

**FIRST DRAFT OF THE RECOMMENDATION  
ON THE ETHICS OF NEUROTECHNOLOGY****PREAMBLE**

**Recognizing** the profound and dynamic impacts of neurotechnology on human mind, lives and flourishing, and societies, environment, and ecosystems,

**Considering** the major and growing global prevalence of neurological and mental health conditions, along with the profound suffering they cause for individuals and societies worldwide,

**Acknowledging** the potential of neurotechnology to offer innovative solutions and deliver better preventive and therapeutic treatments for millions, benefitting humanity as a whole and providing opportunities for health improvements in all countries,

**Also considering** that neurotechnology raises fundamental ethical issues for instance regarding self-determination, privacy, personal identity, freedom of thought, risk of discrimination, inequality and challenges to democracy, and that justice, trust and fairness must be upheld so that no country and no one should be left behind, either by having fair access to neurotechnology and enjoying their benefits or in the protection against their risks, while recognizing the different circumstances of different countries and respecting the desire of some people not to take part in all technological developments,

**Recalling** that, by the terms of its Constitution, UNESCO seeks to contribute to peace and security by promoting collaboration among nations through education, the sciences, culture, and communication and information, in order to further universal respect for justice, for the rule of law and for the human rights and fundamental freedoms which are affirmed for the peoples of the world,

**Given** the leading role of UNESCO, at the forefront of the international dialogue, knowledge production and standard setting on the ethics of science and technology and bioethics,

**Convinced** that the Recommendation presented here, as a standard-setting instrument developed through a global approach, based on international law, focusing on human dignity and human rights, as well as gender equality, social and global justice and development, physical and mental well-being and health, diversity, interconnectedness, global solidarity, fairness, non-discrimination, inclusiveness, and environmental and ecosystem protection, can guide neurotechnology in a responsible direction,

**Guided** by the purposes and principles of the Charter of the United Nations,

**Emphasizing** that specific attention must be paid to low- and middle-income countries (LMICs), including but not limited to least developed countries (LDCs), landlocked developing countries (LLDCs) and small island developing States (SIDS), as they have their capacity but have been underrepresented in the development and access to neurotechnology,

**Underscoring** that global cooperation and solidarity facilitates fair access to neurotechnology and enables the realization of the full potential of neurotechnology, while addressing the ethical challenges, mitigating against potential misuse, and ensuring that national neurotechnology strategies are guided by ethical principles in full respect of international human rights law,

**Noting** that ethical guidelines, frameworks and open science promote innovation, development and policies aligned with international human rights law,

**Also recalling** that in November 2023, the General Conference of UNESCO, at its 42nd session, adopted 42 C/Resolution 29, by which it mandated the Director-General “to prepare a standard-setting instrument on the ethics of neurotechnology in the form of a recommendation”, which is to be submitted to the General Conference at its 43rd session in 2025,

**Bearing in mind** the Universal Declaration of Human Rights (1948), the instruments of the international human rights framework, including the Convention Relating to the Status of Refugees (1951), the Discrimination (Employment and Occupation) Convention (1958), the International

Convention on the Elimination of All Forms of Racial Discrimination (1965), the International Covenant on Civil and Political Rights (1966), the International Covenant on Economic, Social and Cultural Rights (1966), the Convention on the Elimination of All Forms of Discrimination against Women (1979), the Convention on the Rights of the Child (1989), and the Convention on the Rights of Persons with Disabilities (2006), the Convention against Discrimination in Education (1960), the Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005), as well as any other relevant international instruments, recommendations and declarations,

**Also noting** the United Nations Declaration on the Right to Development (1986); the Declaration on the Responsibilities of the Present Generations Towards Future Generations (1997); the Universal Declaration on Bioethics and Human Rights (2005); the United Nations Declaration on the Rights of Indigenous Peoples (2007); the Declaration of Ethical Principles in relation to Climate Change (2017); the Recommendation on Science and Scientific Researchers (2017); the Recommendation on the Ethics of Artificial Intelligence (2021); the Recommendation on Open Science (2021); the Human Rights Council's resolution on "The right to privacy in the digital age" (A/HRC/RES/42/15) (2019); the Human Rights Council's resolution on "New and emerging digital technologies and human rights" (A/HRC/RES/41/11) (2019), and the UN Guiding Principles on Business and Human Rights (2011),

**Recalling** that the 2021 Recommendation on the Ethics of Artificial Intelligence, recognizes ethical questions related to AI-powered systems for neurotechnology and brain-computer interfaces,

**Also conscious** of the existing ecosystem of national policies, and other frameworks and initiatives elaborated by relevant United Nations entities, intergovernmental organizations such as OECD, including regional organizations, as well as those by the private sector, professional organizations, non-governmental organizations, and the scientific community, related to the ethics and regulation of neurotechnology,

1. **Adopts** the present Recommendation on the Ethics of neurotechnology on this XXX day of November 2025;
2. **Recommends** that Member States, with the support of UNESCO's Secretariat, apply the provisions of this Recommendation by taking appropriate steps, including whatever legislative or other measures may be required, in conformity with the constitutional practice and governing structures of each State, to give effect within their jurisdictions to the principles and norms of the Recommendation in conformity with international law, including international human rights law;
3. **Also recommends** that Member States engage all actors, to ensure that they play their respective roles in the implementation of this Recommendation; and bring the Recommendation to the attention of international, regional and national authorities and bodies, research and academic organizations, institutions and organizations in public, private and civil society sectors involved in neurotechnology, so that the development and use of neurotechnology are guided by both sound scientific research as well as ethical analysis and evaluation.

## **I. SCOPE OF APPLICATION AND DEFINITIONS**

### **I.1. SCOPE**

This Recommendation:

1. Addresses ethical issues related to neurotechnology, as it can have many positive and adverse impacts on human health, human flourishing and on the enjoyment of human rights.
2. Considers neurotechnology for people of diverse backgrounds and abilities, and various fields, including health, non-medical direct-to-consumer (DTC), such as wellness devices, neurogaming), addressing various settings where neurotechnology may be utilised.
3. Focuses on humans only but acknowledges important considerations that apply to animals in research.

4. Approaches neurotechnology ethics as a systematic normative reflection based on a holistic, multicultural, multidisciplinary, pluralistic and evolving framework of interdependent values, principles, and actions that can guide societies in dealing responsibly with the impacts of neurotechnology on human beings, societies, and the environment and ecosystems.
  - (a) It considers ethics as a basis for the normative evaluation and guidance of neurotechnology, with human rights, human dignity, well-being, and the prevention of harm as a compass and foundation.
  - (b) It draws upon a full range of scholarship, commentary and views from neuroscience, medicine, engineering, psychology, ethics, human rights, law, sociology, anthropology and other disciplines.
5. Covers the measurement, recording, and modification of the human nervous system, the handling, analysis, treatment, storage, use and reuse of the data collected, along with other societal and environmental impacts, including the emergence of new cognitive states.
6. Recognizes that interventions involving the nervous system are very sensitive because the highly complex human nervous system is the coordinating centre of behaviour and mental processes. It enables the exercise of self-determination, the capacity to act as moral agents, to be responsible for actions, cooperate with others, deliberate about collective decisions and develop personality.
7. Further recognizes that humans develop and flourish in their interaction with other human beings and a nurturing material and cultural environment, highlighting that autonomy is not just individual but also relational, as it arises from and impacts one's interactions and belonging with the community.
8. Addresses the ethical and human rights concerns that arise from the rapid developments and the convergence of neurotechnology with other technologies such as spatial computing, extended reality (XR), artificial intelligence (AI), sensors and semi-conductors. Notably, other biometric data when processed to infer sensory, motor, and mental states raises similar ethical concerns. Therefore, this Recommendation applies to both neurotechnology and the use of cognitive biometric data, ensuring that ethical principles and practices are consistently applied across these domains.
9. Further addresses the integration of AI with neurotechnology, which can enhance precision and predictive capabilities, such as improving processing speed, reducing cost, optimizing neurotechnology systems. However, it also magnifies ethical threats, including cybersecurity concerns, lack of transparency, the potential for algorithmic bias, and risks to autonomy, mental privacy and of manipulation.
10. Promotes the peaceful use of neurotechnology and seeks to raise awareness on the profound ethical challenges and threats that come with the military and security applications of neurotechnology. Calls on all concerned to act responsibly with regard to neurotechnology.

## **I.2. DEFINITIONS**

11. **Nervous system.** The nervous system includes the central (brain, spinal cord) and peripheral (somatic, autonomic, enteric) nervous system. Scientific evidence demonstrates that nervous system activity is the basis of sensory, motor, and mental states (which include cognitive, affective, and conative states), and supports consciousness, sleep and the experience of pain. The nervous system activity and structure provide information inherent to all human beings and the community, regardless of gender, ethnicity, language, or religion. The nervous system activity is also instrumental in social and cultural interactions.

