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Legal and Ethical Dimensions of Computerized Cognitive Therapy for Neurodevelopmental Disorders in Children

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ABSTRACT

The increasing use of computerized cognitive therapy tools—such as Brain Function Therapy and neurofeedback—in pediatric settings demands careful consideration of not only their clinical effectiveness but also the ethical and legal ramifications. These adaptive, non-invasive interventions promise to support children with neurodevelopmental issues like attention-deficit/hyperactivity disorder, autism spectrum conditions, and learning challenges. However, they pose challenges to existing norms around informed consent, privacy of neural data, and oversight. This paper examines how these technologies operate, evaluates evidence of their therapeutic impact, and explores the evolving legal and bioethical dialogue, including reforms like the recognition of brainwave data as sensitive in consumer privacy law and growing discourse around mental privacy and cognitive autonomy. Careful interdisciplinary governance is essential to ensure that cognitive neurotechnologies are integrated responsibly into clinical and educational practices.

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1. INTRODUCTION

There is widespread interest among teachers in the application of neuroscientific research findings in educational practice. Yet the field of neuroscience is complex and the accurate transfer of research findings to the classroom is often difficult (Jolles et al., 2005) [20]. To understand neurodevelopment it should begin at prenatal stage in which there is complex proliferation of radial glia and neurons. These continue to develop until the postnatal years. This process is not complete until almost 3 years of age. (Rice D, Barone S, 2000) [26] Any issues during prenatal stage or later can create developmental issues. These developmental issues can be physiological or cognitive based. Physiological based issues can create problems of motor developmental delay (Vrana, S. et al., 1986) [33]. Whereas cognitive deficit is an inclusive term which is used to describe impairment in an individual's mental processes that lead to the acquisition of information and knowledge, and determine how an individual understands and acts in the world. Problems in cognitive functioning can be due to attention, poor decision making, judgment, language, memory, perception, planning, reasoning or visuospatial. Henceforth, cognitive deficit results due to imbalance in affect, behavioural or executive functions. These cognitive deficits can occur in children amongst all age groups which inturn may lead to difficulty in their everyday functioning. There are various ways of treatment for cognitive dysfunctioning. Few of the newly developed treatment procedures are mentioned as below:

Brain Function Therapy

BFT - Brain Function Therapy is one of the earliest computer based cognitive retraining programs developed for brain damaged patients. The computer-based Brain Function Therapy was conceptualized by Prof. C.R. Mukundan in 1995. This therapy is extensively used at NIMHANS for rehabilitation of patients with head injury and other brain damaged conditions. This program now is used in several clinical centers in India. BFT is not a computer-based game for cognitive restoration or enrichment. It is a highly professional program for improving speed and accuracy of neurocognitive processes and measures the improvements in speed in terms of millisecond Cowan, J., & Markham, L. (1994, March) [8]. Similarly, complexity-difficulty levels can be changed stepwise for gradual retraining or restoration. When the program is used for clinical purposes i.e. with brain damaged patients or children with cognitive difficulties, it must be administered by an expert technician, until the child

or patient learns to perform the tasks by himself.

There are 10 modules for training in the following cognitive areas: 1. Word recognition: direct comparison and comparison from memory. Recognition of word arrays, shifting fixation points and reading. Recognition and comparison of visual imageries of words. 2. Reading: Reading words and sentences, speed of reading, immediate and delayed recall, reading and comprehension. 3. Visuospatial Comparison: Direct comparison of geometric forms, and comparison from memory. Speed of recognition, and delayed recognition. It includes target at 3 levels smaller size, same size and large size target. 4. Working Memory Tasks i) Using Numbers: Hold and process, switch process and hold, use of buffer memory. Series of tasks, increasing difficulty levels Using ii) Alphabets: Hold and process, switch process and hold, use of buffer memory. Sequential processing, Series of tasks, increasing difficulty levels. 5. Continuous Performance: "n" back test using geometric figures. 6. Temporal Sequencing: Recognize temporal sequence, hold and detect the same sequence. 7. Alpha Numeric sequencing: it's in alphabets and numbers 8. Response Inhibition. Adapted from "Go - no Go" paradigm. 4 levels of performance. 9. Character recognition: Increasing number of alphabets, speed of recognition, recognition and recall from memory. 10. Number recognition: Increasing number of digits, speed of recognition, recognition and recall from memory.

