out to furnish understanding about BCI-based intervention purposes concerning memory, attention, visuospatial, learning, collaboration, and communication, social, innovative and emotional abilities are highlighted. Only non-invasive BCI kind of functions are being investigated primarily based upon representative, non-exhaustive and cutting-edge research inside the field. This article examines the growth of BCI lookup so far, whilst extraordinary BCI paradigms are investigated. BCI-based purposes ought to effectively alter students' cognitive capabilities when used for their education and rehabilitation. Future instructions to look at BCI-based functions for education and rehabilitation of college students with neurodevelopmental issues regarding the special populations worried are discussed.

**Keywords:** Brain-computer interfaces (BCIs); Training; Rehabilitation; Children; Neurodevelopmental Disorders; Autism spectrum disorder

## Introduction

Brain Computer Interface (BCI) is the today's development of Human Computer Interaction (HCI). BCI permits both direct generated commands between exterior software program purposes and human Genius (active BCI) or the verbal exchange between topics and machines that lead to a seamless and really helpful trip for the person (passive BCI). With the assist of BCI applications, the intelligence can engage seamlessly with a mechanical machine and is consequently regarded a fast-growing technological know-how specifically advisable for fields such as Artificial and Computational Intelligence [1]. There are many elements that have contributed positively to this improvement such as the multiplied understanding of neurobiological procedures and laptop gaining knowledge of algorithms. Human intelligence with greater than a hundred billion nerve cells is accountable for many complicated govt functions, like reasoning, planning of duties and processing thoughts. As a result, the intelligence generates a superb quantity of neural endeavor that can be given as enter in many BCI purposes specifically designed for non-disabled people [2]. These purposes can educate greater integrative competencies such as thinking, learning, production, and appreciation of speech, memory, emotion. BCI purposes exist in general as an choice to herbal conversation and manipulate by way of processing the activity, which derives without delay from Genius generated recreation and no longer from the interplay with the peripheral worried system. For example, they can serve as a medium of verbal exchange for humans who are now not in a position to manipulate manually a PC, by means of changing their thought, intention, or choice to a command for an exterior machine, such as a laptop or phone. Moreover, subjects' intellectual states being monitored the use of an Electroencephalogram (EEG) can be analyzed with the assist of a motor imagery BCI [3]. The customers can then research to manipulate their physiological and psychological states. Additionally, scientists have analyzed this ongoing Genius recreation to extract intelligence patterns, primarily based on the International 10–20 System, in order to precisely role electrodes (Figure 1).

The machine contains duties such as sample cognizance and sign processing that are generally delivered robotically. The up to 256 electrodes that are positioned on the user's scalp make the detection of alerts an convenient as nicely as a transportable way for psychometric or cognitive lookup Furthermore, BCI purposes can be utilized in painting, clever domestic controlling, interest education games, stroke rehabilitation, lie detection and they can substitute frequent manage gadgets like mice or joysticks [4,5]. According to BCI are compact gadgets that consist of software program and hardware equipment to extract beneficial statistics from human indicators that are in a position

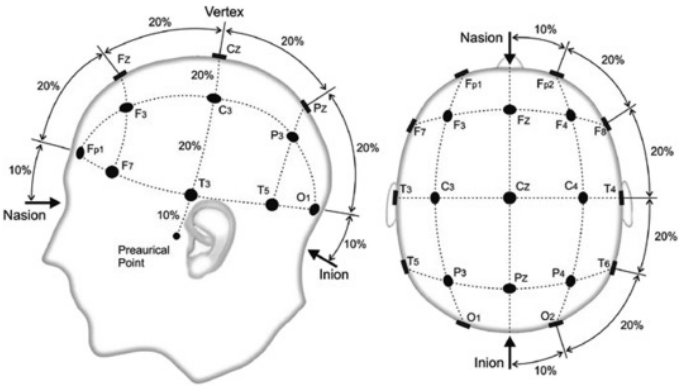


**Figure 1:** showing the International 10–20 system.

***Corresponding author:** George Drigas, Department of Medical Physics and Neurology, Iran, E- mail: gdrgas@sina.ac.ir

**Received:** 31-Aug-2023, Manuscript No: JNID-23-114816; **Editor assigned:** 01-Sep-2023, Pre-QC No: JNID-23-114816 (PQ); **Reviewed:** 15-Sep-2023, QC No: JNID-23-114816; **Revised:** 20-Sep-2023, Manuscript No: JNID-23-114816 (R); **Published:** 27-Sep-2023, DOI: 10.4172/2314-7326.1000463

**Citation:** Drigas G (2023) Applications Based on Brain-Computer Interfaces for Training and Rehabilitation of Kids with Neurodevelopmental Disorders. J Neuroinfect Dis 14: 463.

