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Human Intelligence In The Loop

XRSI's Responses to the United Nation's Questionnaire on **"Neurotechnology and Human Rights"**

July 2023

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Table of Contents:

About XRSI

Headquarters in the San Francisco Bay Area, USA, and Torino, Italy, X Reality Safety Intelligence (XRSI) is a **501(c)(3) global non-profit,** a **Standards Developing Organization(SDO)** and the world's leading organization dedicated to providing intelligence and advisory services that are vital for the protection and well-being of emerging technology ecosystems. With a strong emphasis on critical aspects such as **safety, privacy, security, human rights, human well-being**, responsible innovation, governance, and regulation, XRSI offers comprehensive expertise to ensure the responsible and ethical advancement of emerging technologies. By placing the emphasis on **Human Intelligence**, XRSI brings together a global network of experts and thought leaders committed to shaping the future of technology in a way that prioritizes the welfare of individuals and society as a whole. We offer **standardization**, **certification**, **policymaking**, and **workforce development professional advisory services** for the emerging technology domain.

With its, XRSI currently has over 200 diverse and multidisciplinary advisors from around the globe, XRSI provides impartial, practical information about XR and metaverse-related risks and opportunities to governments, individuals, corporations, universities, agencies, and other organizations worldwide. XRSI launched the first novel XRSI Privacy Framework for the Immersive domain to address the Privacy and Safety Issues in the XR and Spatial Computing technologies. Since 2019, XRSI has created various programs focusing on the most critical aspects of the emerging technology domain, such as Medical XR (Medical XR Advisory Council), Child Safety (Child Safety Initiative), Diversity and Inclusion (CyberXR Coalition), Trustworthy Media Platform (Ready Hacker One), and the Metaverse Reality Check (The MRC), an oversight board by and for the citizens. XRSI is a member of the World Economic Forum (WEF) Global Coalition of Digital Safety as well as part of the Metaverse Initiative by WEF. XRSI advises over 60 governments and provides oversight to several key open source efforts pertaining to Metaverse-related technologies, including the International Telecommunication Union (ITU), and The Metaverse Standard Forum.

Executive Summary

The rapid advancement of neurotechnologies presents a unique intersection of opportunities and challenges in the realm of human rights. While these technologies hold the promise of revolutionizing healthcare, education, and alleviating human suffering, they also pose significant risks, particularly to privacy, personal agency, freedom of thought, and non-discrimination. The development of consumer-oriented neurotechnologies further amplifies these risks, potentially infringing on the rights of vulnerable groups such as individuals with neurological or psychiatric conditions, young people, and those within the criminal justice system.

The assessment of these risks necessitates the development of robust regulatory frameworks for reading the brain (mind-mapping), neuromodulation (writing to the brain or rewiring it), and the standards for the collection, naming, and storage of neural data. Furthermore, it is crucial to ensure that end-users are adequately educated about the risks to their neural sovereignty before participating in technologies that can read or write to their brains.

Balancing the opportunities provided by neurotechnologies (restoration of function, mental health, human agency) against the identified risks and impacts is a complex task. Protection and regulation should be crafted in a way that is broad and flexible enough to accommodate future, unforeseen capabilities and use cases.

Individual national legal frameworks play an important role in addressing these challenges. However, the collection and use of this data is often cross-jurisdictional. Further, there is significant variability in how comprehensive these frameworks are within and across countries, and whether neurorights are subsumed under other types of data or biometric policies. If global corporations are involved in the read-write technologies, how is this addressed? Neural data also pose unique challenges in that this data is intimately involved in decision-making, human thought and human agency. Thus, most countries have legislation and regulation that are unable to address the unique challenges posed by neurotechnologies. Further, existing legislation that covers citizen privacy and data protections often does not consider or cover mental privacy and personal brain data. These issues leave the protection of neuro rights vulnerable.

At the international level, the regulatory and governance gaps regarding neurotechnology and human rights are amplified. Cross-jurisdictional treatment of human rights, data rights and privacy must be considered. Evaluation, oversight, and enforcement become leading issues. Identifying the appropriate international organizations, bodies, or agencies to oversee and prevent potential abuses or misuses resulting from the use of neurotechnologies is critical.

XRSI RESPONSES TO THE QUESTIONS

I. All stakeholders (core questions)

General

Q 1- 3 are left unresponded intentionally.

Impact, opportunities and challenges

Question 4. What human rights will be mostly impacted by the development and use of neurotechnologies? Identify the three rights most impacted and briefly explain why.

The advent and application of neurotechnologies carry substantial implications for numerous human rights. Drawing from a wealth of insights collected from diverse sources and the deliberations among XRSI advisors participating in this questionnaire, it becomes evident that the Universal Declaration of Human Rights (UDHR), established and endorsed by the United Nations in 1948, may require the incorporation of new rights. These additions are particularly necessary to address the rights most susceptible to the influence and deployment of neurotechnologies. While there was not a unanimous agreement on the three rights most impacted, there is an overall common concern for the following human rights, including novel rights such as right to mental privacy, and right to interactive agency.

Proposed Novel Human Right: Right to Mental Privacy

The "Right to Mental Privacy,"[1][2][3] is a critical consideration in the context of neurotechnologies. This right is centered on safeguarding the privacy of our inner mental processes, thoughts, and emotions. With the advent of neurotechnologies and machine learning, systems can now detect and interpret human emotions and behaviors from various cues, including facial expressions, vocal nuances, physiological markers, and subtle gestures. This capability, while technologically impressive, raises significant privacy concerns as the Artificial Intelligence (AI) systems can

[1] Wang, M., Hu, J., & Abbass, H. A. (2020). BrainPrint: EEG biometric identification based on analyzing brain connectivity graphs. Pattern Recognition, 105, 107381.
[2] Armstrong, B. C., Ruiz-Blondet, M. V., Khalifian, N., Kurtz, K. J., Jin, Z., & Laszlo, S. (2015). Brainprint: Assessing the uniqueness, collectability, and permanence of a novel method for ERP biometrics. Neurocomputing, 166, 59-67.
[3] Wachinger, C., Golland, P., & Reuter, M. (2014). BrainPrint: Identifying subjects by their brain. In Medical Image Computing and Computer-Assisted Intervention–MICCAI 2014: 17th International Conference, Boston, MA, USA, September 14-18, 2014, Proceedings, Part III 17 (pp. 41-48). Springer International Publishing.

reveal emotions and reactions that individuals did not intend to express or were not consciously aware of. Furthermore, the collection and interpretation of behavioral data can lead to invasive personal profiling, predicting individuals' actions, reactions, and interactions in extreme detail. Therefore, the "Right to Mental Privacy" underscores the need for our thoughts, emotions, and inner mental processes to remain private and secure amidst the rapid advancements in neurotechnologies.