12. **Neurotechnology.** Neurotechnology refers to devices, systems, and procedures—encompassing both hardware and software—that directly access, monitor, analyze, predict or modulate the nervous system to understand, influence, restore, or anticipate its structure, activity, function, or intentions (speech, motor). Neurotechnology combines elements of neuroscience, engineering, and computing, among others.

13. Neurotechnology spans medical and non-medical applications and includes tools that measure, infer, and influence nervous system activity, whether through direct interaction with the nervous system or by interfacing it with devices and systems. It includes but is not limited to:

(a) Technical tools that measure and analyse physical (i.e., acoustic, electrical, optical, magnetic and/or mechanical), chemical and biological signals associated with the structure of and functional signals from the nervous system. These may be used to identify, record, and/or monitor properties of nervous system activity, understand how the nervous system works, diagnose pathological conditions, or control external devices (brain machine interfaces (BMI), often referred to as brain computer interfaces (BCI)). Of note, both open-loop (i.e., fixed-parameter brain stimulation) and closed-loop systems (i.e., state dependent stimulation) introduce complex ethical issues.

(i). Examples include but are not limited to Electroencephalography (EEG), Magnetoencephalography (MEG), Magnetic resonance imaging (MRI), Functional Magnetic resonance imaging (fMRI), Positron emission tomography (PET), Functional Near-infrared spectroscopy (fNIRS), Implanted microelectrodes, Optogenetics, Optical imaging, Diffusion weighted imaging, Calcium imaging, Voltage dye sensors, or Microdialysis.

(b) Technical tools that interact with the nervous system to change its activity, for example, to restore sensory input, such as hearing (i.e., cochlear implants) or Deep Brain Stimulation (DBS) to treat tremors and other pathological conditions. They are meant to either modulate the functions of the nervous system and/or send signals directly to the nervous system by applying acoustic, electrical, magnetic or optical stimulation and/or inhibition of the peripheral or central nervous system.

(i). Examples of this neurotechnology are implanted microelectrodes, BMI, DBS, Optogenetic optical stimulation, Transcranial electrical stimulation (tES), Transcranial Magnetic Stimulation (TMS) or Neuropharmacological infusion.

14. Of note, several sensor technologies collect data indirectly informing about neural activity. Even if they are not neurotechnology *per se*, they raise similar ethical and human rights issues as neurotechnology when used to infer mental states. They include but are not limited to eye-tracking, Video Oculography, Typing dynamics, Voice recognition and analysis, Gait analysis, Skin conductance, Heart rate variability, Sleep movement monitoring, Blood pressure measurement, or facial- emotion recognition systems.

15. **Neural data.** Neural data are qualitative and quantitative data about the structure, activity and function of the nervous system. They encompass data relating to a nervous system's activity, including both direct measurements of neuronal structure, activity and/or function (i.e., neuronal firing or averaged bioelectric signals from EEG) and indirect functional indicators (i.e., blood flow in fMRI and fNIRS). At the neurobiological level, neural data are the most direct

correlates of mental states.

16. **Cognitive Biometric Data.** Neural data, along with data collected by non-neural biometric technologies can be processed to infer mental states, which this Recommendation refers to as “cognitive biometric data”.

17. **Whole lifecycle.** Neurotechnology should be considered from the early stages of mining for materials, prototyping, research, design and development to deployment and use, including maintenance, operation, trade, financing, monitoring and evaluation, validation, end-of-use, disassembly, termination, disposal and recycling. The whole lifecycle of neurotechnology includes its convergence with other technologies and the diversity of actors who are involved in every stage.

## II. AIMS AND OBJECTIVES

18. This Recommendation has been created with the aim of guiding the development and use of neurotechnology in ways that are ethical, safe and effective for the good of humanity, individuals, communities, societies, the environment and ecosystems, and to prevent harm in the present and the future based on international law, in particular the Charter of the United Nations and international human rights law.

19. The objectives of this Recommendation are:

- (a) to ensure the protection, promotion and respect of human rights and fundamental freedoms, human dignity and equality, including gender equality, and to respect cultural diversity during the whole neurotechnology lifecycle;
- (b) to guide the actions of Member States, individuals, groups, communities, institutions, private sector companies and every other relevant actor to ensure the embedding of ethics in all stages of the neurotechnology lifecycle;
- (c) to ensure that neurotechnology in its whole lifecycle is evidence-based, reliable and reproducible;
- (d) to provide a universal framework that not only articulates values and principles, but also translates into concrete policy recommendations and effective implementation to guide Member States in their engagement with neurotechnology in its whole lifecycle, consistent with their obligations under international human rights law and other international standards;
- (e) to foster multi-stakeholder, multidisciplinary and pluralistic dialogue and consensus building about ethical issues relating to neurotechnology;
- (f) to promote justice and equitable access to developments and knowledge in the field of neurotechnology and the sharing of benefits;
- (g) to ensure accountability and solidarity among all actors to prevent misuse of neurotechnology and to uphold human rights and ethical standards.

## III. VALUES AND PRINCIPLES

### III.1. VALUES

#### III.1.1. **Respect, protection and promotion of human rights, fundamental freedoms and human dignity**

20. The inviolable and inherent dignity of every human being is the foundation of universal human rights and fundamental freedoms. Respect, protection, and promotion of human dignity,

as established by international human rights law, are essential in the whole lifecycle of neurotechnology. Dignity encompasses the recognition of the intrinsic and equal worth of each person. Neurotechnology must never be used in ways that objectify, exploit individual vulnerabilities, or undermine the dignity or rights of any individual, including people living in vulnerable situations.

### **III.1.2. Promoting human health and well-being**

21. Prioritizing the development and application of neurotechnology that promotes comprehensive human health and well-being, viewing health as a holistic state of physical, mental, and social well-being.

22. The responsible allocation of resources for neurotechnology should be directed toward preventative, diagnostic, therapeutic, assistive, and rehabilitative purposes that benefit the largest number of people and those who stand to gain the most, rather than consumer-driven or commercial applications.

### **III.1.3. Ensuring and respecting diversity and fairness**

23. Respect for diversity and fairness, must be upheld in the whole lifecycle of neurotechnology. Special consideration should be given to neurodiversity, minority groups, Indigenous Peoples, and underrepresented voices.

24. Given that widely recognized neurotechnological innovation largely occurs in the urban well-resourced sector, specific attention to underserved and marginalised people is crucial to prevent bias, ongoing disparities in healthcare, stigma, neglect, and disrespect. Technological assimilation, or using technology as a tool of colonisation (a term the Recommendation refers to as “technological colonialism”), can threaten cultural diversity and heritage, therefore must be protected against.

25. Equitable access to neurotechnology should be prioritized globally, ensuring that its benefits are accessible to all, regardless of socioeconomic status or geographical location. Special attention must be given to low- and middle-income countries, resource-constrained settings, and marginalised communities, including the specific needs of different groups, ages, segments, cultural systems, languages, communities, and marginalised and vulnerable populations, people with disabilities, neurological disorders, and mental health conditions.

26. Individuals and groups should be allowed to make lifestyle choices, express beliefs and opinions, share personal experiences, and participate in co-designing technologies, provided that these choices are made in ways that respect the rights of others.

### **III.1.4. Consideration for cross-cultural perspectives on human knowledge and its sharing**

27. Respectful knowledge sharing on the human nervous system and its functions across communities and cultures fosters trust and strengthens global cohesion in the pursuit of health and quality of life.

28. It is essential that any research and development involving diverse groups and communities is done with their permission and guidance, and conducted with their full prior and informed consent and partnership in ways that serve their interests and respect their traditional knowledge and epistemic contributions.

### **III.1.5. Commitment to peace, fairness and justice in society**

29. The use of neurotechnology should be used to promote, not undermine freedom of thought especially in situations where refusal to use the technology could lead to competitive disadvantage. Such interferences include but are not limited to the use of force, threats,

undisclosed access, manipulation, or any scenario where consent is compromised, including as a result of power imbalances.

30. The use of neurotechnology should be particularly scrutinized to avoid uses that segregate, objectify or subordinate individuals or communities, reduce social cohesion by exacerbating pre-existing inequalities or generating novel inequalities that divide and antagonize individuals against each other, and thereby threaten the coexistence between humans, other living beings and the natural environment.

### **III.1.6. Global Solidarity and International Cooperation**

31. The Recommendation should guide all actors in the development, deployment and use of neurotechnology to act in solidarity and call for accountability in instances where neurotechnology may be misused in ways that threaten human rights.