to furnish manage output for quite a few conversation gadgets and computers. Definition presented in the literature describes the total vary of features of a BCI in phrases of receiving, editing, sorting and using Genius wave indicators from a human intelligence with neuromuscular deficiencies and degenerative nerve diseases. BCI detects a plethora of talent signals, particularly Delta inside the frequency scale of 0.5–3.5 Hz, Theta inside 3.5–7.5 Hz, Alpha inside 7.5–12 Hz, and Beta inside 12–30Hz and Gamma alerts with frequency vary of 31 and up. Oscillatory Electroencephalography (EEG) output that is generated via a widespread community of neurons and Event-Related Potentials (ERPs), the intelligence generated comments that is seen after a unique event, are of unique pastime to BCI. EEG undertaking can be captured from the very starting of supplying a stimulus, which can generate with a time-delay a substantive electrical wave in EEG, up till the stop when the EEG will settle down. Forming a BCI gadget requires the following steps: sign acquisition, sign pre-processing, sign classification and records manipulation. BCIs chiefly facilitate conversation for human beings with extreme motor incapacity that can't talk in any other case however might also furnish beneficial conversation and rehabilitation of extraordinary issues even for more healthy human beings or humans with much less quintessential motion disorders. BCI lookup can capitalize on advances in cognitive neuroscience when dealing with education tasks, remarks analysis, accessibility, concentration, exhaustion, stimulation and misery amongst others current an everyday BCI machine together with statistics acquisition, preprocessing, and characteristic extraction and translation algorithms. (Figure 2) [6,7].

## Methodology

### Experimental design and performance evaluation

#### BCI for learning, memory and attention

Brain-Computer Interface (BCI) technology has shown great promise in various applications, including those related to learning, memory enhancement, and attention improvement. While many BCI applications are still in the research and development stage, they hold significant potential for enhancing cognitive abilities and addressing various neurological conditions. Here are some ways in which BCIs can be applied to learning, memory; BCIs can help individuals learn new skills faster by providing real-time feedback and guidance. For example, BCIs can be used to improve motor skills, language learning, or playing musical instruments. BCIs can monitor a user's cognitive state and adjust the difficulty of learning materials in real-time. This ensures that the learner remains engaged and challenged at an appropriate level. BCIs can create virtual tutors that adapt to the learner's pace and comprehension level, offering customized instruction and feedback. BCIs can stimulate specific brain regions to enhance memory encoding. This can be especially useful for individuals with memory impairments or those looking to improve memory retention for learning purposes. BCIs can assist in retrieving memories by targeting the brain regions associated with specific memories. This could be beneficial for individuals suffering from memory disorders or age-related cognitive decline. BCIs can potentially enhance the consolidation of memories during sleep, helping users retain information more effectively. BCIs can monitor brain activity to detect lapses in attention or focus. When attention wanes, BCIs can provide cues or interventions to help users regain concentration. BCIs can assist individuals with attention-deficit/hyperactivity disorder (ADHD) by providing neurofeedback to help them control their attention and reduce distractibility. Meditation and Mindfulness: BCIs can be used to guide users in achieving a state of mindfulness or deep concentration by providing real-time feedback on their brain activity. It's important to note that while the potential for BCIs in these areas is significant, there are also numerous challenges and ethical considerations [8-10].

#### BCI for spatial and visuospatial skill

Brain-Computer Interface (BCI) technology can also be applied to enhance spatial and visuospatial skills, which involve the ability to perceive, understand, and manipulate spatial relationships between objects in the environment. Improving these skills can have various practical applications, from enhancing navigation abilities to aiding individuals with spatial impairments. Here's how BCIs can be used for spatial and visuospatial skill enhancement: BCIs can provide real-time navigational guidance, especially for individuals with visual impairments. By processing spatial data from sensors or cameras, BCIs can translate this information into auditory or tactile cues to help users navigate unfamiliar environments. BCIs can be used in training programs to improve spatial awareness and understanding. For instance, they can assist in teaching individuals how to read maps, understand 3D structures, or develop a sense of direction. BCIs can enhance VR and AR experiences by allowing users to interact with