Proposed Novel Human Right: Right to Interactive Agency

Platforms utilizing neurotechnologies can extensively track individuals' behavior and emotions in real-time and create AI models that predict their actions and reactions. Additionally, these platforms can inject targeted promotional experiences, guiding behaviors, emotions, and beliefs. This creates a dangerous situation known as the "AI Manipulation Problem"[4], where AI-powered systems impart targeted influence on individuals, through their reactions, and repeatedly adjust tactics to maximize persuasive impact. This process could greatly impact their cognitive liberty and interactive agency. The right to interactive agency must be upheld to ensure human autonomy and free will in environments influenced by neurotechnologies.

Article 3: Right to life, liberty and security of person

The neural code is one of the two fundamental codes of human life. Its protections therefore are intertwined with one's right to life, liberty and security. If this code were violated, taken without consent, or manipulated, then a person's autonomy would be diminished.

Article 4: No one shall be held in slavery or servitude

This applies as mental coercion, based on mind-reading and subsequent manipulation, or neuromodulation (writing to the brain), could create a state of mental servitude.

Article 7: Right to equality and equal protections before the law without discrimination

Individuals who utilize neurotechnology to move from disability to ability, whether in the sensory, motor, or cognitive domain, should not be discriminated against. Individuals should have the right to avail of such technology that would be helpful to them. In the future, individuals should have the right to sensory, motor, or cognitive neuroenhancements if so desired. Individuals should not be discriminated against if they decline such enhancement. Individuals' thoughts or mental proclivities should not be used to discriminate against them, e.g., by potential employers or insurance companies due to indicators of potential development of neurological disease states. Finally, neurotechnologies should not be used in ways that could exacerbate existing inequalities.

Article 12: Right to freedom from arbitrary interference with his privacy; right to the protection of the law against such interference or attacks

[4] Rosenberg, Louis. (2023). The Manipulation Problem: Conversational AI as a Threat to Epistemic Agency: https://www.researchgate.net/publication/369355910_The_Manipulation_Problem_Conversational_AI_as_a_Threat_to_Epistemic_Agency

This can be read as the right to mental privacy. Neurotechnologies, both invasive and non-invasive, have the ability to collect neural data, and depending on the sophistication of the interpretive algorithms, which may improve over time, become increasingly able to interpret those neural signals. At some point, brain sensing technologies may be able to peer into an individual's thought processes, understand the sensory signals they perceive in the world, or decode their intentions to act. Individuals have the right to keep their thoughts, perceptions, and intentions private. Individuals should also have the right not to incriminate themselves by such thoughts, or to have them legally used against them. The use of personal and sensitive information could lead to discrimination (Article 12), manipulation, incarceration, monetary penalty, or persecution.

Article 18: Right to freedom of thought, conscience, belief, and religion

Neurotechnologies could be used to interpret an individual's thoughts, beliefs and values (e.g. about religion). These could be held against an individual in terms of their personal freedoms (e.g. freedom from incarceration) or freedom from harm (see Article 12). Actors threatened by a person's beliefs, as encoded in their neural signals, may also try to manipulate, coerce, or rewrite a person's mental processes by neuromodulation or writing to their brain.

Article 19: Right to freedom of opinion and expression; the right to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.

The same application of neurotechnology described under Article 18, the ability to read thoughts that are related to opinion or freedom of expression, could occur. Similarly, the risk of actors threatened by a person's opinions, as encoded in that individual's neural signals, to manipulate, coerce, or rewrite a person's mental processes by neuromodulation or writing to their brain, also exists.

Article 23: Right to freedom to work, choice of work, without interference and with equal protections and remuneration

Read-write neurotechnologies provide the possibility of potential employers or other actors peering on an individual's private thoughts, mental processes, and risk of developing neurological disease. The right to choose work for equal protections and pay should be afforded to all, independent of their private neural processes.

Article 25: Right to adequate living (food, water, energy, healthcare), protections for vulnerable populations, security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond one's control

Neurotechnology may become a life-giving part of healthcare - individuals have the right to avail of such technology as it may support their body or mind and prevent disability. An individual taking advantage of such a technology should be protected in the event that technology fails, and they should lose a job as a result, become sick, or disabled.

Article 26: Right to education, right to full development of the human personality, tolerance

Neurotechnologies might lead to interpretation of thoughts or opinions that could be used to deny one an education, or the full development of their human potential. On the other hand, neurotechnology may also enable individuals to avail themselves of cognitive support, cognitive enhancement, new educational opportunities, or the ability to fully realize their human potential. Such technology should be used to support the goals of equal access to education and human development, and not to stifle it.

Question 5. What are the biggest challenges and risks that the development, test and use of neurotechnologies pose to human rights? Will such risks be amplified by the development of consumer-oriented neurotechnologies?

Neurotechnology should be considered dual use, with both risks and benefits in the consumer space. The development, testing, and use of neurotechnologies pose significant challenges and risks to human rights, with the potential to reshape our understanding of privacy, autonomy, and the essence of human experience. Consumerization of this technology and data collection amplifies risk in unique ways.

The Challenges and Risks The challenges and risks associated with neurotechnologies span ethical, legal, and social dimensions.