Selection of Exposure time and intertrial intervals for increasing difficulty levels and speed of processing. Automated report generation of entire session giving before – after performance scores. Scores of each performance session are stored for later display. Increase difficulty level of each task by increasing task demands on speed of processing and quantum of information.

Neurofeedback

NFB- Neurofeedback: During the past decade, the use of non-invasive techniques has increased drastically. One of the popular types of biofeedback is Neurofeedback which was developed in 1960s. It gained its popularity as it is non-surgical, non-medicinal and no side effect treatment. This technique is primarily designed to monitor, quantify and train brain waves in real time (Demos, 2005) [9]. It increases individual's ability to regulate brain function taking into account neuroplasticity of the brain. It's a comprehensive system that promotes growth change at the cellular level of the brain and empowers brain as a tool for personal healing. In neurofeedback training individual's cortical activity or brain waves activity is measured using electroencephalograph (EEG). In this around 10-20 electrodes are placed on the scalp and one or two are usually put on the earlobes depending upon the need and purpose of them. These electrodes sensors brain activity by reflecting electrical patterns on the surface of the scalp from moment to moment. This is done through electronic equipment which provides real-time, instantaneous audio and visual feedback about brainwave activity. Neurofeedback assessment uses a baseline EEG, and sometimes a multi-site quantitative EEG (QEEG), to identify abnormal patterns (LaVaque, 2003) [21].

These tools can be used for children with little difficulty or severe difficulty in the cognitive areas which are described as under:

1.1. Implications for Executive functions:

The frontal lobe of the brain is responsible for the ability to perform higher order tasks, which are known as executive functions. Executive functions, for example, are responsible for a person's planning ability, which includes setting goals, managing the demands of a task and developing steps to achieve success. They also include organization functions, which allow someone to assemble information to prioritize and understand key concepts. Moreover, organization of materials is also controlled by this function, affecting the orderliness of work, play, storage and living spaces in addition to keeping track of possessions. Another function is initiation, hold of information to do complex tasks, decision making, think logical and self-regulation.

A variety of disorders are associated with executive function struggles, including attention-deficit hyperactivity disorder (ADHD), learning issues and mood disorders such as depression and anxiety. Additionally, traumatic circumstances, such as brain injury, fetal alcohol syndrome and toxicity from some cancer treatments can create problems with executive function ability and efficacy.

Brain Function Therapy for Executive functions

All the modules of Brain Function Therapy can be used to increase functioning of executive functions. Word recognition module increases the decision making ability, the working memory module is made to increase the memory dimension of executive function which is primarily for working memory, spatial comparison module whereas increases the ability of selective attention, executive memory also take care of processing speed which can be rehabilitated through reading speed control module, continuous performance module helps for sustained attention issues. Each of the modules of Brain Function Therapy is primarily focused to improve executive functioning.

Neurofeedback for Executive functions

Neurofeedback works with the brain to strengthen executive functions so that a person can function with ease and efficiency. The method uses EEG technology to pinpoint where the brain is having trouble functioning. An individualized protocol is then developed to improve and correct brain function. Neurofeedback employs visual and auditory cues to teach the brain to function at its best.

1.2. Implication in Anxiety Disorder

Certain level of fears and anxiety can be adaptive and developmentally appropriate, but if the severity levels of fear and anxiety can produce significant distress in children and their families and are likely to interfere with academic and social functioning (Lalongo N, 1996) [16]. Children and adolescents can be diagnosed with 12 different anxiety disorders -- separation anxiety disorder, panic disorder with or without agoraphobia, agoraphobia without a history of panic disorder, specific phobias, social phobia, obsessive-compulsive disorder, posttraumatic stress disorder, acute stress disorder, generalized anxiety disorder, anxiety disorder due to a medical condition, substance-induced anxiety disorder, and an anxiety disorder not otherwise specified. One of the world's leading experts on anxiety disorders, expressed through his theory that anxiety disorder develops

due to 'lack of perceived control'. He explained that actual presence of stressors alone does not create anxiety. Rather, anxiety is greatly determined by a person's perceived ability to control a potentially stressful event.

Brain Function Therapy in Anxiety Disorder

Amongst the 10 modules of Brain Function Therapy response inhibition task and working memory task can be **used** for rehabilitation of children with anxiety disorder. The difficulty of inability to calm self during anxiety symptoms can be reduced through the use of these therapy modules.