32. International cooperation is essential to addressing cross-border issues related to neurotechnology. Particular attention must be given to differing perspectives on acceptable use to prevent abuse and uphold global ethical standards.

### **III.1.7. Sustainability**

33. Considering that sustainability requires that neurotechnology be developed and used with a deep respect for environmental stewardship, prioritizing the minimisation of ecological harm throughout the lifecycle of the materials used, including, for mining extraction, data processing and storage, recycling and disposal practices.

34. The unregulated development of neurotechnology, especially for non-medical purposes, might lead to disproportionate consumption of resources and energy and waste production.

35. Respect for Indigenous rights, in accordance with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), requires that neurotechnology, through its whole lifecycle, be guided by a profound respect for Indigenous rights, ensuring that their lands (including during mining), knowledge, communal rights, and privacy are honoured in all activities, including those related to resource extraction.

### **III.1.8. Integrity and Responsibility**

36. Integrity requires that all actors in the whole lifecycle of neurotechnology field act with ethical steadfastness. It includes adhering to ethical guidelines and ensuring that all actions align with both professional standards and societal values.

37. Integrity includes a commitment to taking responsibility for one's actions and being accountable for their outcomes. This involves not only acknowledging successes but also owning up to mistakes and taking corrective actions when necessary.

38. Scientific integrity is the commitment to the rigorous pursuit of truth through evidence-based, objective and transparent research practices. It ensures that all scientific endeavours are conducted with honesty, accuracy, and respect for the scientific method of disciplines relevant for neurotechnology.

## **III.2. ETHICAL PRINCIPLES AND HUMAN RIGHTS**

39. This Recommendation embraces a human-centred approach through fundamental ethical principles including but not limited to self-determination, agency, freedom of thought, privacy, cognitive liberty, personal and collective identity, trustworthiness, respect, reciprocity, and justice. Furthermore, it incorporates the respect, promotion and protection of human rights.

### **III.2.1. Beneficence, Proportionality and Do No Harm**

40. Neurotechnology should promote health and well-being, and empower individuals to make informed decisions about their nervous system and mental health while fostering a better understanding of themselves.

41. Neurotechnology should contribute to human flourishing without causing harm or subordination, whether physically, economically, socially, politically, culturally, or mentally. The “do no harm” principle must guide the whole lifecycle of neurotechnology, ensuring that the quality of life is protected and promoted.

42. Embracing neurotechnology for enhancement may lead to the risk of not only unexpected damage to the nervous system, but also to amplified inequalities within society.

43. Any restrictions to human rights must meet all applicable requirements under human rights law, including the principles of legality, legitimate aim, necessity and proportionality.

44. The principles of proportionality, balance and legitimacy should govern the use of neurotechnology and the data it enables, to ensure their use is: (a) appropriate and proportional to the objective and expected benefits that are aimed to be achieved; (b) do not infringe upon the foundational values of this document; (c) appropriate to the context and target user group; (d) based on safety principles and rigorous scientific evidence.

### **III.2.2. Self-determination and Freedom of Thought**

45. Throughout the whole lifecycle of neurotechnology, the protection and promotion of the rights of freedom of thought, and self-determination must be secured.

46. Individuals have the right to make free, informed, and voluntary decisions about their engagement with neurotechnology throughout the whole lifecycle, in accordance with international human rights law and other international standards, including the right to refuse or withdraw from its use, at any time, ensuring their autonomy and respect for their decision-making capacity is upheld and where surrogate consent is used, the best interests of the affected individual are considered. Individuals who are enrolled in research should be informed of potential side effects and given the opportunity to disclose if they have any contraindications for the procedures used. Informed consent procedures should be affirmative, dynamic, and require opt-in, comprehensive and transparent providing detailed information about the purposes, risks, benefits, alternatives, and possible outcomes of the technology in all its application domains, ensuring that consent is voluntary and that individuals fully understand the implications for their privacy, autonomy, and well-being.

47. Neurotechnology should never be used to exert undue influence or manipulation, whether through force, coercion, or other means that compromise self-determination and freedom of thought. This protection covers both the internal processing of thoughts and their external expression, ensuring freedom from any interference.

### **III.2.3. Protection of Neural and Cognitive Biometric Data for Mental Privacy**

48. Neurotechnology and cognitive biometric technologies raise issues pertaining to the right to privacy due to their increasing ability to collect direct and indirect data about the nervous system that is uniquely sensitive because they can be processed and analysed to provide deep insights into the processes that underpin our mental states and behaviour, including self-awareness and introspection. As it becomes increasingly difficult to anonymize data, there remains persistent risks of misuse of this data by revealing neurobiological correlates of diseases, disorders, or general mental states without the authorization of the person from whom data are collected.

49. Mental privacy is fundamental for the protection of human dignity, personal identity, and



agency. The collection, processing, modification, and sharing of neural data must be conducted with free and informed consent, in ways that respect the ethical and human rights principles outlined in this Recommendation.

50. There should be clear safeguards against the misuse or unauthorised access of neural and cognitive biometric data, including affirmative consent, data minimization and purpose specification, data rights (such as rights to access, correct and delete), and data security, particularly in contexts where such data might be aggregated with other sources.

#### **III.2.4. Non-Discrimination and Inclusivity**

51. All actors involved in the whole lifecycle of neurotechnology, particularly in its interface with other technologies like AI, must commit to upholding ethical principles that prevent discrimination, stigmatisation, targeting, or exploitation of any individuals or groups, particularly those in vulnerable situations.

52. There is a shared responsibility to ensure that these technologies do not perpetuate or amplify existing inequalities or create new forms of discrimination based on neurological or mental characteristics, or other grounds protected under human rights law.

53. Non-inclusive technological development and standardisation may drive a trend toward homogenisation and the dominance of neurotypicality and capacities that may threaten cultural and collective identity.

54. Garnering the trust and acceptance of communities in the whole lifecycle of neurotechnology requires transparent engagement with the public, seeking their input and validation to align these technologies with societal values and the common good.

55. Discrimination on any grounds, including intellectual differences or those related to atypicality, should be condemned. Neurotechnology should not be used to inform, justify, or reify such discrimination. Care should be taken to evaluate neurotechnology solutions promoted through governments for essential services such as education.

56. Neurotechnology should not be used to perpetuate stereotypes, stigma, or discrimination against older persons.

#### **III.2.5. Accountability**

57. Maintaining trust and integrity throughout the whole lifecycle of neurotechnology requires all actors to adhere to the highest ethical standards, remain open to feedback, be committed to adjusting practices in response to new evidence or ethical concerns, and be held accountable for their actions.

58. Accountability is grounded in responsibility, clear and transparent communication, and a duty to anticipate and address potential harms—whether short-term, long-term or arising from unintended use and impact.

59. A commitment to accountability requires global, governmental, societal and collective action to ensure those harmed by neurotechnology have access to justice, and that those responsible for wrongdoing are required to take meaningful steps to identify, prevent, mitigate and account for how they address and redress their adverse human rights impacts, including through corrective actions and reparations.

#### **III.2.6. Trustworthiness and Transparency**

60. To guarantee the respect, promotion and protection of human rights and fundamental freedoms, all actors throughout the whole lifecycle of neurotechnology must ensure that their activities are transparent, grounded in scientific evidence, and aligned with international

principles of responsible conduct and scientific integrity. This includes preventing the replication or amplification of biases, ensuring that neurotechnology is traceable and explainable, its capacities and limitations are accurately portrayed, the conditions for accountability are clearly defined, adhering to ethical guidelines in research and development, including the registration of trials, fair participant selection, and approval by independent ethics committees.

### **III.2.7. Epistemic Justice, Inclusive Engagement and Public Empowerment**

61. Ensuring fair and equitable distribution and creation of knowledge about neurotechnology, including recognizing diverse ways of knowing, and that all individuals and communities can participate in its creation, sharing, and applications.

62. Promoting open and accessible education, along with public and community engagement, to ensure diverse populations can gain and exchange knowledge about nervous system functioning, mental health, and medical and non-medical applications and tools of neurotechnology.

63. Effective public and community engagement throughout the whole lifecycle of neurotechnology requires respect for diversity, including linguistic, social, cultural, heritage, and identity, to respect different ways of knowing and understanding. This respect for diversity ensures that the knowledge and perspectives of diverse communities are valued and included in decision-making processes, and respects self-determination.

64. Grounding education in human rights ensures that the knowledge shared and produced respects the rights of all individuals, preventing epistemic injustice where certain groups may be marginalized or excluded from knowledge production and dissemination.

65. All communities should have a voice in decisions that affect them, particularly when it comes to the development and use of neurotechnology.