Specific risks to human rights:

- Right to personhood and selfhood (e.g. neuromodulation may stably alter the function and circuitry of the brain that results in significant changes in personality or ability)
- Freedom from discrimination (e.g. neuromapping technologies can impact what is learned about a person's mental or neurological state, or their state of mind; this can influence employment, healthcare)
- Right to mental privacy (i.e. of thoughts or unique biometric identification through neurowearable devices)
- Right to interactive agency (I.e. ensuring individuals maintain autonomy and free will, safeguarding against undue influence or manipulation by the use of neurotechnologies.)
- Right to freedom from persecution for beliefs, opinions or thoughts
- Right to not be hurt or manipulated by neurotechnology (i.e. brain circuits can be directly written to or be primed to respond in particular manner)
- Right to not incriminate oneself (i.e. neuromapping technologies can impact what is learned about a person's mental or neurological state, or their state of mind; this can be used against one in legal proceedings, or to restrict physical freedoms, through incarceration)

Specific challenges of developing, testing, and using neurotechnology:

- *Cybersecurity:* As neurotechnologies become more integrated into our daily lives, they become potential targets for cyberattacks. This could lead to unauthorized read-write access to sensitive neural data, manipulation of worn or edge-based neural devices, or even direct harm to individuals.
- *Encryption*: Neural data that is collected needs to be named, encrypted and secured as it is produced on a consumer device or wearable. Standards for data use need to be made interoperable.
- *Data Collection and informed consent:* Consumers need a comprehensible way of understanding the significance of the data they are sharing, where it is stored, how it will be used, and what the risks are of that sharing.
- *Ethics of Use:* Neurotechnologies have the potential to influence our thoughts, emotions, and behaviors in unprecedented ways. This raises profound ethical questions about autonomy, consent, and the potential for manipulation by companies.
- *Use of neural data for surveillance, by the state, or other corporations:* Due to the sensitive nature of neural data, and what it can reveal about thoughts, opinions, and the state of the data producer, such data can be used for sophisticated surveillance operations carried about by governments or other entities which aim to control, harm, or sell products to individuals.
- *Lack of Control:* As neurotechnologies become more sophisticated, there is a risk that individuals may lose control over their own neural data. This could lead to situations where individuals are unable to control who has access to their neural data and how it is used.
- *Potential Misuse of Technology:* The dual-use nature of neurotechnologies means that they can be used for both beneficial and harmful purposes. This raises concerns about the potential misuse of these technologies, particularly in contexts such as national security or consumer marketing.
- *Risk of Physical Harm:* Invasive neurotechnologies, such as brain implants, carry the risk of physical harm, including infection, bleeding, and damage to brain tissue. Both invasive and noninvasive consumer devices can be used to rewrite the brain, or inflict harm to the brain because of specific energies or patterns of energy delivered.[5]

Amplification of Risks in Consumer-Oriented Neurotechnologies

[5]https://nap.nationalacademies.org/catalog/25889/an-assessment-of-illness-in-us-government-employees-and-their-families-at-overseas-embassies

The development of consumer-oriented neurotechnologies amplifies these risks in several ways:

- *Lack of Informed Consent:* In the consumer space, informed consent is often handled differently than in the medical field. In healthcare, risks and benefits are presented at a grade level that can be understood by a wide population, and in the language of a subject's choice. End-user license agreements (EULAs) are written with legal language that even sophisticated consumers may not understand. This almost always results in consumers not fully understanding the risks associated with the collection and use of their neural data. Healthcare and research informed consent, which derive authority from IRBs, have provisions to revoke consent and data use and storage. This is not a requirement for consumer devices which collect data.

- *Consent, privacy, and legal duty to protect as corporate rights are transferred:* If a company is dissolved, the status of the data they were storing or protecting is unclear. If a company is acquired, often the acquisition of sensitive consumer data is part of the acquisition or the IP, and the duty to protect and informed consent provisions do not often transfer. Consumer data may in fact be the only IP of a company, and may be shared with other companies as part of profit-sharing, sales, or IP/licensing agreements. Consumers may not have the right to revoke consent for acquiring or storing their data as they do in the healthcare or research capacity with carefully crafted and reviewed protocols. Companies to whom such sensitive data is transferred are not under the same obligations to protect such data

- *Differing Protections for Data:* Depending on the data producer, data collection device, or context, equally sensitive health data may be protected differently. This could result in less stringent protections for neural data collected by consumer devices compared to those in a healthcare or research setting. An example is heart rate data collected by a physician in a clinic versus the same data collected by a consumer wearable device. These data have different privacy, security and protection assignments. Similar issues are recognized to exist in the consumer genetic sequencing space.[6]

- *Cross-Jurisdictional Issues:* Consumer digital data often crosses jurisdictions and geographic borders, which can result in differing regulations depending on the country, context, or governing body. This could lead to inconsistencies in how neural data is viewed, categorized, and protected.

- *Potential for Misuse:* The potential for misuse of neurotechnologies is particularly concerning in the consumer space, where there may be less oversight and regulation. This could lead to situations where neural data is used for purposes such as targeted manipulation, or even discrimination, in the legal, enforcement, insurance, employment, or educational contexts. Further, brain metrics and interpretation of neural data,

[6]https://advocacy.consumerreports.org/wp-content/uploads/2020/07/DTC-Genetic-Testing-White-Paper-4.pdf

especially for neuromapping, is not always well validated, and may not be objective. Data interpretation may also be context sensitive. Further, algorithms today will need significant refining to accurately and precisely detect and map states, traits, and thoughts. Another inevitable challenge is that an algorithm built for an individual may change over time due to an individual's neural plasticity or the neural collection device moving in position relative to the brain tissue or regions from which it records. Medical devices that have approval from regulatory bodies are clear as to whether they have been validated for diagnostic or therapeutic purposes, while consumer devices have no such regulatory pressures.

- *Device hacking:* Any wearable or implantable device has the potential to be accessed by hackers. Pacemakers and insulin pumps are examples of implantable devices which save lives, but have been accessed by white hackers to demonstrate the vulnerability of such devices to cyber threats, and being programmed to do harm (e.g. deliver fatal shocks or electrical rhythms to the heart, release too much insulin into the bloodstream). These risks exist for wearable and implantable neural devices as well. Companies developing such devices, whether in the healthcare or consumer space, will need robust cybersecurity for these devices, that will need constant patches and updates.

The Need for Robust Regulatory Frameworks

In light of these challenges and risks, there is a pressing need for robust regulatory frameworks that can protect individuals' rights while also fostering innovation in neurotechnology. Such frameworks should include provisions for informed consent, data protection, data storage revocation, right to remain anonymous, and safeguards against misuse. They should also promote transparency and accountability in the development and use of neurotechnologies, and ensure that individuals have control over their own neural data–including the ability to transact with it, and to revoke consent over its use. Finally, regulatory frameworks must require adequate cybersecurity safeguards of individuals' neural data, and that security must be constantly re-evaluated and updated as both security and hacking technologies advance. Cybersecurity also involves the protection of wearable and implantable devices from hacking, so they can be used to damage, harm or kill an individual.