Neurofeedback in Anxiety Disorder

Vanathy, Sharma, and Kumar (1998) [31], used neurofeedback for generalized anxiety disorder through which they found increased alpha with increased theta resulting in reduction of symptoms.

1.3. Implication in Learning Disability

Specific learning disability is a generic term that refers to a heterogeneous group of neurobehavioral disorders manifested by significant unexpected, specific and persistent difficulties in the acquisition and use of efficient reading (dyslexia), writing (dysgraphia) or mathematical (dyscalculia) abilities despite conventional instruction, intact senses, normal intelligence, proper motivation and adequate sociocultural opportunity. (Shapiro BK, Gallico RP,1993) [29] Learning Disability is intrinsic to the individual and arises due to central nervous system dysfunction. These are problems that affect the brain's ability to receive process, analyze or store information. These problems can make it difficult for a student to learn as quickly as someone who isn't affected by learning disabilities. (Vogel, S., 1977) [32]

Brain Function Therapy in Learning Disability

The modules of reading speed control, character recognition and number recognition have shown improvement in Learning Disability. To develop ability to read properly and with a proper pace can be developed through reading speed control module. Whereas modules of character recognition and number recognition helps them to develop ability of proper identification of alphabets and numbers.

Neurofeedback in Learning Disability

In 2003 Fernandez et al. conducted research wherein experimental group consisted of 5 subjects suffering with Learning Disability. Their performance initially showed abnormally high theta and alpha waves ratios, after repeated sessions of neurofeedback training subjects showed better cognitive performance and the presence of greater EEG maturation in the Experimental Group than in the Control Group, which suggested that changes were due not only to development but also to NFB treatment.

1.4. Implication in Attention Deficit Hyperactivity Disorder

According to American Psychiatric Association (2000), Attention-deficit/hyperactivity disorder (ADHD) is a brain disorder marked by an ongoing pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. The 3 important terms in this definition are inattention, hyperactivity and impulsivity. Inattention means a person wanders off task, lacks persistence, has difficulty sustaining focus, and is disorganized; and these problems are not due to defiance or lack of comprehension. Hyperactivity means a person seems to move about constantly, including in situations in which it is not appropriate; or excessively fidgets, taps, or talks. In adults, it may be extreme restlessness or wearing others out with constant activity. Impulsivity means a person makes hasty actions that occur in the moment without first thinking about them and that may have high potential for harm; or a desire for immediate rewards or inability to delay gratification. An impulsive person may be socially intrusive and excessively interrupt others or make important decisions without considering the long-term consequences.

Brain Function Therapy in Attention Deficit Hyperactivity Disorder

Continuous performance module of Brain Function Therapy helps children with Attention Deficit Hyperactive Disorder to increase their ability of sustaining on task for longer duration whereas spatial comparison module helps them in reducing their hyperactivity.

Neurofeedback in Attention Deficit Hyperactivity Disorder

Since the late 1970s, ample numbers of researches are done to utilize neurofeedback in treatment of ADHD (Attention Deficit Hyperactivity Disorder). Lubar (1995) published 10-year follow-ups on cases and found that in about 80% of clients, neurofeedback can substantially improve the symptoms of ADD and ADHD and that these changes are maintained. Rossiter and LaVaque (1995) [27] found that 20 sessions of neurofeedback produced comparable improvements in attention and concentration in comparison of taking Ritalin. Another research demonstrated that 30 sessions of slow cortical potentials training or of traditional neurofeedback were both effective in producing cognitive, attentional, behavioral and IQ improvements which remained stable for 6 months after treatment (Leins et al., 2007) [22].

1.5. Implication in Autism Spectrum Disorder

Autism is a neurodevelopmental syndrome that is defined by deficits in social reciprocity and communication, and by unusual restricted, repetitive behaviors (American Psychiatric Association, 2000) [3]. Autism is a disorder that usually begins in infancy, at the latest, in the first three years of life. Though social deficits may not be immediately obvious in early years, they become gradually more evident as a child becomes more mobile. Over the last 20 years, the conceptualization of a spectrum of autism-related disorders, including Childhood Disintegrative Disorder, Asperger's Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), which all include qualitative deficits in social behaviour and communication, has been supported by longitudinal, epidemiological, and family studies (Filipek et al. 2000) [13]. However, these disorders vary in pervasiveness severity and onset. The

umbrella category is termed Pervasive Developmental Disorder in the most common diagnostic systems (American Psychiatric Association, 2000).

