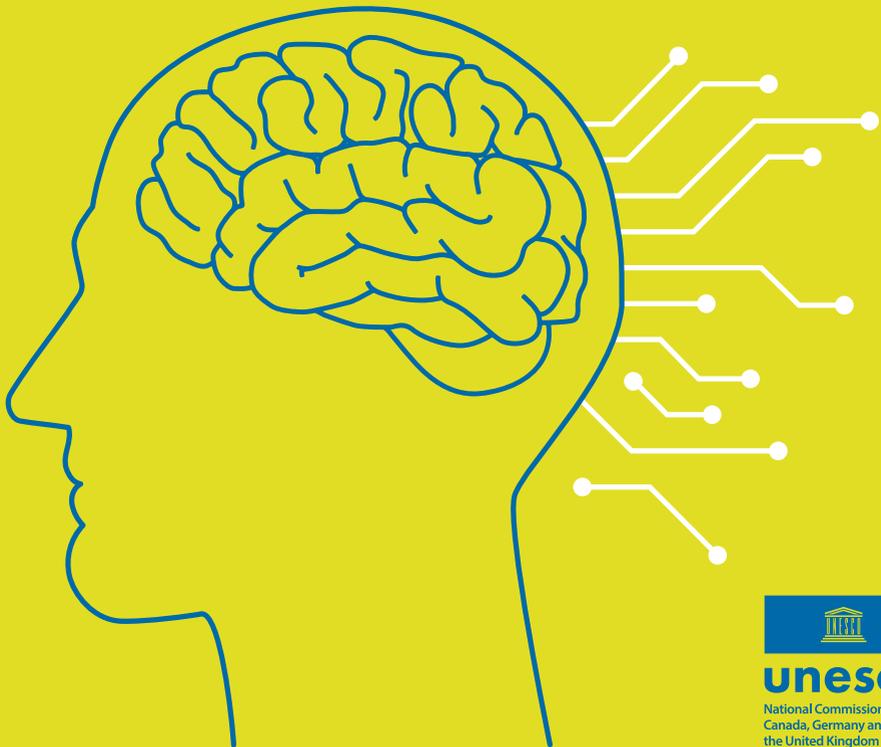


The UNESCO Recommendation on

The Ethics of Neurotechnology: Technological Change Serving Humanity



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The UNESCO Recommendation on the Ethics of Neurotechnology

UNESCO's overarching goal is, that since wars begin in the minds of women and men, it is in the minds of women and men that the defences of peace must be constructed.

This idea is both noble and right: Preventing conflict requires more than military or economic alliances – it needs mutual understanding between people and countries in education, culture, and science, including the ethics of emerging technologies.

Neurotechnologies represent a new form of such emerging technologies. They may soon measure, analyse or influence the minds of humans and will therefore have a significant impact on human dignity, human rights and autonomy.

To promote these values and foster mutual understanding, UNESCO regularly adopts international standards in the form of Recommendations – especially on the ethics of emerging technologies. Negotiated word by word by all 194 Member States, they set shared global norms and guide national policy making.

The UNESCO Recommendation on the Ethics of Neurotechnology is the latest such Recommendation. It is a global agreement that promotes the ethical use of neurotechnologies. It provides guidance on how neurotechnology can be used safely

and fairly in many different areas of life, including healthcare, education and consumer use. It also outlines principles for handling data derived from our interactions with neurotechnology as well as data that can be used to infer mental states.

The ethical use of neurotechnology means ensuring that these technologies as well as neural data and data that can infer mental states are used responsibly and equitably to benefit people and the planet, in line with the United Nations Charter and internationally recognised human rights law. Achieving this requires clear and up-to-date regulations or guidelines for various types of neurotechnology, data, and fields in which they are applied.