We would like to highlight that neurotechnology can be extremely beneficial, and that includes neurotechnology developed in the consumer space. Any frameworks developed should recognize this potential and not constrain development of such technology outside the research or healthcare space. Examples of maintaining this balance include the Chilean experiment in neural rights' protection. The Chilean government (Ministry of Science and Ministry of Economy) have decided to approach the creation of regulatory norms around technology from a new angle. This approach will be regulatory experimentation through sandboxes, platforms that enable fostering innovation, attracting investment, and enhancing public-private co-learning as a response to the challenges posed by emerging technologies.

In conclusion, all technology is always dual use. While neurotechnologies hold immense potential for advancing our understanding of the brain and improving human health and

well-being, they also pose significant challenges and risks to human rights. Addressing these challenges and mitigating these risks will require foresight, design flexibility, and a joint effort from all stakeholders, including, but not limited to consumers, physicians, neuroscientists, technologists, business leaders, ethicists, regulators, policymakers, and citizens at large.

Question 6. What groups are more vulnerable or at risk? Please, identify three and explain why.

Neurotechnology, a field that merges neuroscience with technology, has the potential to revolutionize our understanding of the human brain and treat a variety of neurological and psychiatric disorders. However, with these advancements come ethical considerations and potential risks, particularly for certain vulnerable populations. Three groups that are more vulnerable or at risk include individuals with neurological or psychiatric conditions, young people, and individuals within the criminal justice system.

- **Individuals with neurological or psychiatric conditions, those with disabilities:** Neurotechnology's medical use cases often target individuals with neurocognitive impairments, such as brain injuries, neurodegeneration, psychiatric illnesses, and neurodevelopmental disorders. These individuals may not be able to give informed consent or may be making decisions under duress, leading to the acceptance of unreasonable risks or intrusive data privacy terms. For instance, a patient with dementia or caregiver with a healthcare power of attorney might agree to an experimental neurotechnology treatment without fully understanding the potential side effects or privacy implications. Further, these individuals might be targeted for the development and testing of these technologies, potentially exposing them to unproven treatments with unknown long-term effects.

- **Young People:** Young people, particularly those in their teens, are another vulnerable group. Due to peer pressure or social pressures, they may be more likely to use neurotechnologies without fully understanding the risks. The developing brain is also more susceptible to potential negative effects of these technologies. For example, a teenager might be more easily coerced, or use a neurowearable device to enhance cognitive performance without fully understanding how it might impact their brain development or mental health (e.g. in a manner similar to the use of stimulant medications for attention). Furthermore, the use of neurotechnology in educational settings could lead to privacy concerns or unequal access to educational opportunities.

- I**ndividuals within the Criminal Justice System:** The use of neurotechnology within the criminal justice system raises a host of ethical and legal concerns. There is a risk that these technologies could be used for enhanced interrogation, coercive interrogation or admission of guilt, without right of appeal. This data could also be used as a form of lie detection, potentially infringing on these individuals' rights. This could lead to false positives and/or wrongful convictions, especially as mind-reading data may not be

validated for this use. Further, individuals should maintain the right of non self-incrimination. An individual's neural data should never be used against them for conviction or sentencing purposes, or to coerce a false confession.

In conclusion, while neurotechnology holds great promise, it is crucial to consider its ethical implications and potential risks, particularly for vulnerable populations. As we continue to navigate this rapidly evolving field, it is essential to develop guidelines and regulations that protect these individuals and ensure that the benefits of neurotechnology are accessible to all.

Question 7. What methods can be used to identify and assess the potential risks and impact of these technologies on human rights, in particular the human rights of persons with disabilities and other groups in vulnerable situations? Will such risks be amplified by the development of consumer-oriented neurotechnologies?

The development and use of neurotechnologies have the potential to significantly impact human rights, particularly those of persons with disabilities and other vulnerable groups. Identifying and assessing these potential risks and impacts requires a multi-faceted approach that considers the ethical, legal, and social implications of these technologies.

Risk assessment

Risk assessment can be flagged by certain practices which signal that data collection may be infringing on human rights, health or well-being. These include (but are not limited to) these practices.[7]

1. Is having your brain read or written to a requirement or condition for access to employment, healthcare, education, for being labeled a “good citizen,” or for getting health or life insurance, loans, etc.?
2. Is the neural data being banked?
3. Is the neural data being encrypted? Is cybersecurity maintained and up-to-date?
4. Is non-relevant biometric data for the task at hand or the stated goal collected?
5. Is neural data collection opt-in or opt-out?
6. Is neural data storage revocable by the data producer?
7. Were privacy and data rights written into consumer and government neurotechnology collection models?
8. Are individual rights protected as part of the neural read or write model with adequate informed consent, or was only a EULA provided, whose purpose is to protect a company or corporation legally, and not the consumer or end-user?
9. Is neurotechnology being used to capitalize on attention, addiction circuits, or being used exclusively to advertise?

[7] Chander, Divya. “I Think, Therefore I Am, Neural Sovereignty and Neural Rights in the 21st Century,” in Ethics at Work, ed. Kris Ostergaard, RE:Humanize Publishing, 2022.

10. Is brain reading being used to perform financial transactions? To enter passwords? To be uniquely identified for legal, consumer, or government transactions?
11. Is reading one's brain a requirement for fair treatment in the legal system (e.g. for defense, lie detection, conviction or sentencing)?
12. Is reading one's brain or indirect biometric measures of brain and arousal state being used to surveil individuals? Is this data being sold to governments or other corporations that may use this data in a nefarious way–to exert control or exact harm?

Amplification of risk by the development of consumer-oriented neurotechnologies?

Do companies have a fiduciary responsibility to their shareholders, or to the end-users they serve? If we shift the stakeholder argument to promote responsibility to protect and serve the end-user, consumer orientation should not amplify risk. However, given corporation responsibility towards shareholders and maximizing profit, the risk profile to consumer end-users is markedly amplified.

Companies protect biometric data differently, and it is often leveraged as IP or sold to improve the value of a company, which does not directly help consumers.