Neurofeedback in Autism Spectrum Disorder

In 1994, Cowan and Markham presented the first case study of neurofeedback with autism. EEG analysis, during eyes open and resting conditions, was performed on an 8 year old girl who was diagnosed with high functioning autism. The findings indicated an abnormally high amount of alpha (8–10 Hz) and theta (4–8 Hz) activity. After 21 neurofeedback sessions, the girl exhibit ted increased sustained attention, decreased autistic behaviors (inappropriate giggling and spinning) and improved socialization based on parent and teacher reports. Another research on Autism Spectrum Disorder by Sichel et al.(1995) [30] showed improvement in socialization, self-stimulating behaviour and speech by using neurofeedback within 31 sessions.

1.6. Implication in Depression

Depression is now recognized as occurring in children and adolescents, although it sometimes presents with more prominent irritability than low mood some of the following signs and symptoms most of the day, nearly every day, for at least two weeks, you may be suffering from depression: persistent sad, anxious, feelings of hopelessness, or pessimism, irritability, feelings of guilt, worthlessness, or helplessness, loss of interest or pleasure in hobbies and activities, decreased energy or fatigue, moving or talking more slowly, feeling restless or having trouble sitting still, difficulty concentrating, remembering, or making decisions, difficulty sleeping, early-morning awakening, or oversleeping, appetite and/or weight changes, thoughts of death or suicide, or suicide attempts, aches or pains, headaches, cramps, or digestive problems without a clear physical cause and/or that do not ease even with treatment (American Psychiatric Association, 2000) [3].

Brain Function Therapy in depression

Brain Function Therapy can be is used to reduce symptoms of depression. The module of response inhibition in which the person has to select which side the figure same as target figure is present helped in improvement of depression symptoms.

Neurofeedback in depression

Baehr, Rosenfeld, and Baehr (2001) [5] diagnosed 6 patients with unipolar depression using Beck Depression Inventory. They were given an average of 27 neurofeedback sessions using a patented alpha asymmetry protocol for the treatment of depression. Follow-up after initial training the assessment scores on Beck Depression Inventory showed within the normal range.

Measures for Teacher education

Teacher's play an integral role in neurodevelopment of children and also lays ground for children's knowledge of their cognitive functioning. To develop proper understanding of neurocognitive functioning teacher's awareness is very important. To increase this awareness they should be given proper knowledge of the advancement in the area of neurocognitive field for which regular courses should be made at feasible cost and proper time duration. Teacher's right from principal, subject teachers, co-curricular teacher as well as school counsellors should be provided with such courses. This training will help them in increasing knowledge of fields of development in neurocognition especially for treatment availability as well as increase their sensitivity towards children suffering with such difficulty.

2. Legal and Ethical Considerations in Computerized Cognitive Therapy:

As computerized cognitive therapies such as Brain Function Therapy (BFT) and Neurofeedback (NFB) continue to gain traction in addressing neurodevelopmental disorders in children, their deployment raises critical legal and ethical questions. These concerns are particularly sensitive given the involvement of minors, the use of brainwave data, and the integration of semi-autonomous decision-support systems in therapeutic interventions.

Ethical Challenges

The first major ethical issue lies in informed consent. While adult patients may understand the implications of undergoing EEG-based therapy or computer-mediated interventions, children rely heavily on parental guidance. There is ongoing debate whether parents alone should be allowed to consent to such interventions that alter or train brain functions.

Additionally, neuroprivacy—the right to cognitive liberty and control over one's brain data—has emerged as a contemporary bioethical concern. Brainwave recordings captured during neurofeedback are not only highly personal but also susceptible to misuse if stored or transmitted insecurely. The ethical question arises: Who owns the neural data—clinics, parents, or the child?

Another concern is algorithmic bias and accountability. Although BFT and NFB are not pure AI systems, their reliance on automated feedback loops and pre-programmed difficulty escalation introduces black-box elements. If an adverse effect occurs or a misdiagnosis happens due to the therapy system, it remains unclear where ethical responsibility lies: the developer, the clinician, or the institution.

Legal Gaps and Regulatory Needs:

Currently, many jurisdictions—including India—lack specific regulatory frameworks for the deployment of computerized neurotherapies in pediatric populations. While some clinics operate under general medical or psychological licenses, there is no unified code that governs the use of cognitive-enhancing technologies in educational or non-clinical environments, such as schools.