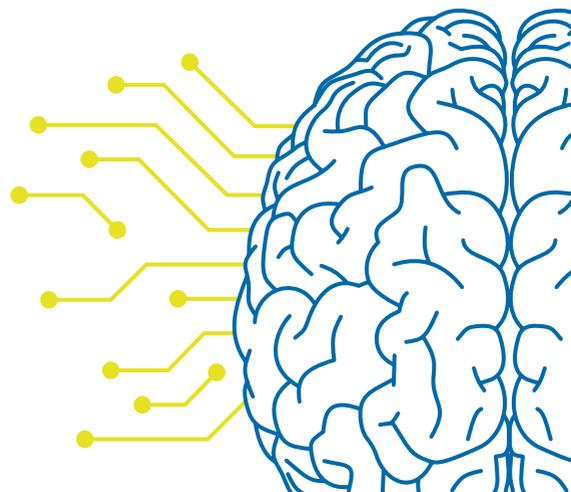
The UNESCO Recommendation was developed over two years (2023-2025), during which time diverse stakeholder were consulted in several rounds and intense negotiations between the Member States were held. It now provides a shared global framework to help countries develop their own national regulations and systems to ensure neurotechnology as well as neural data and data that can infer mental states are used ethically and for the benefit of all.

How does the UNESCO Recommendation define neurotechnologies?

Neurotechnologies encompass all kinds of devices, systems and procedures that interact with the human nervous system. Two examples:

Wearable devices such as EEG headbands (EEG = electroencephalography) can measure, monitor, and analyse the brain's electrical activity and collect data on this. These non-invasive devices can also modulate and influence brain activity, for example, to improve concentration or regulate sleep.

Devices such as deep brain stimulation implants interact more directly with the nervous system, allowing for a more precise influence. These applications can alleviate the symptoms of chronic neurological diseases such as Parkinson's, dystonia or epilepsy.



Furthermore, the UNESCO Recommendation covers two different types of data. The first type is neural data, such as EEG data, which reveals information about the structure, activity and function of the nervous system. Many neurotechnology applications collect, process, modify or share this type of data. Secondly, the Recommendation refers to indirect neural data and non-neural data that can be used to infer mental states. Examples include data on eye tracking, heart rate variability, and skin conductance. Although these data are not collected using neurotechnologies, they can be used to interpret or predict mental states, such as a person's emotions or level of consciousness. As these data raise similar ethical and human rights issues to those associated with neural data, they are also covered by the Recommendation.

Neurotechnologies have a broad range of applications. First, they can address medical, rehabilitative, or assistive needs. Second, they serve leisure purposes like gaming or sports. Third, they may enhance mental and physical capacities beyond what is therapeutically necessary – a process often referred to as 'human enhancement'. Neurotechnologies can also be applied across various societal contexts, including education and the workplace, as well as among diverse populations such as children, the elderly, and persons with disabilities.

Why do we need a global standard-setting instrument for ethical neurotechnology?

The diverse types of neurotechnology, the data involved, and the areas of application of these technologies are immense, as are the potential benefits and risks to human well-being.

On the one hand, there is great potential to treat severe diseases, improve mental health and emotional well-being, and promote social inclusion.

On the other hand, there are risks, such as threats to individual privacy from data misuse, social inequality from uneven access to neurotechnologies, or ethical concerns over their use for human enhancement.

The fact that the benefits and risks of neurotechnology use are global in nature makes things even more complex: Devices and systems are traded internationally, and neural data or other data that may be used to infer mental states can circulate around the globe in a matter of milliseconds. Furthermore, domestic decisions on the use of neurotechnology (e.g. in the workplace or education sector) can easily have international repercussions.

To unlock neurotechnology's potential for all humankind and to reduce risks across the globe, UNESCO's 194 Member States adopted the Recommendation on the Ethics of Neurotechnology in November 2025 as the first global standard-setting instrument in the field.



What are key characteristics of the UNESCO Recommendation?