Companies are often vulnerable to data breaches, and thus far, standards for cybersecurity for this uniquely sensitive data do not exist, or are not uniformly enforced, with adequate penalties.

Finally, given the cost of consumer neurotechnology devices and therapeutics, and market forces, the end-user who would most benefit may not have access to the technology due to financial resources or awareness of the services. This would amplify inequality in reaching individual human potential. The ideal is to democratize the technology, cost, distribution and access. Consumer development may actually help on this front, but it could also become an exclusionary wall.

Risk mitigation

- **Regulatory Frameworks and Standards:** Frameworks, standards,[8] and regulation can be used to assess the potential risks and impacts of neurotechnologies on human rights. These should be flexible to evaluate risks on a case-by-case basis, context-sensitive, and should be able to change as neurotechnology evolves. These frameworks should focus on vulnerable data and vulnerable individuals' situations. They should facilitate the responsible development and use of neurotechnologies. They should address key issues such as data privacy, encryption, storage, informed consent, right to revoke, and the potential misuse of technology. They should expressly forbid this data from being collected without knowledge, or to be used in surveillance, control, or harm operations. Finally, such frameworks or bodies should be used to certify standardization, privacy, and safety of such devices and products, and that companies/stakeholders that are providing safe, private, secure, interoperable neurotechnology services to end-users.

[8]https://standards.ieee.org/wp-content/uploads/import/documents/presentations/ieee-neurotech-for-bmi-standards-roadmap.pdf

- **Proper Informed Consent Models:** Informed consent should replace EULAs for end-user, patient and consumer protection. Informed consent is an ethical principle first, and a legal principle secondly. An individual has the right to fully understand and agree to any neurotechnology interaction before it happens. The end-user must understand all risks and benefits, at a grade level or reading level appropriate to them, and in their preferred language–minimizing the potential of misunderstanding. The end-user should have the right to ask questions after they receive this information so they can make well-considered decisions about their participation, care, and use of such devices. They must also consent to the collection of data, its storage and use. They have the right to revoke access to their neural data for both storage and use. They have the right to remediation if their data is not adequately protected. For consumer devices, we should ensure that any such consent and protections granted follow the consumer's data, and are not eliminated if a company dissolves, is acquired, or merges with another company. A full record of this informed consent process must be stored, a copy given to the consumer or end-user, and should always be fully accessible to them, and to anyone making decisions on their behalf should they become incapacitated.

- **Data Trusts:** Neural data might be valuable if stored so it can produce actionable insights and promote health and well-being for the data producer, or other humans. There are multiple models of good data governance. One example is data trusts; these provide independent, fiduciary stewardship of data. There are many models of how to accomplish this, but a fiduciary trust indicates the highest level of protection. Data trusts represent an approach to stewarding data that can support the purpose of maximizing positive societal impact while protecting from harm.[9]

- **Education and Awareness:** Education can ensure that end-users are educated about the risks to their neurorights before participating in technologies that can read or write to their brains. The development of educational programs and resources that inform individuals about the potential risks and benefits of neurotechnologies, as well as their rights and responsibilities when using these technologies can be developed. Governments, international bodies, and trusted community leaders can also provide this information.

- **Risk Assessment Models:** The use of risk assessment models can also be an effective method for identifying and assessing the potential impacts of neurotechnologies on human rights. These models consider a range of factors, including the type of technology, its intended use, the potential for misuse, and the potential impacts on various human rights. For example, the IEEE Brain Initiative[10] is working on developing a framework for assessing the ethical and societal implications of neurotechnologies.

- **Stakeholder Engagement:** Engaging with a wide range of stakeholders, including individuals with disabilities or those who use neurotechnology today, advocacy groups,

[9] https://theodi.org/article/what-is-a-data-trust/
[10] https://brain.ieee.org/resources/standards/

neuroscientists, neurotechnologists, physicians, ethicists, cybersecurity experts, white hackers, developers, governments, regulators, and policymakers, is crucial to identifying and assessing potential risks. Multi-stakeholder involvement ensures that a wide range of perspectives and experiences are considered in the development and implementation of neurotechnologies.

- **Democratization of access:** The democratization of access to neurotechnologies will also be a significant advancement in safeguarding human rights. By making these technologies more accessible to a broader population, we empower individuals to exercise greater control over their own cognitive, mental, and neurological well-being. Democratization ensures that the benefits of neurotechnologies are not limited to a privileged few and rather are available to all–regardless of socio-economic status. This promotes equality, inclusivity, and the protection of fundamental human rights alluded to in Question 1. Accessible neurotechnologies allow individuals to enhance their cognitive abilities, improve mental health, and potentially overcome physical and neurological limitations. It enables people to make informed decisions about their own bodies and minds, ensuring autonomy and self-determination.

Question 8. From a human rights perspective, what opportunities could the use of neurotechnologies bring? Can these opportunities be balanced against the identified risks and impact?

The use of neurotechnologies could bring about several transformative opportunities that would support human rights. These opportunities primarily revolve around the potential to alleviate human suffering, pain, to treat neurological or psychological diseases, traumatic injuries, promote mental well-being, and enhance educational opportunities, cognition, performance, and even physiological capabilities.[11]

- **Alleviation of Human Suffering:** This can be achieved through the development of non-pharmaceutical and reversible interventions for neurological and psychiatric disorders. Such interventions could provide relief to individuals who have not responded well to conventional treatments, thereby improving their quality of life and reducing the cost to society associated with the disability. In some cases, we have seen that even non-invasive neurotherapeutics have induced neural plasticity and restored function to subjects.

- **Alleviation of Pain**: Although this overlaps with diminishing human suffering, it is a particular kind of respite from suffering. Using non-pharmaceutical interventions, it is possible to distract from or treat pain, by rewiring those peripheral nerves or brain

[11] Chander, Divya. "I Think, Therefore I Am, Neural Sovereignty and Neural Rights in the 21st Century," in Ethics at Work, ed. Kris Ostergaard, RE:Humanize Publishing, 2022.

centers that are responsible for transmitting pain signals, or processing and perceiving pain.

- **Treatment of Neurological or Psychological Diseases:** Neurotechnologies could revolutionize the treatment of neurological or psychological diseases and traumatic injuries. They have been used to treat things like depression, PTSD, OCD, dementia/memory loss. They could potentially enable the mobilization of neural circuits important to brain plasticity, which could be used to treat neuropsychiatric conditions, brain injury, and neurodegeneration.