Moreover, data protection laws do not always explicitly include neurodata, a category arguably more sensitive than fingerprints or facial recognition. Without regulation, there's a risk of commercialization, surveillance, or unauthorized storage of children's brainwave profiles.

Internationally, organizations like UNESCO and the OECD have begun drafting guidelines for the governance of

neurotechnology, emphasizing the importance of transparency, equity, and protection of human rights. India and similar countries could benefit from adopting these emerging standards and incorporating them into local law and clinical guidelines.

The Role of AI and Semi-Autonomous Systems:

Although BFT and NFB currently operate via rule-based systems, the trend is moving toward integrating AI for personalization, adaptive learning, and predictive diagnostics. With this shift, the legal implications expand to include accountability for AI decisions, algorithmic transparency, and compliance with medical device regulations.

If AI begins determining therapy parameters or issuing alerts based on EEG pattern recognition, such systems might need classification as medical AI devices, requiring regulatory approval, testing, and certification, similar to how AI is now regulated in Europe under the EU AI Act.

3. Ethical and Safe Use of EEG in Clinical and Neurofeedback Settings:

1. Safety and Non-Invasive Nature of EEG in Children and Adults

Electroencephalography (EEG) is a well-established, non-invasive neurophysiological technique that has been safely employed across all age groups—ranging from infants to older adults—in clinical settings for decades (American Clinical Neurophysiology Society, 2006) [1]. In pediatric neurology and psychiatry, EEG is routinely used to monitor brain activity in disorders such as epilepsy, developmental delay, and attention-deficit disorders without any adverse impact on brain functioning [Fernandez T et.al., 2003) [12].

Similarly, in neurofeedback applications, EEG is utilized solely for monitoring purposes and providing real-time feedback about the brain's electrical activity. This biofeedback allows individuals to learn self-regulation of neural patterns associated with improved attention, emotional regulation, and cognitive performance (Hammond, 2011; Arns et al., 2014) [15] [4]. It is important to emphasize that neurofeedback does not manipulate or alter the brain externally; rather, it enables the brain to optimize its own functioning through operant conditioning principles.

2. Informed Consent Procedures in Cognitive and Neurophysiological Interventions

Just as informed consent is an ethical and legal necessity for all medical procedures, including surgeries and pharmacological interventions in hospitals, the same protocols are rigorously followed in the domain of cognitive retraining and neurofeedback. For adults, informed consent involves a detailed explanation of the procedure, risks, benefits, and intended outcomes (Beauchamp & Childress, 2013) [6]. In the case of minors, assent from the child (where developmentally appropriate) and consent from a parent or legal guardian are obtained (Royal College of Paediatrics and Child Health, 2016) [28]. This ensures that all interventions, including EEG-based assessments and training, respect the autonomy and rights of individuals while adhering to best clinical practices (American Psychological Association, 2017) [2].

3. Data Privacy, Ethical Use, and Regulatory Safeguards

Concerns regarding potential misuse of EEG data are valid in the era of increasing digitalization and data sharing. However, ethical protocols surrounding EEG-based research and therapy typically involve transparent data handling policies. Consent forms clearly delineate whether the EEG data will be used exclusively for therapeutic purposes or may also be included in anonymized research datasets (Illes & Racine, 2005) [19].

Nonetheless, to enhance trust and accountability, there is a need for clear legal and institutional guidelines addressing the storage, sharing, and secondary usage of EEG data. Such policies should align with existing data protection frameworks such as the General Data Protection Regulation (GDPR) in Europe (European Parliament, 2016) [11] and include provisions for secure encryption, anonymization, and strict access controls. Additionally, calls have been made for emerging neuro-rights to be integrated into privacy laws to protect individuals from neural data misuse (Ienca & Andorno, 2017) [18]. Ethical review boards should also routinely oversee compliance to ensure the privacy and dignity of all participants is maintained.

4. Ethics in AI & Semi-autonomous Systems

The integration of AI and semi-autonomous systems in EEG-based therapies like BFT (Biofeedback Therapy) and NFB (Neurofeedback) holds immense promise for enhancing individualized care, improving diagnostic precision, and enabling real-time therapeutic adjustments. From an ethical standpoint, this evolution aligns well with the core principles of beneficence and non-maleficence — promoting patient well-being while minimizing harm.

