Australian Human Rights Commission

Protecting Cognition: Background Paper on Human Rights and Neurotechnology

March 2024

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Contents

Commissioner Foreword

Neurotechnology potentially offers profound benefits for both individuals and our society. From improving the quality of life for people with a disability, expanding the mind and challenging what it means to be human, this technology is truly a modern marvel.

However, as with all new and emerging technologies, human rights must be central to the development and deployment of neurotechnological products in the global market.

The Australian Human Rights Commission (Commission) is concerned that this rapidly evolving technology is not currently supported by adequate safeguards and regulation to protect people from harm and to preserve their human rights.

Our research, which has been informed by consultations and feedback with stakeholders from across the world, indicates that business, civil society, regulators and academia share concerns about how this technology is already being developed and deployed in ways that are potentially inconsistent with human rights. There are significant human rights and freedoms which may be impacted by neurotechnology and must be better protected.

The Commission has produced this background paper to inform people about what neurotechnology is, how it may impact human rights and some of the key challenges raised by the technology. This background paper is intended to spark discourse and raise the profile of human rights and neurotechnology in Australia and overseas. It is by no means a comprehensive assessment of all of the challenges posed by neurotechnology.

I look forward to civil society, business, regulators, government and academia using this resource to further their discussions about neurotechnology, and to help ensure that human rights are at the heart of those conversations. I hope that it is informative piece which stimulates debates at a policy level to spur further considerations.

Lorraine Finlay
Human Rights Commissioner

Executive summary

The rapid advancement of neurotechnology in recent years has created significant opportunities for collecting, storing and utilising neural data to understand and/or manipulate the human mind.[1] Such applications potentially have immense benefits for both individuals and the broader community. It is not uncommon to see articles about the significant positive impacts of the technology – such as people being able to walk again[2] or improving our understanding of how to treat chronic pain.[3]

However, neurotechnologies also raise profound human rights problems which may require the international community to reconsider how it approaches several human rights.

Brain implants are not a fundamentally new technology and have been used in medical procedures for some time. For example, since 1997, deep brain stimulation has been eliminating tremors associated with Parkinson's disease via electrical impulses to the basal ganglia of the brain.[4]

However, as technologies improve, the potential application of neurotechnologies multiplies. This is especially so when brain computer interfaces (BCIs) are utilised in conjunction with artificial intelligence (AI), which, in combination, is still a rapidly evolving area of experimentation.[5]

Neurotechnology, especially when used in conjunction with AI (or other forms of emerging technologies), draws into question the traditional boundaries placed around an individual's internal thoughts and processes. There is a growing body of literature and international policy which considers the need to ensure rights-based approaches that protect the human mind.

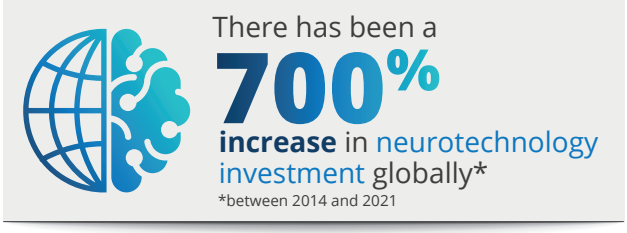
It is likely that neurotechnologies will only become more pervasive and embedded in the everyday lives of individuals over the coming decade.[6] While it is important to harness the benefits of these neurotechnologies, there must also be greater scrutiny of the legal, ethical and safety implications of their development and deployment.

This background paper seeks to stimulate discussion and advance Australia's understanding of both neurotechnology and its human rights risks. It is by no means a comprehensive analysis of every issue associated with neurotechnology. It is intended to provide a high-level 'snapshot' of current issues and challenges which must be considered.

1. Background and context

It is increasingly important to discuss the challenges associated with neurotechnology as investment and interest in the field is accelerating.

With one in eight people living with a neurological disorder, neurotechnology can assist many people when used in medical applications.[7] There is also a growing market of consumer-oriented neurotechnological products.



Between 2014 and 2021, there has been a 700% increase in neurotechnology investment globally.[8] The broad range of potential applications of neurotechnology increases its viability as an investment option.

The United Kingdom's (UK) Information Commissioner's Office (ICO) cites the Regulatory Horizons Council's prediction that the neurotechnology market could be valued at $17.1 billion USD by 2026, with the largest segments being neuromodulation, neuroprosthesis and neurosensing.[9]

Many governments are also investing heavily in neurotechnologies as organisations compete to innovate, scale and secure market share. The industry is greatly assisted by government initiatives – such as the United States (US) government's BRAIN Initiative and the Human Brain Project by the European Union (EU), which will contribute $6.6 billion USD and €1.19 billion respectively.[10] Further:

- China plans to invest $1 billion USD until 2030 in the China Brain Project[11]
- Japan plans to invest ¥40 billion JPY in its Brain Initiative[12]
- Canada invested $267 million CAD in the Canada Brain Research Fund in 2021[13]
- Spain has provided for a €200 million EURO investment in its National Center for Neurotechnology[14]
- UK invested €98 million EUROS in research funding for neurotechnology between 2011 and 2020.[15]

However, it is not just the international community that is delving into the neurotechnological industry. In 2016, the Australian Brain Alliance was established with the support of the Australian Academy of Science.[16] From 2016 to 2020, Australia's public investment in neurotechnology totalled $350 million USD.[17] However, the Australian Academy of Science is currently advocating for an Australian Brain Initiative (comparable to initiatives in other countries) with a proposal for $500 million in funding across five years.[18]