The UNESCO Recommendation on the Ethics of Neurotechnology

1. is **science-based and promotes research and development** in neuroscience, especially to provide innovative healthcare globally;
2. is **human rights-based**, in particular based on the Charter of the United Nations and international human rights law;
3. promotes the **peaceful use of neurotechnology** for the good of humanity, individuals, communities, societies, the environment and ecosystems.
4. addresses ethical and human rights issues across the **whole life cycle** of neurotechnology;
5. promotes the empowerment of individuals to make **free and informed decisions** concerning their nervous system and mental health;
6. **prohibits any implicit and explicit coercion** to use neurotechnology, especially with regard to vulnerable groups such as children, the elderly and people with disabilities or mental health conditions;
7. promotes **fair and equitable access of neurotechnology globally**, ensuring that its benefits are accessible to all;

8. calls for **comprehensive and uniform cybersecurity standards** to ensure the integrity, confidentiality and security of data;
9. stipulates a **cautious integration of neurotechnology in education**, focusing not on academic performance but on mental health and well-being;
10. demands a **strictly voluntary deployment of neurotechnology in the workplace** with active and clear opt-in and opt-out procedures.

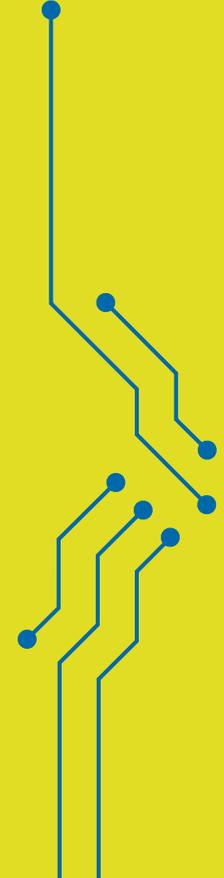


UNESCO Recommendation on the Ethics of Neurotechnology
(adopted on 11 November 2025)



Implementing the UNESCO Recommendation on the Ethics of Neurotechnology on Member State level

The UNESCO Recommendation on the Ethics of Neurotechnology provides global guidance for building national frameworks for the ethical use of neurotechnology. Implementing this guidance requires translating it into specific national policies and regulations. The following overview highlights examples of key policy actions in four critical areas of national neurotechnology application.



Neurotechnology for medical, rehabilitative or assistive purposes

Neurotechnology presents significant opportunities to improve quality of life through medicine, rehabilitation, and assistive care. Examples include deep brain stimulation, which can alleviate symptoms of Parkinson's and other movement disorders, and brain-computer interfaces, which can bypass and repair damaged neural pathways, allowing paralysed patients to control motor devices or muscles. When repair is not possible, such systems can substitute or enhance impaired functions, helping restore independence by translating brain activity into digital commands. Promoting research and innovation in these fields is therefore an ethical necessity.

Nevertheless, even in clearly human-centred applications, neurotechnology raises significant ethical issues. Mental privacy could be violated if neural data are collected or shared without consent, and patients might be exposed to such technologies without transparent opt-in processes. On a societal level, unequal access – both within and between countries – to neurotechnology for medical, rehabilitative, or assistive purposes could become a major ethical concern in the near future.

The UNESCO Recommendation provides Member States with regulatory guidance for developing a globally fair and innovation-friendly ecosystem for neurotechnology, while bearing in mind the potential risks. Member States shall, for instance:

- establish incentive structures, such as tax incentives, grants and awards, to promote and enable innovation ecosystems for neurotechnology development for medical applications (§ 79);
- invest in research of high-quality neurotechnology for the public good, especially for applications that foster human health and well-being (§ 71);