### **III.2.8. Best Interests of the Child and Protection of future generations**

66. The nervous system is rapidly evolving during childhood and critically changing during adolescence, which makes it crucial to preserve the privacy, self-determination and the right of children and adolescents to participate in decisions that affect them. Technology should be rigorously assessed to ensure it serves the best interests, well-being and healthy development of children, as they grow into autonomous individuals and safeguard the rights of future generations by ensuring that today's decisions promote their future wellbeing.

67. From an ethical perspective, while recognizing the potential benefits of neurotechnology for early diagnosis, instruction, education, and continuous learning, it is equally important to make a commitment to the holistic development of the child. This includes nurturing their social life, fostering meaningful relationships, and promoting a healthy lifestyle encompassing nutrition and physical activity.

### **III.2.9. Global and social justice, enjoying the benefits of scientific progress and its applications**

68. Access to and benefits arising from research and development in neurotechnology must be shared equitably among all contributors to that research and development, with a particular focus on ensuring global distribution that promotes fairness and reduces disparities.

69. Neurotechnology developments should be leveraged to reduce global health inequities. These technologies should serve as catalysts for improving the quality of life, particularly in resource-limited settings.

70. Research, development, and trials in neurotechnology must adhere to the highest

ethical standards, ensuring the non-exploitative participation of all individuals involved. This includes safeguarding the rights and well-being of participants, and patients and their caregivers, as well as ensuring the ethical collection and use of data. Special attention should be given to ensure that those contributing to research and development have their fair share of the benefits and do not bear disproportionately the risks.

71. Efforts, including international cooperation, should be made to overcome, and never take advantage of, the lack of necessary technological or medical infrastructure, education and skills, as well as ethical-legal frameworks, particularly in LMICs, LDCs, LLDCs and SIDS, affecting communities.

72. The development and impact assessment of novel neurotechnology should consider the implementation of human-centred paradigms in which end-users are not merely passive recipients of the technologies but active co-shapers on an equal footing.

#### **IV. AREAS OF POLICY ACTIONS**

##### **IV.1. GOVERNMENT INVESTMENT, USE AND REGULATION**

73. Member States, private actors and international institutions should actively support the research, development, and deployment of neurotechnology for the public good. Investments should prioritize applications that foster human flourishing, and the use of which respects, promotes and protects individual and collective human rights. This commitment should include funding for interdisciplinary research that not only advances neurotechnological innovation but also studies the ethical, legal, social, environmental and cultural implications of these technologies, and supports the implementation and clinical translation of technological prototypes. Particular attention should be given to the development and implementation of adequate technical, institutional, procedural and other safeguards to ensure that they equitably benefit society and that human rights are upheld.

74. Member States should establish clear prohibitions against the use of neurotechnology in contexts that violate individual and collective human rights. Member States should conduct human rights due diligence, including regular, comprehensive human rights impact assessments, concerning neurotechnology that they develop, design, deploy, use, sell, operate or procure, in order to prevent and mitigate their adverse human rights impacts. Specifically, neurotechnology should not be used for purposes such as non-consensual interrogation in law enforcement, criminal and civil justice, development or deployment of weapons targeted at the nervous system, social control, attempts at coercive behavioural conformity based on personal beliefs or thoughts, political or other opinion, gender identity or sexual orientation, or surveillance of mental states, among others. Governments should adopt legislation that ensures neurotechnology is deployed responsibly, and based on human rights, with robust oversight mechanisms to enforce adherence to these restrictions and protect mental privacy and freedom of thought for all individuals. These policies should be developed in consultation with diverse actors, including civil society, end-users, neurotechnology experts, ethicists, and human rights advocates, to ensure broad consensus and respect for global human rights norms.

75. Member States should ensure transparency and accountability in their support, oversight, and regulation of neurotechnology, particularly in publicly funded initiatives such as brain research and development programs. While recognizing the limitations in disclosing certain sensitive information, governments should require government sponsored neurotechnology projects to publicly disclose the objectives, methodologies, intended uses, and societal impacts of their neurotechnology initiatives wherever possible. This transparency is crucial for fostering public trust and ensuring that neurotechnology advances are aligned with ethical standards and

human rights.

76. Member States should apply a comprehensive approach to regulatory and policy measures to protect against human rights harms related to neurotechnology developed, marketed, operated or used by the private sector. This includes legislative and regulatory measures and accompanying guidance, incentives, and transparency requirements. This comprehensive approach should also require human rights due diligence, ensuring that businesses identify, prevent, mitigate, and account for their adverse human rights impacts through context-dependent processes, including human rights impact assessments, meaningful public and community engagement, and transparent communications.

77. Member States should ensure that any use of neurotechnology in the justice system, including its consideration by the judiciary should be grounded in robust scientific evidence, be implemented ethically in accordance with human rights, and be aimed at promoting public safety while protecting the rights and dignity of all those involved. This requires respect for fundamental rights, such as human dignity, bodily integrity, confidentiality of personal data, due process and fair trial rights, including the presumption of innocence, and the right against self-incrimination, as well as freedom from torture and ill-treatment, the right to privacy, and the right to freedom of thought.

78. Member States should establish comprehensive incentive structures, such as tax incentives, grants, and awards, with a particular focus on encouraging the construction and development of manufacturing, computational resources, and data analytics capabilities within public research institutions and small and medium enterprises (SMEs). Member States should also incentivize and support partnerships that leverage the computational resources and data analytics capabilities of private firms to advance public research goals. These incentives should prioritize rewarding transparency, participatory development processes, and contributions to societal benefits, aiming to foster an environment where public institutions and companies innovate responsibly and align with human flourishing goals.

79. Member States should establish a coordinated, cross-sectoral approach to assessing the impacts of neurotechnology across the whole lifecycle. This approach should include, but is not limited to:

- (a) Economic Impact Assessments: Conducted by relevant national bodies responsible for economic and labor policies to assess how neurotechnology impacts economic growth, jobs, social justice, and environmental sustainability;
- (b) Benefit-Risk Assessments: Managed by entities responsible for public health, medical research, and consumer protections, these assessments should rigorously evaluate the risks and benefits associated with the development, deployment, and use of neurotechnology, including research, clinical applications, and consumer products. The process should include thorough documentation, ethical oversight, and continuous monitoring to ensure the safety, well-being, and equitable treatment of all individuals involved;
- (c) Privacy Impact Assessments (PIAs): under the oversight of relevant national authorities or agencies responsible for data protection and privacy, these assessments should evaluate and mitigate risks to individuals' mental privacy posed by neurotechnology. This includes ensuring that appropriate safeguards are in place to protect neural and cognitive biometric data in compliance with national and international privacy standards, and the data policy practices discussed herein;

- (d) Human Rights Impact Assessments (HRIAs): with oversight from relevant national human rights institutions or international bodies, identify, prevent, and address potential human rights impacts of neurotechnology. The process should ensure that neurotechnology respects and promotes human rights, with particular attention to vulnerable people and people living in vulnerable situations. HRIAs should involve meaningful public and community engagement to incorporate diverse perspectives.

80. Member States should promote equitable access to neurotechnology worldwide. To achieve such goals, efforts should be made to support the reduction of final costs for end users, pursue the development, adoption and continuous support of non-proprietary software solutions, and explore reimbursement strategies or subsidisation commensurate with conventions in local jurisdictions, in sectors of crucial potential benefits.

81. Member States should adopt agile regulatory frameworks, including the use of regulatory sandboxes—controlled environments for developing, testing, and evaluating neurotechnology—in response to rapid advancements in neurotechnology and its convergence with other technologies such as AI, spatial computing, and immersive technologies. These sandboxes should be used to explore innovative applications, particularly in workplace settings, with appropriate ethical oversight provided by regulatory bodies or national authorities. These frameworks should facilitate innovation, ensure ethical data processing, and safeguard rights by incorporating mechanisms for regular monitoring, evaluation, and dynamic policy adjustments in line with technological and ethical developments.

## **IV.2. DATA POLICY**

82. Member States should develop a robust regulatory and legal framework to govern the collection, processing, sharing, and all other uses of neural and cognitive biometric data. This and existing frameworks should recognize this data to be both personal and sensitive data in medical and non-medical contexts.

83. Member States should ensure that their existing privacy policies comprehensively cover stringent safeguards for individuals' neural and cognitive biometric data. If current policies do not adequately address these areas, Member States should adopt targeted legislation or regulatory frameworks to secure these protections. These safeguards should for example include affirmative informed consent, data minimization and purpose limitation, data rights (including the right to access, correct, and delete data), and stringent data security measures, such as advanced cybersecurity protocols to prevent unauthorized access and breaches. Such legislation or frameworks should prohibit the practice of tying access to goods or services to the disclosure of neural and cognitive biometric data, require explicit opt-in for any data sharing, and forbid the use of such data for targeted advertising without the individual's explicit, affirmative informed consent.

