

## Neurogadgets: Technological Revolution or Natural Transition to Portable Neurotechnologies in Psychology and Psychiatry?

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Over the past decade, there has been a growing interest in the application of wearable neurotechnology in everyday life. In this way, the boundary between consumer electronics and clinical diagnostics has begun to fade. We are entering an era in which the "laboratory" is no longer confined to the four walls of the clinic, but is brought into the patient's daily life through so-called neurogadgets. But is this a radical revolution, or simply a logical evolution of our quest for a deeper understanding of the human mind in its natural environment?

### The new tools: Beyond stationary systems

The transition to portability is driven by three main technological pillars:

- **Wearable EEG (Electroencephalography):** Modern dry electrodes and wireless headbands allow long-term monitoring of brain activity without the need for contact gel. Such monitoring can now be performed even during sleep. Not long ago, sleep monitoring was an unthinkable procedure outside of a neurolab. This opens the door to real-world monitoring of various mental functions and stress levels outside of a controlled environment.
- **Wearable fNIRS (Functional Near Infrared Spectroscopy):** As a portable alternative to expensive fMRI, wearable fNIRS devices measure the hemodynamic response of the brain. This allows for the study of social interactions and prefrontal activity during movement - something that was previously unthinkable with standard imaging.
- **Photobiomodulation (PBM):** Wearable PBM devices use low-intensity laser or LED light (usually in the near infrared spectrum) to modulate neuronal function. Their potential in treating depressive conditions, cognitive decline, and rehabilitation after trauma is transforming them from expensive experimental tools into affordable therapeutic agents.

### Applicability and biofeedback 2.0

The main advantage of these new neurotechnologies is the transformation of the passive patient into an active participant. Biofeedback, powered by wearable EEG and fNIRS, enables self-regulation in real time and in the peaceful environment of the home.

Patients can visualize their levels of attention, relaxation or anxiety and apply therapeutic techniques exactly when they are needed most.

This "democratization" of neurotechnologies increases accessibility. The patient no longer needs to travel to a specialized center for each session; therapy can be hybrid, reducing costs and treatment time. What does the client gain and lose? Ethical challenges or what is the price of accessibility.

Despite the optimism, the transition to wearable neurotechnology hides serious pitfalls:

1. Data validity: Can consumer devices achieve the signal quality of clinical equipment? The “noise” of everyday movement often compromises the accuracy of diagnostics.
2. Neuro-privacy: Brain activity data is personal data and is among the most critical personal information. In this regard: who owns this data when it is collected by commercial applications? Is there a risk of its disclosure? And what could be the consequences of this?
3. Lack of professional supervision: The risk of self-diagnosis and self-treatment (especially with photobiomodulation) without the supervision of a qualified psychologist or psychiatrist can lead to unforeseen side effects or delays in conventional treatment.

### From questions to their answers

Recent research in the field of wearable EEG and fNIRS shows a significant breakthrough in the quality of the received signals, especially when measuring them in “wild environments” (ecological settings). We no longer rely only on static images; the devices allow researchers to observe prefrontal activity during real social situations in everyday life. In most of the offered devices, the data remains encrypted and cannot be “extracted” without the presence of specific software for each device. And this makes them inaccessible to third parties. Moreover, the application of the smart device itself plays the role more of a connection between the sensor and the server, with the extracted biological data being processed remotely, namely by the server.

The EU is debating the classification of neurodata as “sensitive biometric data”. This means that practitioners using cloud platforms to store EEG recordings from wearable devices are directly responsible for their cybersecurity and encryption according to medical information standards.

In photobiomodulation (PBM), studies highlight the effect of the so-called “systemic photobiomodulation”. Through wearable devices applying near-infrared light to the vagus nerve or transcranially, microglia modulation is achieved, which opens new horizons for the treatment of resistant depression and neuroplasticity in dementia.

Thus, the main open question remains the very good accessibility of neurogadgets, which requires them to have measurement accuracy close to medical equipment, and the data processing software itself to be “smart”. Thus, most biofeedback systems using neurogadgets fall into the category of “high-risk systems” if they are used for diagnosis or determination of emotional state, e.g. (emotion recognition). This requires manufacturers and therapists to be extremely transparent about the algorithms that interpret EEG or fNIRS signals. The application of photobiomodulation requires that the doses and power of the light used be within the safe range, so as to avoid the risk of “overdose” and the occurrence of side or undesirable effects.

The ethical side of the issue. Currently, protection against “neuro-marketing” and unauthorized mood modulation through portable PBM devices is actively discussed, emphasizing the need for informed consent, which specifically explains the risks of changing neural excitability. The integration of these devices into psychological practice in Europe is no longer just a matter of ethics and goodwill, but of strict legal regulation.

Neurogadgets are not just “toys” for biohackers; they are the harbinger of a paradigm shift in psychology. The shift toward portability is natural, but it requires us as researchers and practitioners to build robust ethical frameworks and rigorous validation protocols. The revolution is not in the device itself, but in how we integrate this data into the therapeutic process without losing the human aspect of care. The natural shift toward portable neurotechnologies is a fact, but it requires “digital hygiene” on the part of psychologists. The role of the therapist is transformed from a sole source of expertise to a curator of data who helps the patient interpret the signals of his or her own brain without falling into the trap of technological determinism.

### The clinician as a “bridge of meaning” in the digital age

Although wearable neurotechnologies promise to democratize access to data on brain function, they cannot replace the most important element in psychological care: the therapeutic relationship and contextual understanding.

The role of the modern clinician is transforming from a passive observer to an active “curator of meaning”. In a world flooded with streams of raw data-EEG frequencies, fNIRS oxygenation levels, and photobiomodulation parameters-it is the specialist psychologist or psychiatrist who must translate these numbers into the language of human experience. Technology can register the biological marker of anxiety, but only the clinician can decipher its existential or cognitive cause.

The transition to neurogadgets requires us to adopt a new form of “digital empathy”. We must be prepared to navigate between the algorithmic predictions of the devices and the subjective world of the patient, while preserving the ethical boundaries of his cognitive freedom. Ultimately, neurotechnologies are simply more precise tools; the direction of treatment and moral responsibility for it remain in the hands of the person. The challenge for psychology and psychiatry today is not how to compete with technology, but how to weave it into a more humane, informed, and effective clinical practice.

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