- **Assistive Technologies for Brain Injury Recovery:** Neurotechnologies could play a crucial role in the recovery from brain and spine injuries (e.g. stroke, spinal cord transection, ALS) by interfacing with machines or neural stimulation. Assistive technologies, such as cochlear implants and brain computer interface communication tools, could help individuals regain lost functions. Augmentation of sensory, communication, and motor abilities facilitates independent self-care and personal safety, participation in community life, and engagement in the workforce. It can enable a person who may be experiencing disability to recover human autonomy, agency, and the ability to perform ADLs (activities of daily living) without assistance. This can restore a measure of human dignity.

- **Enhanced Cognition and Performance:** Neurotechnologies could also be used to enhance human cognition and performance. This could be achieved through peak performance training and enhanced educational personalization. Such enhancements could lead to significant improvements in various aspects of human life, including education, work performance, cognitive abilities, happiness, and mental well-being.

- **Enhanced Physiological Capabilities:** Neurotechnologies could also be used to enhance sensory and motor capabilities by a combination of noninvasive and implantable devices. These augmentations need not be limited to those that read or write to the brain directly. These can include non-specific forms of physiological stimulation of nerves, body parts, or even bionics, exoskeletons, or immersion in virtual or hybrid worlds. Augmented human movements exist worldwide today.

Continued response to Q8…Can these opportunities be balanced against the identified risks and impact?

All technology is dual use. Neurotechnology has been around for many decades, and as described in the previous section, it has the potential to alleviate human suffering and support the advancement of human rights. Its improvement and impact is also exponentially rising. Stopping the development or use of this technology will not be productive because bad actors will continue to do so.

The previous answer identifies a number of techniques by which risk can be mitigated. The opportunities this present are enormous. By focusing on mitigating risk in the realm of neurotechnology, one has the opportunity to apply novel technology, regulation, frameworks and solutions to adjacent fields. An example would be how we manage cybersecurity, data protection, data storage, data trusts, or informed consent. Similarly, we can apply these data protection and governance models to the development of AI, or the protection of genetic data. We are in a window of opportunity to increase education and global awareness on this subject prior to its extensive impact.

There is a complexity to the balance, which may be unique to neural data. Collection of brain activity or neuromodulation is particularly intrusive–there is an interaction with a fundamental code of life, and something that gives us our sense of self.

Opportunities to mitigate risks can include the perspective that neural data should be considered synonymous with one's very self or personhood and that it should be labeled as and protected as a human right.

Finally, we must recognize that we may not fully appreciate the future ramifications or exponential development and capability of the technology being developed. Any such protections, regulations, and frameworks should be crafted in a way that is broad and flexible enough to accommodate future, unforeseen capabilities.

National Framework

Question 9. Is the national legal framework adequate to face the challenges that the development, test and use of neurotechnologies pose to human rights? Please explain briefly and indicate the relevant pieces of legislation and whether there are plans to develop any (or further) legislation.

The national institutional framework for human rights plays a crucial role in addressing the challenges posed by neurotechnologies. However, the rapid advancement of neurotechnologies and their potential implications for human rights necessitate a thorough examination of the existing framework.

In the case of Chile, the country has been proactive in addressing the challenges posed by neurotechnologies. The Chilean Senate has passed a constitutional reform that recognizes and protects neuro-rights, setting a precedent for other nations. This reform is a significant step towards ensuring that the national institutional framework for human rights is well-equipped to address the challenges posed by neurotechnologies.

Adequacy of National Legal Framework for Neurotechnologies: The adequacy of the national legal framework in facing the challenges posed by neurotechnologies varies significantly from country to country. In many cases, existing legislation may not fully address the unique challenges posed by these technologies.

In Chile, the government has taken steps to address this issue by passing a constitutional reform that recognizes and protects neuro-rights. This reform includes provisions for the protection of mental privacy, personal identity, free will, and equal access to cognitive enhancements. However, it is essential to note that the development of legislation in this area is an ongoing process, and further legislation may be necessary as neurotechnologies continue to evolve.

Question 10. Does national legislation on privacy and data protection cover mental privacy and/or personal brain data? Please explain.

National legislation on privacy and data protection plays a crucial role in protecting mental privacy and personal brain data. However, the unique challenges posed by neurotechnologies may not be fully addressed by existing legislation.

In Chile, the constitutional reform passed by the Senate includes provisions for the protection of mental privacy and personal brain data. This legislation recognizes the right to mental privacy as a fundamental human right and includes provisions to protect individuals from unauthorized access to their personal brain data.

Question 11-12 are left unresponded intentionally.

Question 13. What national entity would be best placed to exercise scrutiny and oversight to prevent potential abuses or misuses derived from the use of neurotechnologies? Is there any procedure in place to that effect?

The identification of a national entity best placed to exercise scrutiny and oversight to prevent potential abuses or misuses derived from the use of neurotechnologies is a complex task. It requires a comprehensive understanding of the national context, the specific challenges posed by neurotechnologies, and the capabilities of potential oversight entities.

A special consortium at the national level, including civil society, tech companies, and other stakeholders, could be an effective approach to exercise scrutiny and oversight in neurotechnologies. This consortium could provide a platform for collaboration and dialogue among different stakeholders, facilitating the development of effective oversight mechanisms and promoting responsible innovation in neurotechnologies.

International Framework

Question 14 (Also Question 26, Civil Society specific question). What are the main international regulatory and governance gaps that you have identified as regards neurotechnology and human rights?

The rapid advancement of neurotechnology has outpaced the development of international regulations and governance structures, leading to several significant gaps. These gaps pose challenges to the protection of human rights, privacy, and ethical considerations in the use of neurotechnology.