84. Member States should develop and implement specific policies to reduce the ecological footprint of neurotechnology, particularly in relation to large-scale data centers and computing resources used for processing and storage of neural and cognitive biometric data. These policies should emphasise data minimisation, ensuring that only the necessary amount of data is collected and processed, and promote the proportional use of neurotechnology, aligning its deployment with genuine needs and minimising unnecessary environmental impact. Measures should include optimising energy efficiency, using renewable energy sources, promoting the recycling and sustainable disposal of neurotechnology-related equipment, and ensuring the rehabilitation of affected environments.

85. Member States should support and incentivise the development and implementation of technological innovations and design standards for neurotechnology that prioritize the protection of mental privacy, such as state-of-the-art encryption, secure databases with multi-factor authentication, cutting-edge anonymization techniques, and edge-processing and storage (processing and storing data closer to where it is being generated), leading to greater action-led results in real time storage of neural and cognitive biometric data.

86. Member States should incentivise neurotechnology manufacturers to prioritize privacy and ethics by design, requiring the incorporation of privacy-preserving technologies as default features in their devices.

87. Member States should encourage ethical data sharing by establishing secure, data repositories for neural and cognitive biometric data used in research. These repositories should meet stringent cybersecurity, data privacy, and ethical use standards (including data minimisation and purpose limitations), tiered access and other privacy-enhancing approaches. Appropriate funding mechanisms should be established for the curation and maintenance of data and data governance processes streamlined.

88. Member States should prioritize efforts to reduce obstacles to cross-border data sharing in neurotechnology research, working towards greater alignment of data protection standards, particularly concerning neural and cognitive biometric data, by establishing clear protocols for data transfer that ensure secure and compliant data exchanges across borders, and standards for interoperability of data, including governance frameworks for data sharing.

89. Member States should consider specific guidelines for the ethical use of neural and cognitive biometric data in AI development and research, including consent procedures for uses of neural and cognitive biometric data in training and application of AI models, ensuring transparency and respecting individual and community rights.

### **IV.3. INTELLECTUAL PROPERTY (IP)**

90. Member States should adopt policies to ensure that neural and cognitive biometric data, as individual human activity derivatives, are not subject to proprietary rights. IP protection should only apply to original data compilations (created through a process of aggregation, organization, or selection, resulting in a new dataset) that meet strict and ethical criteria.

91. Member States should collaboratively establish clear, harmonised guidelines for IP rights applicable to neurotechnology on an international scale. These guidelines should address the patentability of AI-generated inventions and the ethical implications of IP laws, ensuring they promote global accessibility and innovation.

92. Member States should ensure that all actors adopt IP management strategies that encourage innovation and avoid overly restrictive patent use, fostering an open innovation ecosystem. This approach should continuously adapt to the evolving landscape of neurotechnology. The impact of IP policies on the neurotechnology sector should be continuously monitored to ensure they stimulate innovation while ensuring ethical use and broad accessibility.

93. Member States should foster an environment of co-creation in neurotechnology, by facilitating policies and incentives for co-ownership and preferential licensing agreements to ensure equitable compensation and recognition for all contributors.

94. Member States should adopt policies with respect to open science that balance the protection of IP with the promotion of immediate publication of results and data sharing. Particularly with the convergence of digital technologies and the increasing concentration of those innovations in industry sectors, this balance is crucial to ensure that IP protection

mechanisms do not hinder scientific research, innovation, and the wide dissemination of knowledge and new technologies. As a basic rule of equitable partnership, when Indigenous Peoples are involved in neurotechnology research and development, open science processes, IP management strategy, should be developed in collaboration with them from the beginning.

#### **IV.4. CYBERSECURITY**

95. Member States should collaborate internationally to establish comprehensive standards for cybersecurity across all neurotechnology domains. These standards should encompass hardware, software, and data security measures to protect against potential cyber threats. By implementing uniform cybersecurity standards, Member States should ensure the integrity, confidentiality, security, and availability of neural data, as well as enhance user trust and confidence in neurotechnology devices. Additionally, these standards should evolve in tandem with technological advancements and emerging cyber threats to maintain robust protection against evolving risks.

96. Member States should employ red-teaming exercises—adversarial challenges to test the efficacy of security systems—as a proactive measure to assess and enhance the safety, security, and resilience of neurotechnology systems. By conducting regular red-teaming exercises, Member States should proactively identify and address security gaps, test incident response procedures, and strengthen the overall safety and cybersecurity posture of neurotechnology devices.

#### **IV.5. COMMUNICATION, PARTICIPATION, AND INFORMATION**

97. Member States should promote communication and develop engagement policies for neurotechnology that foster informed, inclusive, and respectful dialogue between researchers, developers, diverse users, and the broader public to respect individual and community rights, promote public trust, and harness the collective intelligence and diversity of communities.

98. Member States should collaborate with international organizations, educational institutions, and private and non-governmental entities to develop and disseminate accessible and engaging educational materials tailored to diverse audiences to bridge knowledge gaps, particularly in underserved regions about the nervous system and mental health functioning, as well as the benefits and risks of neurotechnology. These programs should aim to increase public understanding of the technologies' functionality, safety, efficacy, and societal impact, empowering individuals to make informed decisions and to enable their ethical reflection about their use of neurotechnology.

99. Member States should implement public and community engagement processes that facilitate genuine mutual learning and collaboration throughout the whole lifecycle of neurotechnology. These processes should include regular and inclusive consultations with a wide array of actors. The aim of these engagements should be to inform policy development, shape ethical guidelines, increase public awareness and understanding, align investment priorities, and ensure that neurotechnology deployment aligns with public interests and values. Special attention should be given to involving groups traditionally underrepresented in technological policymaking, thereby fostering responsible innovation in the field.

100. Member states should collaborate in the co-creation of accurate, precise, and accessible language and terminology for discussing neurotechnology that involves actors from diverse backgrounds to ensure that the language used is inclusive, non-stigmatizing, and accurately reflects the technologies' capabilities and limitations. Member States should establish regulatory frameworks that require clear and ethical communication standards for

neurotechnology. These frameworks should require evidence-based reporting of capabilities, risks, and limitations across all applications to avoid exaggeration of claims, including but not limited to applications in sleep, attention, memory, and emotional regulation. Within these frameworks should be specific guidelines for ethical marketing and protocols for responsible communications about early-stage research and emerging technologies.

101. Member States should develop policies that foster effective collaboration between end-users, researchers and innovators throughout the whole lifecycle of neurotechnology product development, with special focus given to the places where the neurotechnology is being developed. These policies should mandate the creation of diverse advisory panels, including representatives from various user groups and respecting neurodiversity. Member States should also establish platforms for ongoing dialogue and feedback between users, researchers and developers. Advisory panels should be involved in the process of developing and testing new neurotechnology products to optimize device efficacy, usability, longevity, and sustainability. This collaborative approach aims to ensure that innovations in neurotechnology are context-compatible and meet the needs of diverse user populations.

102. Member States should develop age-appropriate, contextually-appropriate, culturally-appropriate, and linguistically-appropriate education about neurotechnology. This should include training modules to aid in the supportive use of these technologies at home, both for the user and for caregivers and family members.

## **CONSIDERATION FOR SPECIFIC USERS**

### **IV.6. CHILDREN AND ADOLESCENTS**

103. Member States should promote healthy brain development through policies that evaluate the impact of neurotechnology on children and adolescents.

104. Member States should safeguard children and adolescents from implicit and explicit coercion to use neurotechnology. Member States should pay attention to the autonomy of children and adolescents through informed consent and assent that is adapted to and respectful of age and decision-making capacity.

105. Member States should fund research and development grants focused on creating user-friendly assistive neurotechnology tailored for children and adolescents with disabilities. These projects should involve children, adolescents, parents and caregivers in the design process to ensure the technologies meet their specific needs. Educational programs should be developed to teach children and adolescents and their caregivers how to effectively use and maintain these technologies, with support available in multiple languages and accessible without discriminating against those who either cannot or choose not to engage with the proposed technology.

106. Member States should ensure research involves strict oversight and close follow-up of all neurotechnology research involving children and adolescents. This oversight is crucial during the developmental phases of childhood to address and mitigate any unforeseen long-term effects. Such research must include comprehensive monitoring protocols and periodic evaluations to ensure the ongoing safety and well-being of young participants, taking into account their unique developmental needs and vulnerabilities. In the framework of research, involving children and adolescents in medically vulnerable situations (i.e., children in epilepsy monitoring units), special attention will be given to consent and assent, particularly considering particular aspects of research (time, iterations) to prevent any form of instrumentalization.