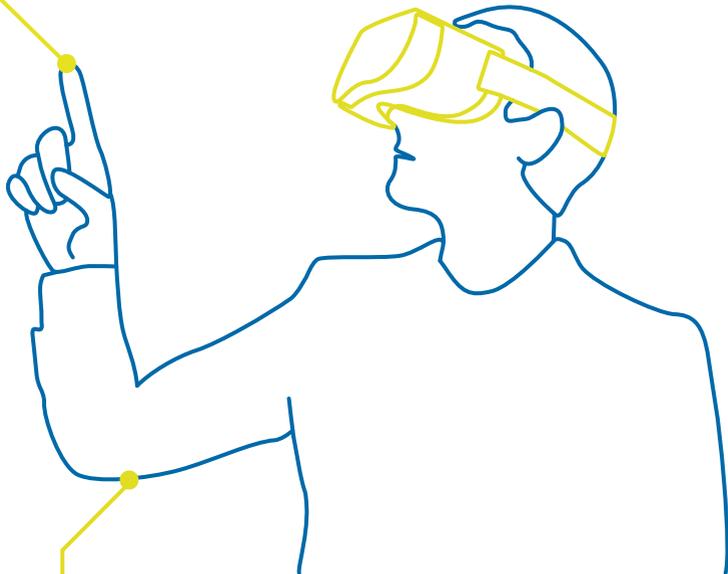
- develop (or update) policies that safeguard individuals' neural data as well as data allowing mental states inferences (e.g. by requiring explicit opt-in or a legal basis for collecting, processing, modifying or sharing such data, with the exception of life-threatening medical emergency situations) (§ 49, § 86);
- prioritise equitable access to evidence-based and reliable neurotechnology globally, ensuring that its benefits, especially for human health and the common good, are accessible to all, regardless of socioeconomic status or geographical location (§ 29, § 81).



Neurotechnology in consumer and commercial applications

The use of neurotechnology in consumer and commercial products is expanding rapidly. New sensors that read brain and neural activity – along with biosignals such as heart rate and skin conductance – combined with AI processing are enabling new applications and products in neurotechnology. They may, for instance in ‘neurogaming’, provide real-time feedback to optimise focus or enable virtual environments to respond to the user’s neural signals.

Despite the undeniable potential of such new applications, they pose significant risks to human health and well-being. These dangers include the misuse of collected data and the risk of dependency on these devices. Moreover, the use of neurotechnology for human enhancement raises even more complex ethical issues and could lead to new forms of inequality in society.



The UNESCO Recommendation therefore urges Member States to create an environment that fosters human-centred neurotechnology innovations in the recreational consumer and commercial domain. Member States are encouraged, for instance, to:

- establish a regulatory framework that balances innovation with protecting individual rights and well-being, e.g. by ensuring that neurotechnology does not cause harm or may lead to misuse, abuse or manipulation, especially if devices exploit the dopamine reward system (§ 132, § 138);
- ensure that devices that include neurotechnology, such as Extended Reality (XR) glasses or smart earbuds with neural sensors, contain accessible and straightforward opt-out features (§ 139);
- address the profound ethical and human rights related questions that arise from recommender systems, priming and nudging, marketing during sleep and dream, neuromarketing and closed-loop environments (§ 140);
- incentivise neurotechnology manufacturers to prioritise privacy and a code of ethics by design, facilitating the incorporation of privacy-preserving technologies as default features in their devices (§ 89);
- ensure that any policies, laws and regulatory frameworks that govern the use of neurotechnology for human enhancement or augmentation do not exacerbate social inequalities, lead to discrimination or compromise human dignity (§ 156).



Neurotechnology in labour and employment

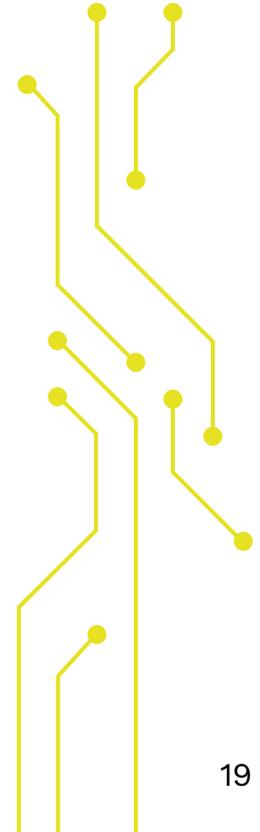
Neurotechnology reshapes working conditions. Automated monitoring of fatigue and stress could enhance safety for truck drivers and machine operators, while neurofeedback tools may boost concentration. Brain-computer interfaces could also enable people with motor or speech impairments to re-enter the workforce.