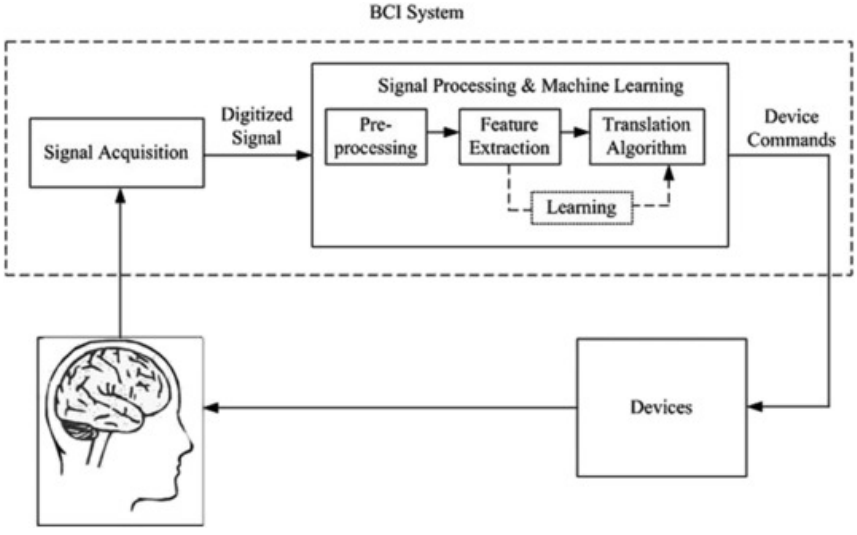


**Figure 2:** showing basic layout and process of a BCI system.

virtual objects and environments using their thoughts. This can be particularly useful for training simulations, architectural design, and gaming. BCIs can be integrated with prosthetic limbs and robotic devices to improve spatial control. Users can manipulate these devices more precisely and intuitively, which is crucial for tasks that require fine motor skills. BCIs can be used in rehabilitation programs for individuals with spatial impairments resulting from stroke, traumatic brain injuries, or neurodegenerative diseases. BCIs can assist in exercises that aim to restore spatial skills and coordination. BCIs can be used as tools to assist in solving complex spatial problems, such as architectural design, city planning, or logistics optimization. They can provide real-time data analysis and suggestions. BCIs can be employed to enhance spatial memory by providing cues and reminders related to specific locations or objects in a person's environment. BCIs can be integrated into wearable devices to assist individuals with visual impairments in recognizing and interacting with objects and people in their surroundings. BCIs can be combined with AI systems to create intelligent interfaces that understand and respond to a user's spatial intentions. This can be valuable for controlling smart home devices, autonomous vehicles, or robotic assistants. The development of BCIs for spatial and visuospatial skills enhancement is still ongoing, and the field continues to advance. Ethical and privacy considerations must be taken into account when implementing BCIs in various applications [11-13].

Neurodevelopmental disorders, such as autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), and cerebral palsy, present unique challenges in the lives of affected children and their families. These disorders often manifest as difficulties in communication, motor skills, attention, and social interactions. While conventional therapies and interventions have shown some success, the emergence of brain-computer interfaces (BCIs) offers exciting new possibilities for improving the training and rehabilitation of children with neurodevelopmental disorders. This discussion explores the applications of BCIs in addressing the specific needs of these children [14].

## Discussion

One of the most promising applications of BCIs for children with neurodevelopmental disorders is in augmentative and alternative communication (AAC). Children who struggle with speech or are non-verbal due to conditions like ASD can benefit significantly from BCIs that translate their brain activity into text or speech output. BCIs can bridge the communication gap, enabling these children to express their thoughts, needs, and emotions more effectively. Furthermore, BCIs can adapt and evolve with the child's cognitive development, making them versatile tools for long-term support [15]. BCIs can be utilized to create customized cognitive training programs for children with neurodevelopmental disorders. These programs can target specific cognitive deficits commonly associated with these conditions, such as attention and executive function deficits in ADHD. BCIs can provide real-time feedback and adapt the training tasks to the child's performance, ensuring engagement and efficacy [16]. Long-term use of BCIs for cognitive training may lead to significant improvements in academic and social skills. Children with conditions like cerebral palsy often face challenges in fine and gross motor skills. BCIs can help in rehabilitation by enabling brain-controlled assistive devices, such as exoskeletons or robotic arms. These devices can provide support and feedback, allowing children to practice and improve their motor skills in a safe and controlled environment. BCIs can help children regain a sense of independence and improve their overall quality of life. Children with neurodevelopmental disorders often struggle with social interactions and emotional regulation. BCIs can be used to create immersive virtual reality (VR) environments that simulate social scenarios [17]. These environments can provide real-time feedback and guidance to help children practice social skills, recognize emotions in others, and manage their own emotions. BCIs can make these simulations more personalized and adaptable to each child's specific needs. BCIs can collect data on a child's brain activity during therapy sessions, allowing for a personalized approach to treatment. By monitoring the child's neural responses, therapists can adjust the intensity and content of interventions in real-time. This personalized feedback loop can optimize the therapeutic process and lead to more effective outcomes. While the potential of BCIs in training and rehabilitating children with neurodevelopmental disorders is promising, several challenges must be addressed. These include issues related to accessibility, cost, privacy, and ethical considerations. Additionally, BCIs must be designed with a child's comfort and safety in mind, ensuring that they are user-friendly and non-invasive [18].