107. Member States should enact specific regulations that prohibit the use of marketing techniques—such as neuromarketing, biometric emotional analytics, immersive advertising, and



virtual or augmented reality advertising—that rely on sensitive neural and cognitive biometric data collected from children and adolescents. Recognizing the heightened vulnerability of children and adolescents in digital environments, these regulations must explicitly forbid any practices that use such data to influence or exploit children and adolescents.

#### **IV.7. OLDER PERSONS**

108. Member States should promote healthy aging and support elderly individuals by funding and implementing evidence-based programs that integrate neurotechnology into routine care. These programs should involve the entire support ecosystem, including family, caregivers, and medical teams, to enhance quality of life. Priority should be given to developing and implementing tools that prevent, delay, and treat age-related health conditions, impairments, and neurodegenerative diseases. Member States should ensure that access to these neurotechnology programs is equitable and does not exacerbate socioeconomic inequalities.

109. Member States should establish guidelines for neurotechnology design sensitive to the needs of older adults, carefully considering human-computer interface factors for usability (such as fonts, buttons, and colour) and experience for enhanced visual and auditory cues.

110. Member States should preserve, support, and promote autonomous decision-making for older people using neurotechnology for sensorimotor and cognitive support. The consent process should accommodate potential cognitive challenges faced by older adults, ensuring that consent is informed, ongoing, and adaptable to changing health conditions. Policies should be in place to ensure that assistive neurotechnology recognize changing cognitive capacities over time and respect users' preferences.

111. Member States should develop ethical guidelines to ensure that neurotechnology such as robotic caregivers enhance rather than replace human interaction, particularly in the care of individuals with neurodegeneration. These guidelines should emphasize the augmentation of human care, not its replacement.

#### **IV.8. WOMEN AND GENDER**

112. Member States should adopt and enforce comprehensive policies that promote and respect gender equality and diversity in the whole lifecycle of neurotechnology. The policies should prioritize inclusive research for addressing women and gender specific needs and differences, require targeted data collection and analysis, include education and training programmes on inclusive research practices, ensure public and community engagement with women and gender health experts and advocacy groups and, incentivise gender responsive technology design, to meet the needs and conditions specific to women and gender minorities. Affirmative action policies are necessary to close gender gaps in these fields, increase representation, engagement and leadership.

113. Member States should establish clear guidelines and legal frameworks to ensure that workplaces and research environment, throughout the whole lifecycle of neurotechnology, are inclusive and supportive, particularly for women and gender minorities, and safeguard against harassment and discrimination. This should include robust mechanisms for reporting and addressing incidents of harassment and discrimination, ensuring accountability and support.

114. Member States should adopt a range of measures that prioritize ethical and equitable research and innovation and support programs that foster women's and gender minorities' participation in neurotechnology. This includes funding and other policies that prioritize ethical and equitable research and innovation, but also affirmative action initiatives to support the participation of women and gender minorities in neurotechnology through targeted education

programs, employment opportunities, entrepreneurship support, and leadership development within the sector. Member States should also provide support systems such as mentorship programs, networking opportunities, and resources to help women and gender minorities overcome barriers to participation and succeed in the neurotechnology field.

#### **IV.9. PERSONS WITH PHYSICAL DISABILITIES**

115. Member States should adopt policies that harness the potential of neurotechnology by removing barriers experienced by persons with physical disabilities and providing support thereby contributing to achieving equal enjoyment of human rights. They should implement regulatory frameworks that require accessibility assessments for all new neurotechnology products to ensure these products do not perpetuate existing disabilities or health disparities. These frameworks should include protocols for testing with diverse groups of persons with disabilities to ensure technology meets a wide range of needs and does not unintentionally exclude or disadvantage any subgroup.

116. Member States should create incentive programs to promote the development of neurotechnology for people with disabilities to promote their quality of life and functional independence. These programs should include tax incentives for companies investing in assistive neurotechnology research and development, grants for research institutions focusing on neurotechnology for disability support, expedited regulatory reviews for technologies offering significant advancements in mobility, communication, or daily living assistance, and innovation prizes for breakthroughs in affordable, accessible neurotechnology solutions.

117. Member States should, whenever possible, subsidise the cost of essential neurotechnology devices, such as neuroprosthetics, for persons with physical disabilities. They could encourage public-private partnerships to make advanced neurotechnology affordable and integrate neurotechnology coverage into national health insurance and other reimbursement schemes for persons with physical disabilities. A national database of available neurotechnology resources and support services should be developed to facilitate access and information sharing.

#### **IV.10. PERSONS WITH MENTAL HEALTH CONDITIONS**

118. Member States should foster research and promote awareness-raising initiatives to address the increasing prevalence and special needs of people with mental health conditions, including victims and survivors of trauma and violence, and the relevance of neurotechnology for these communities.

119. Member States should allocate funding for long-term advocacy and efficacy studies, post-market oversight, and tiered scrutiny with special attention to invasiveness and reversibility of neurotechnology interventions. It is important to ensure that people with mental health conditions are well-informed and have reasonable expectations about the process.

120. Member States should prioritize funding for neurotechnology that is designed to improve quality of life and daily functioning of individuals with mental health conditions. This includes technologies that assist in managing symptoms, improving cognitive functions, and providing emotional support at home, in the workplace, in their communities, and in society. Research and development should be guided by feedback and engagement with persons with mental health conditions and their advocates.

121. Member States should establish policies that improve access to timely advances in neurotechnology for those with mental health conditions to ensure that cost is not a barrier to accessing potentially life-altering treatments and supports.

## **HEALTH AND RESEARCH ETHICS**

### **IV.11. HEALTH**

122. Member States should support the development of health applications that prioritize the unmet needs in the provision of neurological and mental health. This should include establishing research funding programs specifically targeted at addressing identified gaps in nervous system care.

123. Member States should build and maintain international solidarity to address global health risks and uncertainties, and ensure that their implementation of healthcare for the nervous system is consistent with international law and rigorous human rights obligations. This could involve creating international forums for sharing best practices in the implementation of neurotechnology in healthcare.

124. Member States should establish oversight mechanisms to evaluate the physical and mental health impacts of long-term use of neurotechnological devices, with special attention to invasiveness and reversibility of neurotechnology interventions. This includes implementing regulatory measures requiring long-term follow-up studies for approved neurotechnology devices and establishing clear criteria for continued approval based on these studies results.

125. Member States should consider the significant cost and impact associated with pathologies related to the nervous system, as well as the potential benefits of early diagnosis and access to preventive and assistive neurotechnology. Public policies should prioritize the promotion of access to these technologies and ensure health cost coverage for individuals in need.

126. Member States should promote the development of reliable and durable neurotechnology for healthcare applications. This includes encouraging the design of devices and systems that require minimal maintenance, ensuring they remain functional and effective under everyday conditions. Regulatory bodies or designated authorities should oversee the enforcement of rigorous standards for quality, safety, and longevity, thereby reducing the burden on users and enhancing the dependability and sustainability of neurotechnological solutions.

127. Member States should ensure the development or strengthening of existing comprehensive neurotechnology medical device reporting systems that track and address adverse effects. In contexts where such systems do not exist, Member States should establish them. Where systems are already in place, they should be updated to specifically include neurotechnology. These systems should be interoperable and contribute to a centralised, public, and transparent international database, managed in collaboration with international organizations, to ensure that global standards are met and accessible for public knowledge, international oversight and research.

### **IV.12. RESEARCH ETHICS**

128. Member States should reinforce the ethical frameworks governing neurotechnology research to ensure robust protection of human participants. Member States should adopt clear guidelines or policies that define the qualifications to ensure that research is conducted by professionals with appropriate knowledge about the nervous system structure and function in addition to brain disorders and is performed in adequate research settings. Furthermore, research protocols, public or private, in the medical as well as the non-medical domain, should be carefully evaluated by registered ethics boards (ethics committees) and specific attention dedicated to individuals with special situations regarding vulnerability such as diminished capacity to consent or to make decisions. Member States should ensure that all research

institutions have mandatory ethics training for researchers.

129. Member States should encourage multicentre international research that involves various cultures and ethnic groups. Member States should promote international cooperation to develop common reporting standards and protocols for interoperability, particularly for implantable neurotechnology devices. This cooperation should aim to enhance the comparability and utility of research globally, improving both the efficacy and ethical integrity of research.