However, deploying neurotechnology in the workplace also raises significant ethical, legal and social concerns. Employers may monitor cognitive states or exploit neural data or data that can infer mental states. Even more, such systems may also create implicit pressure to comply, leading to coercion or discrimination against those who refuse to participate.



The UNESCO Recommendation strikes a balance, enabling the potential of neurotechnology in the workplace to be realised while safeguarding the personal autonomy and privacy of employees. Member States shall, for instance:

- ensure that neurotechnology is not used for any kind of social control, attempts at coercive behavioural conformity (e.g. based on political opinions) or arbitrary and/or unlawful surveillance of mental states (§ 75);
- establish policies that ensure that all deployment of neurotechnology is based on prior consultation and co-decision with workers and their collectives and is to promote their health, well-being, privacy and safety (§ 124);
- make sure that deployment of neurotechnology is strictly voluntary with active individual opt-in of workers based on prior, free and informed consent and with the option to opt-out at any time (§ 124);
- prohibit employers from collecting and using neural data and data allowing mental states inferences for any non-agreed or illegitimate purposes as well as outside of workplace settings and working hours. (§ 125, § 128);
- prohibit employers from sharing workers' neural data and data allowing mental states inferences outside the employer's business and employer's agents without workers' explicit prior approval and only within the scope of a legal basis (§ 125).



Neurotechnology for children and adolescents

Using neurotechnology on children and adolescents raises very sensitive ethical questions. Since their brains are in a critical moment of development, interventions may have amplified benefits and amplified risks. Early interventions could aid conditions like Attention Deficit Hyperactivity Disorder (ADHD), autism, or epilepsy more effectively than conventional treatments. Neuro-feedback or cognitive training tools may improve attention and working memory in educational settings.

However, children and adolescents face greater risks than adults due to factors such as the unknown long-term effects on brain development, limited autonomy, limited capacity to consent, and potential coercion in institutional settings such as schools. This coercion can either be implicit, through peer pressure, or explicit, through the institution itself.

The UNESCO Recommendation sets out specific provisions to protect children and adolescents, as particularly vulnerable user groups alongside older people and people with mental health conditions or disabilities. With regard to children and adolescents, Member States shall, for instance:

- uphold children's rights when neurotechnology is used, especially their right to privacy and freedom of thought, and their right to express their views freely on matters that affect them (§ 63);
- permit the use of neurotechnology on children for medical and therapeutic purposes, as well as other well-justified scientifically proven applications that serve the best interests of the child, such as improving access to sport for disabled children or assisting students with learning difficulties in education (§ 64, § 118);
- ensure that neurotechnology for the purpose of non-therapeutic performance optimisation should not be used for children with full health and cognitive function (§ 118);



- enable individuals, especially children and adolescents, to make free, informed and voluntary decisions about their engagement with neurotechnology, free from any explicit or implicit coercion, particularly in the context of education (§ 45, § 121, § 142);
- enact specific regulations to protect children and adolescents from compulsive use or addiction of neurogaming or digital recreational platforms (§ 138, § 145);
- establish an oversight mechanism for neurotechnology use at all levels of educational settings to ensure it serves student development and addresses risks such as dependency or de-skilling (§ 122);
- facilitate research and development grants focused on creating user-friendly risk-mitigated assistive neurotechnology tailored for children and adolescents with disabilities (§ 143).



UNESCO Member States and partners are invited to work together to translate this Recommendation into national action, ensuring that neurotechnology is developed and used in ways that uphold human rights, equity, and dignity.

Editors

Canadian Commission for UNESCO
150 Elgin Street, P.O. Box 1047
Ottawa, Ontario K1P 5V8
Canada

German Commission for UNESCO e. V.
Martin-Luther-Allee 42
53175 Bonn
Germany

United Kingdom National Commission for
UNESCO
98, 3 Whitehall Ct
London
SW1A 2EL
United Kingdom

Contact

German Commission for UNESCO e. V.
T +49 (0) 228 60 497 -165
E zukunft@unesco.de
www.unesco.de

Editorial team

Kate Declerck, Jeannine Hausmann
(responsible), Maximilian Müngersdorff,
Dan O'Connor

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