1. *Lack of Global Standards:* The absence of a universally accepted regulatory framework for neurotechnologies has resulted in a patchwork of national regulations, leading to inconsistencies and potential misuse ***(Kosal and Putney)***[12]

2. *Inadequate Privacy Laws:* The unique nature of neurotechnology, which involves the collection and analysis of neural data, presents new privacy challenges. Existing privacy and data protection laws may not be equipped to handle these challenges, leaving a significant gap in the protection of individuals' neural data. ***(Information Commissioner's Office (ICO), UK)***[13]

3. *Ethical Implications:* Neurotechnologies raise complex ethical questions, such as those related to cognitive enhancement and algorithmic bias. Current regulations may not adequately address these ethical implications, leading to potential misuse and harm ***(Ienca and Andorno)***.[14]

4. *Protection for Vulnerable Groups:* Vulnerable groups, such as persons with disabilities, may be disproportionately affected by the misuse of neurotechnologies. Current regulations may not provide sufficient protections for these groups, leading to potential discrimination and inequality ***(Genser et al.).***[15]

[12] Kosal, Margaret, and Joy Putney. “Neurotechnology and international security.” Politics and Life Sciences, vol. 22, no. 1, 2022. Cambridge University Press.
[13] Information Commissioner's Office (ICO), UK. *ICO Tech Futures: Neurotechnology.* ICO, UK, 2023.
[14] Ienca, Marcello and Roberto Andorno. “Towards new human rights in the age of neuroscience and neurotechnology.” Life Sciences, Society and Policy, vol. 13, 2017. Life Sciences, Society and Policy.
[15] Genser, J, Hermann S, Yuste R. International Human Rights Protection Gaps in the Age of Neurotechnology. Neurorights Foundation, 2022.

Question 15. What actions would you advocate for to address these gaps and potential human rights impact at the international level? Please elaborate on specific normative or institutional measures you would propose and assess the feasibility of their implementation.

Addressing these regulatory and governance gaps is crucial to ensuring the responsible development and use of neurotechnologies. A multi-pronged approach that involves updating existing laws, developing international standards, and protecting vulnerable groups is necessary.

1. *Development of International Standards:* To address the lack of global standards, international stakeholders, including governments, researchers, and civil society, should collaborate to develop a universally accepted regulatory framework for neurotechnologies.

2. *Updating Privacy Laws:* Privacy and data protection laws should be updated to reflect the unique challenges posed by neurotechnologies. These updates should include specific provisions for the protection of neural data, ensuring that individuals' most intimate information is protected ***(Information Commissioner's Office (ICO), UK)***.[16]

3. *Establishing Data Trusts:* Data trusts provide a fiduciary responsibility to collect, store and use data in a way that protects data producers, and produces value for all, while protecting from harm.[17] An example is the UK Biobank.

4. *Incorporating Ethical Considerations:* Regulations should incorporate ethical considerations to address the complex ethical questions raised by neurotechnologies. This could include requirements for ethical impact assessments and guidelines for the responsible use of neurotechnologies ***(Ienca and Andorno)***.[18]

5. *Protecting Vulnerable Groups:* Specific protections should be established for vulnerable groups, including additional safeguards for persons with disabilities. Measures should also be put in place to ensure that neurotechnologies are accessible and affordable for all, preventing new forms of inequality ***(Genser et al.)***.[10]

Question 16. What international organization, bodies, or agencies would be in your opinion best placed to oversee and prevent potential abuses or misuses resulting from the use of neurotechnologies?

[16] Information Commissioner's Office (ICO), UK. ICO Tech Futures: Neurotechnology. ICO, UK, 2023.
[17] https://theodi.org/article/what-is-a-data-trust/
[18] Ienca, Marcello and Roberto Andorno. “Towards new human rights in the age of neuroscience and neurotechnology.” Life Sciences, Society and Policy, vol. 13, 2017. Life Sciences, Society and Policy.

The oversight and prevention of potential abuses or misuses resulting from the use of neurotechnologies require the involvement of international organizations with the necessary expertise and mandate.

1. *World Health Organization:* As the leading international health agency, the WHO could play a key role in promoting health and serving the vulnerable in the context of neurotechnologies. Its global reach and expertise make it well-suited to this role.

2. *United Nations Bodies:* The UN Human Rights Council and the UN Special Rapporteur on the right to health could monitor the use of neurotechnologies and advocate for the protection of human rights. Their mandate to protect and promote human rights globally makes them ideal for this role.

3. *International Brain Initiatives:* This group, which is focused on promoting ethical research and responsible innovation in the field of neurotechnology, could play a significant role in overseeing the use of these technologies ***(Ienca and Andorno)***.[19]

4. *Neurorights Foundation:* As an organization dedicated to developing a new human rights framework for the neurotechnology era, the Neurorights Foundation could play a significant role in overseeing the use of these technologies and advocating for the protection of neurorights ***(Genser et al.)***.[20]

5. *National Data Protection Authorities:* These authorities, which are responsible for enforcing data protection laws within their respective jurisdictions, could play a crucial role in overseeing the use of neurotechnologies, particularly in relation to the protection of neural data ***(Information Commissioner's Office (ICO), UK)***.[21]

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Closing Remarks

In conclusion, The development and use of neurotechnologies present both significant opportunities and challenges. Fairly advanced neurotechnology exists now, and will be further developed in the future, to read from the brain, write to the brain, and form a closed-loop system through the combination of read-write neurotechnologies. This technology provides unparalleled means for advancing our understanding of the brain, improving human physical and mental health and well-being, relieving suffering, and enhancing human potential. As technology is always dual use, these technologies also pose significant challenges to human rights. Many of these fundamental rights are described in the current framework of the UN Universal Declaration of Human Rights. The right to mental privacy, the right to freedom of thought and expression, and the right to non-discrimination are particularly at risk.

Governments, policymakers, scientists, technologists, and global citizens are well served to recognize this future neurotechnology misuse potential, enshrine neural rights as fundamental human rights, and build robust safeguards against misuse, building on these fundamental human rights. Any frameworks and laws should be flexible, and take into account the possibility that we may not be able to imagine the full scope of such neurotechnology from where we are today. They may need to grow and adapt. Further, the superposition of better algorithms, AI, bionics, robotics, 3D spatial computing, the internet, and the internet of things may further accelerate the development and capability of this technology in ways that we cannot yet perceive. Finally, the collection, encryption, protection, and storage of this most sensitive data, and the informed consent process, will need to be evaluated on an ongoing basis as the threat landscape and our technological means advance in parallel.