130. Member States should ensure that the whole lifecycle of neurotechnology is considered in the design of a clinical trial, including policies to protect patients in case of cessation of activities of the trial sponsor or promoter. Member States should establish requirements for clinical trials to be included in relevant nationally or internationally approved registries, and encourage registration with community and patient registries. Also, clinical trials should report on appropriate medical device reporting systems developed within Member States.

131. Technology developers should ensure that the validation of AI algorithms in neurotechnology research include rigorous testing for biases, as well as measures to enhance explainability and transparency, including the provenance of training datasets. Suitable techniques should be employed to mitigate any biases present in AI models used in neurotechnology applications.

132. Member States should ensure that research efforts not only focus on biomedical risks associated with neurotechnology but also investigate potential effects on an individual's subjective experience, agency and personal identity. Understanding how neurotechnology may impact aspects of self-perception, consciousness, and identity is essential for addressing ethical concerns and ensuring the well-being of individuals using these technologies.

133. Member States should ensure those engaged in research implement regular auditing and monitoring of research practices to ensure adherence to ethical standards. This should include evaluating the adequacy of informed consent, particularly concerning data reuse and the potential commercialisation of neural data.

134. Member States should require researchers in neurotechnology to establish clear and transparent protocols for communicating clinically significant and actionable incidental findings to participants. These protocols should ensure that such findings are conveyed promptly, respecting participants' rights and autonomy. Additionally, Member States should mandate that researchers provide the necessary support and coordination with healthcare providers to address any health concerns that arise from these findings.

135. Member States should ensure that individuals involved in neurotechnology research or receiving neurotechnological interventions are adequately informed about the potential for incidental findings, particularly those with significant health implications. The informed consent process should clearly outline what these findings might entail, the participants' right to choose whether they wish to be informed about such findings, and guarantee that their decisions in this regard will be respected throughout the study or treatment.

## **SPECIFIC DOMAINS OF APPLICATION OUTSIDE OF HEALTH**

### **IV.13. EDUCATIONAL SETTINGS**

136. Member States should approach with caution the integration of neurotechnology in education, ensuring that its use is evidence-based and aligned with the education goals and complements traditional learning methods. Emphasis should be placed on promoting the holistic development of students, focusing not just on academic performance but also on mental health, well-being, and overall interests. To ensure inclusivity, Member States should develop age-

appropriate guidelines for neurotechnology use across different educational stages and learning styles. Regular assessments of neurotechnology's impact on student development, including mental health, should be conducted, with ethical review processes established to oversee deployment. The primary focus should be on fostering critical thinking, creativity, and emotional intelligence rather than solely enhancing academic performance.

137. Member States should adopt policies ensuring the voluntary deployment of neurotechnology in education, grounded in fully informed consent. These policies must include clear, age-appropriate information about the technology's purpose, benefits, and risks, with adequate consideration periods. Considering the increased complexity of obtaining voluntary consent in this context, consent and assent procedures should involve children, adolescents, parents, guardians and all actors necessary to obtain approval required for minors. Ethical oversight mechanisms should be established, including regular consent renewal and immediate cessation of neurotechnology use upon withdrawal, and ensure anonymous feedback channels. Policies must prohibit undue incentives or academic penalties for non-participation and take measures to avoid creating or reinforcing inequalities among students. Additionally, Member States should support student involvement in decision-making about neurotechnology integration and fund training programs on its ethical use, empowering educators and students to critically assess its application.

138. Member States should establish a unified, robust oversight mechanism for neurotechnology use in educational settings, incorporating regular audits, public and community feedback, culturally appropriate and according to local conventions, and strict adherence to safety and ethical standards, including an assessment of reversibility on the nervous system. Continuous research should be funded to assess the long-term psychological and cognitive impacts of these technologies. Oversight should involve periodic reviews based on empirical evidence to adjust neurotechnology usage as needed, ensuring it serves student development and addresses risks like dependency or de-skilling. This comprehensive approach will help maintain the safety, effectiveness, and alignment of neurotechnology with best practices for student well-being and learning outcomes.

139. Member States should invest in educational and professional development programs to equip innovators and business leaders with the skills to integrate ethical considerations throughout the neurotechnology whole lifecycle. This training should include ethical design, human rights law, and societal impact assessment, preparing the next generation of technologists to critically evaluate the implications of their work.

#### **IV.14. LABOUR AND EMPLOYMENT**

140. Member States should establish workplace policies and incentives that prioritize the health and well-being of employees in the use of neurotechnology. These policies should ensure that any deployment of neurotechnology is evidence-based, with a focus on applications that have been scientifically validated to promote employee well-being, such as reducing stress or enhancing workplace conditions (i.e., adaptive and responsive environments that adjust workloads based on cognitive load). Deployment must be on a voluntary basis and employees must have the option to opt out of using neurotechnology without facing any negative consequences or discrimination. Under no circumstances should these technologies be used for punitive measures, mental surveillance, or in ways that could compromise employee health.

141. Member States should require employers to clearly provide employees with comprehensive information about how neurotechnology used in their workplace works, the benefits it offers, transparency about what data are collected, how it is used, and who has access

to it, and clearly disclose any potential risks of their use.

142. Member States should require employers who use neurotechnology in the workplace to adopt transparent policies that disclose the purpose of the use, limit the scope of its use to legitimate purposes in the interest of the employee and third parties (i.e., safety, monitoring fatigue in commercial drivers or tracking attention in air traffic controllers). To respect employees' mental privacy, employers should be prohibited from unauthorized access to neural and cognitive biometric data that may be collected incidentally during routine workplace monitoring. Employers should be prohibited from using neural and cognitive biometric data for any non-consented purposes, particularly those that could negatively impact an employee's job security or privacy.

143. Member States should require employers to adopt best practices for data minimisation and secure storage of neural and cognitive biometric data, ensure that data is stored securely, with access limited to authorised personnel only, is deleted once its intended purpose has been fulfilled. Additionally, upon an employee's departure, all related records should be fully deleted or individual data released to the employee, ensuring that no data is retained after the termination of employment.

144. Member States should ensure that when employees are issued multifunctional devices (i.e., earbuds or headphones that also include neural sensors) that can be used at work or at home, employers should be prohibited from collecting neural and cognitive biometric data outside of workplace settings and working hours and ensure that any data collected during work is used exclusively for agreed-upon purposes. Employers should implement technological safeguards to automatically disable data collection during non-work hours.

145. Member States should ensure that employers respect the right of employees to obtain a copy of any neural and cognitive biometric data collected about them, along with any interpretations drawn from it in an accessible and comprehensible manner. To use these tools without consent constitutes a breach of trust, undermining the value they would otherwise create.

146. Member States should require, through stringent regulations, that any use of neurotechnology in the workplace require explicit employee consent, and be used only for purposes that demonstrably enhance workplace safety, employee well-being and dignity, and not for enhancing productivity at the expense of employee health.

147. Member States should guard against the exploitation of employees, and they should develop stringent regulations against using neural and cognitive biometric data for profiling in the workplace, including in hiring. These regulations should prohibit the use of neural and cognitive biometric data to discriminate against candidates, particularly neurodiverse individuals, ensuring hiring practices are fair and inclusive.

148. Member States should strictly regulate the use of neurotechnology for hiring or maintaining employment, to limit such use where such neural and cognitive biometric data are directly relevant to the specific requirements of the job.

#### **IV.15. CONSUMER AND COMMERCIAL DOMAINS**

149. Member States should proactively establish a regulatory framework that balances innovation in the recreational and commercial domains with protecting individual rights and well-being. This framework should be dynamic, allowing for timely updates as technology evolves and new insights are gained about its impacts on society. This includes providing adequate oversight to ensure that neurotechnology does not cause harm, are used consensually, and include robust mechanisms to protect users from potential psychological distress or manipulation.

150. Member States should strengthen comprehensive consumer protection laws to include

clear labelling on commercial neurotechnology products, detailing their effects, limitations, and risks to prevent misleading claims and ensure transparency. This also includes prohibiting practices of “tying” or requiring the disclosure of neural and cognitive biometric data as a condition to access goods or services, and prohibition about third party data sharing or the uses of this data without affirmative opt-in option.

151. Member States should foster an environment that ensures all claims about consumer, non-medical technologies are supported by robust scientific evidence. They should, by regulation, require that any products claiming to treat, prevent, or diagnose diseases or medical conditions be validated through rigorous safety and efficacy testing, including clinical trials where necessary, and be used under appropriate medical supervision.

152. Member States must enforce informed consent processes that are thorough and transparent across all neurotechnological interventions, ensuring that participation is fully voluntary and respects the privacy and autonomy of individuals. This principle should apply uniformly in various domains such as sports, arts, where robust standards should safeguard against coercive use and respect athletes’ and artists’ individual autonomy, community interests, and IP rights.