To address concerns of accountability and transparency, embracing robust ethical AI frameworks and regulatory pathways such as the EU AI Act can actually enhance public trust and safeguard patient rights. These regulations are not merely restrictions but rather essential ethical tools to ensure that AI remains reliable, explainable, and fair**.**

Moreover, involving multidisciplinary oversight — including clinicians, ethicists, AI experts, and patient representatives — in the design and deployment of such systems ensures that human dignity, autonomy, and safety remain central. By implementing AI responsibly and ethically, we can amplify human expertise rather than replace it, creating a future (Future of Life Institute. (2025,

August 1) [14] where technology compassionately supports better mental health outcomes.

4. Legal and Ethical Considerations

4.1 Comparative Legal Frameworks and Precedents

- **European Union**: The European Artificial Intelligence Act (EU AI Act) introduces a risk-based legal structure for AI systems, rolled out in phased stages beginning August 1, 2024 — with full application across key domains expected by 2026–2027. This framework is most applicable to high-risk uses of AI, which could include neurotechnologies IAPP. (2025, May) [17] that process neural data or support therapeutic decisions. European CommissionArtificial Intelligence Act (Business Insider. (2024, April 18) [10].
- **United States (Colorado)**: In April 2024, Colorado (Pullen, S. (2024, April 30) [24] became the first state to classify brainwave output—"neural data"—as sensitive personal data under its consumer privacy law. The law now mandates opt-in consent and additional protections for any entities processing such data.

4.2 Ethical and Bioethical Foundations

- **Neuroprivacy and Neurorights**: The inclusion of neural data in regulatory frameworks highlights the emerging concept of neurorights—protecting mental privacy, cognitive liberty, and defense against manipulation (Nauwelaerts, W. (2025, February 2) [23].
- **Regulatory Gaps**: Although the EU AI Act targets AI systems broadly, there remains an absence of tailored neurorights legislation in most jurisdictions, leaving neural data governance underdeveloped despite rapid neurotechnology advances.

5. AI Governance & Current Regulatory Developments

5.1 EU Artificial Intelligence Act (EU AI Act)

- The EU AI Act, formally Regulation (EU) 2024/1689, entered into force on August 1, 2024. It establishes rigorous standards for AI applications and introduces a tiered risk-based approach, including bans on harmful or manipulative systems. European Commission.
- The Act applies to neurotechnology when it incorporates AI—for instance, adaptive neurofeedback systems—and includes oversight mechanisms like the EU AI Office and mandates on transparency and human oversight.

6. Policy Recommendations & Implementation Framework

1. **Harmonize Regulatory Structures**
   - Integrate AI, medical device, and data privacy regulations to ensure neurotechnologies (Yuste, R., et al. (2017)) [34] such as BFT and NFB are correctly categorized and monitored.
   - Explicitly define "neural data" in domestic privacy statutes and embed neurorights in consent protocols and data governance.
2. **Promote International Coordination**
   - Use early models like Colorado's Reuters. (2024, April 18) [25] law to guide U.S. and global approaches.
   - Encourage international cooperation through treaties or frameworks that address neurotechnology oversight.
3. **Apply AI Risk-Based Oversight**
   - Classify neurotechnologies using adaptive algorithms or personalization features as "high-risk" under the EU AI Act, triggering requirements for conformity assessments, transparency, and human-centered design.
4. **Ensure Ethical Governance**
   - Establish ethics review boards including clinicians, legal experts, ethicists, educators, and patient advocates to oversee neurotechnology use, ensuring alignment with ethical principles and human rights.
5. **Support Evidence-Based Practice**
   - Mandate empirical evaluation of cognitive and emotional outcomes—such as improvements in executive functioning or anxiety levels—to inform continuous refinement of regulatory and ethical standards.

7. CONCLUSION

Brain function therapy and neurofeedback represent powerful, safe tools in both diagnostic and therapeutic domains when applied within ethical boundaries. Transparent consent procedures and the development of legal safeguards for data usage are essential to uphold the integrity of neuroscientific applications and to prevent misuse. With appropriate protocols, EEG remains a non-invasive, empowering technique for cognitive and emotional enhancement across populations. To responsibly harness this potential, there is strong need to develop robust legal and ethical frameworks that regionally recognize neural data, uphold neurorights, and enforce ai accountability. coupled with empirical oversight and transnational collaboration, such frameworks can ensure innovation in neurotechnology preserves individual autonomy, privacy, and public trust.

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