Contributors Details

Dr. Divya Chander

Divya Chander, MD, PhD, the **XRSI Advisor and a member of the Medical XRSI Council**, is a physician, neuroscientist, neuroethicist, futurist, and entrepreneur. She is a practicing anesthesiologist and served on the faculty of Stanford University for 8 years, leading the neuroanesthesia curriculum for residents. She currently serves as Chair for Neuroscience at the Singularity Group, a Silicon Valley think tank for data and technology acceleration, applications, and ethics. As a Stimson Center Loomis Innovation Council Fellow, and past Nonresident Senior Fellow at the Atlantic Council Geotech Center, she is collaborating with governments and industry to foster good data and technology policy choices for key stakeholders around the world in the area of biometric data rights, data trusts, data security, public health, and pandemic resilience. Her expertise in neural signal processing has led to her developing mind-reading algorithms to automate tracking of states of consciousness. Her research interests center around mapping consciousness, how consciousness will be altered by human augmentation, and how mapping consciousness in humans may enable us to recognize it in non-human, intelligent beings. Dr. Chander founded Lucidify, a continuous remote brain monitoring platform, for the detection of delirium and other altered states of consciousness to support brain health. She serves as medical, science, and technology advisor and board member to a number of companies in the medical, space life sciences, and neurotechnology spaces. Dr. Chander is also passionate about space life sciences and medicine. A finalist for astronaut selection and an alumnus of the International Space University, Dr. Chander has performed remote simulations of trauma rescues, anesthesia and surgery in Mars analogue settings, and is designing habitats and medical spaces to support human space exploration and astronaut health.

Dr. Julia A. Scott

Julia A. Scott, PhD, the **Executive lead for XRSI's Medical XR Advisory Council**, is the director of the Brain and Memory Care Lab at Santa Clara University. Dr. Scott's research program utilizes external partnerships in healthcare to develop projects at the intersection of neuroscience, medical imaging, and virtual reality applications. She received her training in neuroscience at University of California campuses (Davis, San Diego, and San Francisco). She has published widely on normal and abnormal neurodevelopment, as well as brain aging. Dr. Scott is translating her BCI-VR research into digital health applications. She co-founded Gambit Labs in 2021 with the mission of empowering youth to take the lead in ensuring their own well-being by developing specific cognitive skills that underlie healthier habits of mind.

Kavya Pearlman

Well known as the "Cyber Guardian," Kavya Pearlman is an award-winning cybersecurity professional and the **Founder & CEO of the X Reality Safety Intelligence (XRSI)**, a Standard Developing Organization with the mission to help build safety and inclusion in emerging tech ecosystems. Kavya is the pioneer of the novel XRSI Privacy and Safety Framework for the Immersive Technologies Domain, Metaverse Safety Week Annual Awareness Campaign, and various baseline security, privacy, and ethics standards for Emerging Technologies. She has won several awards for her work and has been named one of the Top twenty Cybersecurity influencers for three consecutive years, 2018-2019-2020, and again for the year 2022 by IFSEC Global. Kavya has previously advised Facebook on third-party security risks during the 2016 US presidential elections and worked as the head of security for the oldest virtual world, "Second Life" by Linden Lab. Kavya is the leading voice in cybersecurity, privacy, and Ethics for Emerging technologies including AR, VR, and XR, exploring cross-sections of 5G, AI, and BCI - leading Standards development and promoting Diversity and Inclusion in Immersive Technologies. Kavya serves as the key member of the Global Coalition for Digital Safety at the World Economic Forum (WEF) and a subject matter expert at several Security and safety-focused multidisciplinary groups including INTERPOL's Metaverse Experts Group (i-MEG), United Nations Business and Human Rights Working Group, the Organisation for Economic Co-operation and Development (OECD), Metaverse Standard Forum and the new Metaverse Initiative at WEF. Kavya currently advises over 30 global governments and several big tech corporations on cybersecurity and global policymaking to safeguard humans in emerging tech ecosystems.

Oscar Cartagena

Oscar Cartagena, **LATAM Region Liaison for XRSI**, is an entrepreneurial professional with 25 years of experience in various areas of artistic and technological fields. His expertise has a wide range, covering technical, artistic and commercial aspects of various business verticals linked to technology. His current focus is the XR industry and its potential to transform Chile (and Latin America) into a creative powerhouse. His experience as a technological entrepreneur is long-standing, and over the years he has helped multiple Startups and consolidated companies to materialize their ideas through strategy, branding, marketing and/or creative implementation of technology. As a professional, he has been part of international award-winning teams (3

PROMAX BDA in NYC, 1 ACHAP in Chile) and has collaborated with major companies such as Sony Pictures Entertainment, AXN, Animax, Canal E!, New Balance, Coca-Cola , Fanta, FIAT, Soprole, Lenovo, Philips, SURA, ENEL, among others. He currently holds the role of Founder and President of the Chilean Association of Immersive Experiences (ACHEX), a non-profit trade association focused on XR (Augmented, Virtual and Mixed Reality) technology companies in Chile; in order to promote the local XR industry, creating standards and common space with academics and politicians, to properly channel the industry, the needs of creators, companies and eventually the positioning of Chile as a leader of these technologies in the region.

Bhanujeet Choudhary

Bhanujeet Chaudhary (Bhanu), **XRSI's Chief of Staff**, is a strategist with more than 7 years of experience and tremendous working knowledge of technology and operations. Bhanu is the Chief of Staff of XRSI and is passionate about creating a sustainable future using emerging technologies. Around the age of 20, while helping his father with environmental analytics and reporting, Bhanu realized the potential of technological solutions for the future of the planet Earth. Ten years later, Bhanu finds himself utilizing innovative technologies to help build safety and inclusion in various domains intersecting with the immersive ecosystem. The mindset of creating a sustainable future is what drives Bhanu and helps him navigate the uncharted territories of emerging domains. Bhanu's actual journey started a few years ago when he confronted the challenges of the climate crisis first-hand in India. Bhanu decided to move to Canada and position himself to create a global impact by utilizing emerging technologies to solve complex global challenges. The mistakes of human civilization and empathy towards fellow humans now guide him to make pragmatic decisions to help create sustainable XR and emerging ecosystems. Bhanujeet has a deep understanding of statistics, economics, psychology, machine learning, and organizational development. Fairly recently, Bhanu started using decentralized ledger technologies to create democratic decision-making apparatus for learning and development. Seeing the disparities between east and west first-hand, Bhanu aspires to learn and create inclusion and protection for all humankind. With all the resources and knowledge at his disposal, he continues his mission into the uncharted territories of XR technologies.

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