## Conclusion

In conclusion, the applications of Brain-Computer Interfaces (BCIs) in the training and rehabilitation of children with neurodevelopmental disorders represent a transformative frontier in healthcare and education. These innovative technologies have the potential to reshape the lives of children and their families by addressing specific challenges associated with conditions such as autism spectrum disorder, attention-deficit/hyperactivity disorder, and cerebral palsy. BCIs offer a range of benefits, including enhanced communication, targeted cognitive training, motor skill development, improved social skills, and personalized therapeutic approaches. By harnessing the power of BCIs, we can empower children to overcome their unique challenges and unlock their full potential. However, it is important to acknowledge that the successful integration of BCIs in the care of children with neurodevelopmental disorders comes with its share of challenges. Accessibility, cost, privacy, and ethical considerations must be carefully navigated to ensure that these technologies are inclusive and ethically sound. Additionally, the development of user-friendly and non-invasive BCIs tailored to the needs and comfort of children is crucial for their widespread adoption. As BCIs continue to evolve, interdisciplinary collaboration between clinicians, researchers, engineers, and ethicists will be essential to refine and expand their applications. Ongoing research and innovation will help refine these technologies, making them safer, more effective, and increasingly accessible to children who can benefit from them.

## Acknowledgment

None

## Conflict of Interest

None

### References

1. Lindstrom JM, Seybold ME, Lennon VA, Whittingham S, Duane DD (1998) Antibody to acetylcholine receptor in myasthenia gravis Prevalence, clinical correlates, and diagnostic value. Neurology 51: 933.

2. Evoli A, Tonali PA, Padua L, Monaco ML, Scuderi F, et al. (2003) Clinical correlates with anti-MuSK antibodies in generalized seronegative myasthenia gravis. Brain 126: 2304-2311.

3. Lerner A, Shiroishi MS, Zee CS (2012) Imaging of neurocysticercosis. Neuroimaging Clin N Am 22: 659.

4. Castillo M (2004) Imaging of neurocysticercosis. Semin Roentgenol 39: 465-473.

5. Hingwala, Divyata (2011) Applications of 3D CISS Sequence for Problem Solving in Neuroimaging. Indian J Radiol Imaging 21: 90-97.

6. Goldstein EJ, Spellberg B, Walsh TJ, Kontoyiannis DP, Edwards Jr J, et al. (2009) Recent advances in the management of mucormycosis: from bench to bedside. Clin Infect Dis 48: 1743.

7. Ibrahim AS, Spellberg B, Walsh TJ, Kontoyiannis DP (2012) Pathogenesis of mucormycosis. Clin Infect Dis 54: 16-22.

8. Skiada A, Lass-Floerl C, Klimko N, Ibrahim A, Roilides E, et al. (2018) Challenges in the diagnosis and treatment of mucormycosis. Med Mycol 56: 93-101.

9. Baldin C, Soliman SSM, Jeon HH, Alkhazraji S, Gebremariam T, et al. (2018) PCR-Based Approach Targeting Mucorales-Specific Gene Family for Diagnosis of Mucormycosis. J Clin Microbiol 56: 746-818.

10. Spanakis EK, Aperis G, Mylonakis E (2006) New agents for the treatment of fungal infections:clinical efficacy and gaps in coverage. Clin Infect Dis 43: 1060.

11. Isotalo J, Vahlberg T, Kaasinen V (2017) Unchanged long term rural-to-urban incidence ratio of Parkinson's disease. Mov Disord 32: 474-475.

12. GBD 2016 Parkinson's disease Collaborators (2018) Global, regional, and national burden of Parkinson's disease in 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 17: 939-953.

13. Savica R, Grossardt BR, Bower JH, Ahlskog JE, Boeve B, et al. (2017) Survival and causes of death among people with clinically diagnosed synucleinopathies with Parkinsonism: a population-based study. JAMA Neurol 74: 839-846.

14. Rossi A, Berger K, Chen H, Leslie D, Mailman RB, et al. (2018) Projection of the prevalence of Parkinson's disease in the coming decades: Revisited. Mov Disord 33: 156-159.

15. Darweesh SKL, Raphael KG, Brundin P, Matthews H, Wyse RK, et al.(2018) Parkinson matters. J Parkinsons Dis 8: 495-498.

16. Mezochow A, Thakur K, Vinnard C (2017) Tuberculous Meningitis in Children and Adults: New Insights for an Ancient Foe. Curr Neurol Neurosci Rep 17: 85.

17. Heemskerk AD, Bang ND, Mai NTH, Chau TTH, Phu NH, et al. (2016) Intensified Antituberculosis Therapy in Adults with Tuberculous Meningitis. N Engl J Med 374: 124-134.

18. Van Laarhoven A, Dian S, Ruesen C, Hayati E, Damen MSMA, et al. (2017) Clinical parameters, routine inflammatory markers, and LTA4H genotype as predictors of mortality among 608 patients with tuberculous meningitis in Indonesia. J Infect Dis 215: 1029-1039.