153. Member States should steer the use and development of neurotechnology in the arts toward ensuring the enhanced learning and cultural appreciation without compromising individual autonomy or leading to cultural homogenisation.

154. Member States should adopt policies to prevent the misuse of neurotechnology of consumer technology, especially neurogaming and other devices that exploit the dopamine reward system or seek to induce problematic and unhealthy use and overconsumption. Such regulations should mandate clear labeling of risks, disclosures on their effects on the nervous system, enforce game design standards and safety, privacy and age-appropriate design standards that prevent taking advantage of a person’s physical, mental and emotional vulnerability to lead to compulsive use or addiction of gaming or digital recreational platforms combined with neurotechnology, to promote healthy, balanced use, especially among children.

155. Member States should ensure that devices capable of multiple functions, such as XR glasses or smart earbuds with neural sensors, include hardware-based controls that allow users to selectively disable neurotechnology features while maintaining basic functionality. Regulations should ensure that ‘opt-out’ features are accessible and straightforward, promoting healthy, balanced use especially among children and vulnerable populations.

156. Member States should address the profound ethical questions regarding self-determination, consent, privacy, and the potential for manipulation raised by neurotechnology that arise in the contexts of recommender systems, priming and nudging, marketing during sleep and dream, neuromarketing, and closed-loop environments by adopting comprehensive policies and regulations that:

- (a) Recommender systems: explicitly prohibit the use of neural and cognitive biometric data in recommender systems for manipulative or deceptive purposes, including in political context. These regulations should require that any use of such data within these systems be based on explicit, informed opt-in consent from users.
- (b) Nudging: govern the use of neural and cognitive biometric data for nudging—subtly influencing individuals’ decisions or behaviours, often without their explicit awareness. This is particularly critical in sensitive areas such as political messaging, commercial advertisement, and healthcare. These frameworks should

require explicit, informed consent for any use of such data to influence decisions or behaviour, the right to opt out of these systems, and transparency and clear disclosures at the point of data collection, with strict limitations on using data for purposes beyond those explicitly disclosed.

- (c) Marketing during sleep and dream: prohibit the use of neurotechnology that influences or manipulates individuals during sleep, such as marketing during sleep and dream. Regulations should strictly prohibit commercial, marketing, or political applications that target individuals during sleep, using neurotechnology or neural and cognitive biometric data. Additionally, robust oversight mechanisms should be required to ensure that any research or application of such technologies prioritizes the well-being, privacy, and autonomy of individuals, with particular attention to the potential long-term psychological and cognitive impacts of manipulating sleep states.
- (d) Neuromarketing: safeguard against unethical aims and practices in neuromarketing, including by requiring comprehensive disclosures to ensure that all neuromarketing activities are conducted transparently, with participants' explicit informed consent. This includes ensuring that participants in neuromarketing research or campaigns are fully aware of methods, risks, and intentions and affirmatively opt-in to participation. The use, storage, and potential reuse of the collected data should be strictly regulated.
- (e) Closed Loop Environments: provide clear regulatory guidelines on the design and use of closed-loop environments—such as immersive computing devices that adjust experiences based on detected neural and cognitive biometric data. These policies should require clear and accessible disclosure about how neural and cognitive biometric data are used in these environments, prohibit real-time behavioral modification or manipulation without explicit, informed consent, and implement safeguards specifically designed to prevent abuses such as unauthorized surveillance, manipulative interventions, and practices that could influence voting behavior, political opinions, or exploit psychological and emotional vulnerabilities in real-time.

#### **IV.16. ENHANCEMENT**

157. The use of neurotechnology to improve memory, attention, or other aspects of human mental performance outside of the medical context introduces complex ethical, social, and legal challenges, which can create new kinds of disparities in the global world. When neurotechnology is used in these contexts, it raises crucial questions about equity, consent, individual and community autonomy, and the nature of enhancement of the nervous system itself. Member States should ensure that any policies, law and regulatory frameworks that govern the use of neurotechnology in these contexts do not exacerbate social inequalities or lead to discrimination, address the potential risks (including to reversibility, invasiveness, and risks to self-determination) and fully comply with human rights and dignity.

#### **V. IMPLEMENTATION**

158. Member States and all other actors as identified in this Recommendation should respect, promote and protect the ethical values, principles and standards related to this Recommendation, and should take all feasible steps to give effect to its implementation.

159. Member States shall, according to their specific contexts, governing structures and



constitutional provisions, credibly and transparently advance the ethics of neurotechnology, in line with the UNESCO Recommendation. Member States shall monitor and evaluate policies, programmes and mechanisms related to neurotechnology and its ethics. Progress monitoring could rely on a combination of quantitative and qualitative approaches.

160. Member States should develop capacities in governmental institutions and support government officials to steer the technological development ethically.

161. Member States should establish or designate national organizations responsible for overseeing and coordinating the regulation, vigilance, and oversight of neurotechnology across relevant government agencies. These coordinating bodies should be tasked with ensuring that legal and regulatory frameworks are consistently applied, that public health and safety are protected, and that ethical standards and human rights are upheld throughout the whole lifecycle of neurotechnology. This includes facilitating inter-agency collaboration, monitoring compliance with national and international standards, and ensuring that data and insights from different regulatory domains are shared effectively to inform decision-making and policy development. These bodies should also help coordinate public and community engagement.

162. Member States should strive to extend and complement their own actions in respect of this Recommendation, by cooperating with all relevant national and international governmental and non-governmental organizations, as well as transnational corporations and scientific organizations, whose activities fall within the scope and objectives of this Recommendation. Civil society will be an important actor to advocate for the public sector's interests and therefore UNESCO needs to ensure and promote its legitimacy.

163. UNESCO should publicize and disseminate this Recommendation widely through all available means, and share it with Member States, National Commissions for UNESCO, relevant international and regional partners, human rights institutions as well as with UNESCO ethics advisory bodies for dissemination to all levels and actors in this field.

164. To support Member States implementing this Recommendation by developing concrete programs and policies and developing institutional capacities in the ethics of neurotechnology, UNESCO shall contribute by developing a full-fledged program with the following elements:

- (a) a UNESCO Readiness Assessment Methodology (RAM) to assist Member States in identifying their status at specific moments of their readiness trajectory along a continuum of dimensions;
- (b) a UNESCO methodology for Ethical Impact Assessment (EIA) of neurotechnology based on rigorous scientific research and grounded in international human rights law, along with specific guidance for its implementation in the whole neurotechnology lifecycle, and capacity-building tools and materials to support Member States' efforts to train government officials, policy-makers and other relevant actors on the methodology;
- (c) a UNESCO methodology to evaluate ex ante and ex post the effectiveness and the efficiency of the policies for the ethics of neurotechnology and incentives against defined objectives;
- (d) a UNESCO research program that will focus on the ethics of neurotechnology, grounded on an appraisal that is informed by the current state of technological developments, to assess the current and future impact of neurotechnology on societies and the environment. This evidence-based analysis will be gathered in a UNESCO observatory, to become a shared pool of knowledge and awareness of good practices and innovations available to all Member States and actors, in the form of research reports, data, and statistics regarding policies for ethics of neurotechnology. The research program should take into consideration the

converging developments of neurotechnology with other technologies such as artificial intelligence and quantum technology, work to be conducted in collaboration with other relevant UNESCO initiatives.

- (e) a UNESCO collaborative platform fostering meaningful exchanges and facilitating collaboration among Member States and among all actors to promote a global policy dialogue, including at Ministerial level in the context of a Global Forum on the ethics of Emerging Technologies. Supporting this effort, UNESCO shall establish a network of experts, with balanced representation of all UNESCO's regional groups, on the neurotechnology.

165. Processes for monitoring and evaluation should ensure broad participation of all actors, including, but not limited to, under-represented, vulnerable people or people in vulnerable situations and ensuring social, cultural and gender diversity. The monitoring and assessment of the impact of neurotechnology and related ethics policies and practices should be carried out continuously in a systematic way proportionate to the relevant risks. This should be based on internationally agreed frameworks and involve evaluations of private and public institutions. Data collection and processing should be conducted in accordance with international law, national legislation on data protection and data privacy, and the values and principles outlined in this Recommendation.

## **VI. FINAL PROVISIONS**

166. This Recommendation needs to be understood as a whole, and the foundational values and principles are to be understood as complementary and interrelated.

167. Nothing in this Recommendation may be interpreted as replacing, altering or otherwise prejudicing Member States' obligations or rights under international law, or as approval for any State, other political, economic or social actor, group or person to engage in any activity or perform any act contrary to human rights, fundamental freedoms, human dignity and concern for the environment and ecosystems.