Additionally, Australia is host to one of the top five BCI companies by total investment. As of 2021, NeuroTech Analytics placed Synchron as the second largest by total investment at $130 million USD – behind only Neuralink at $363 million USD.[19]

Synchron works on implantable BCI devices, and is an endovascular BCI leader.[20] Synchron is developing the 'Stentrode' which can be inserted into the brain via blood vessels and used for controlling computers and treating neurological disorders such as paralysis.[21]

In July 2022, Synchron was the first company to utilise an endovascular BCI approach in the US after successful implantation. This will have significant implications for the scalability of neurotechnology as this approach does not require open-brain surgery.[22]

Beyond Synchron, there are also a dozen other private sector companies in Australia that have been identified as operating in the neurotechnology sector, with Australia being placed in the top 10 countries world-wide in terms of the number of neurotechnology organisations.[23]

Despite the success of Australia's neurotechnology industry and the current proposals to establish an Australian Brain Initiative, there has been no Australian institutional responses to the human rights implications of neurotechnologies.[24] This has led to direct criticism of Australia's responses to human rights and neurotechnology as being under-theorised. It has also been noted that Australia lacks a sufficient response from the appropriate regulatory or human rights institutions on how to mitigate the potential harms of neurotechnologies.[25]

1.1 Definitions

Neurotechnologies

This background paper adopts the following definition of neurotechnologies:

> … those devices and procedures used to access, monitor, investigate, assess, manipulate and/or emulate the structure and function of the neural systems of natural persons.[26] They are meant to either record signals from the brain and 'translate' them into technical control commands, or to manipulate brain activity by applying electrical or optical stimuli.[27]

Broadly speaking, there are three central types of neurotechnology:

- devices which monitor brain activity
- devices which intervene in brain activity
- devices which are a combination of the preceding two types. [28]

Brain-computer interfaces

At the core of neurotechnologies are BCIs.[29] BCIs are devices which connect an individual's brain to a computer or device (e.g. a smartphone, computer etc.) external to the human body. BCIs facilitate bi-directional communication between the brain and an external device – either transmitting neural data or possibly altering neural activity.[30] This can operate either by implantation inside of a person's skull or via a non-implantable wearable device.[31]

A non-implantable BCI will generally sit on an individual's head – often in the form of wearable technology, such as helmets, glasses and wristbands. It is these less invasive wearable BCIs which currently dominate the consumer neurotechnology market.[32]

Such technology may assist people with expressive or communicative disabilities to better communicate by decoding images in a person's mind.[33] These devices have already been used to successfully share images and words between people in different rooms via non-implantable BCI devices – enabling individuals to effectively exchange thoughts.[34]

Some BCIs are implanted via surgery inside of a person's skull and placed directly on the surface of the brain.[35] These electrodes then send neural data to a computer for analysis and decoding. Implantable BCIs are not new and have been utilised in medicine for some time. For example, deep brain stimulators have been used to assist people with Parkinson's disease to regain mobility.[36]

1.2 Consultations

The Commission has long engaged with the intersection between human rights and technology (most notably in its 2021 Final Report). As the Commission continued to engage in this space, it became increasingly aware of the pertinent human rights risks associated with neurotechnologies. This led the Commission to focus on neurotechnologies throughout 2023 and 2024.

The positions presented in this background paper are those of the Commission, informed by the views and opinions expressed by participants throughout consultation processes in relation to this paper and a previous submission in 2023. The scope of this background paper was significantly influenced by the consultation process. This background paper is not a substantive analysis of all issues and impacted human rights – only those canvassed during consultations. Some issues are considered in detail, while others are not.

The consultations were held with business, government, regulators, civil society and academia in both written and oral formats. Across 2023, 47 participants gave feedback in discussions with the Commission while a further 22 provided written input.

2. Introduction to neurotechnology

The rapid advancement of neuroscience and neurotechnology in recent years has created opportunities for collecting, storing and utilising neural data to decode and/or alter neural activity.[37] Such applications potentially have significant benefits for both individuals and the broader community. It is not uncommon to see articles about positive impacts of the technology, such as people being able to walk again[38] or improving our understanding of how to treat chronic pain.[39]

Brain implants are not a fundamentally new technology and have been used in medical procedures for some time. For example, since 1997, deep brain stimulation has been eliminating tremors associated with Parkinson's disease via electric impulses to the basal ganglia of the brain.[40]

However, as technologies improve, the potential application of neurotechnologies multiplies. This is especially so when BCIs are utilised in conjunction with AI which, in combination, is still an emerging area.[41]

For example, a recent experiment has seen the integrated use of neurotechnology and large language models to translate brain activity into words.[42] In this experiment, AI was capable of translating private thoughts into readable language by analysing fMRI scans, which measure the flow of blood to different regions of the brain.[43]

As part of this experiment, participants listened to a recording while undergoing fMRI scans. Researchers were interested in how closely the AI translation reflected the actual recording. While most of the words were out of place, the basic meaning of the passage was largely preserved. Effectively, the AI was paraphrasing.

The original transcript of the recording stated:

> I got up from the air mattress and pressed my face against the glass of the bedroom window expecting to see eyes staring back at me but instead only finding darkness.[44]

The decoded brain activity produced:

> I just continued to walk up to the window and open the glass I stood on my toes and peered out I didn't see anything and looked up again I saw nothing.[45]

However, international focus goes beyond neurotechnology utilising AI:

- There have already been proof-of-concept studies demonstrating brain-to-brain interaction facilitated by neurotechnology.[46]
- Scientists have recorded the neural activity of individuals watching movies, and using that neural activity, managed to play back hazy images of the movie.[47]
- Human brains have been directly connected to cockroach brains. This allowed the human to control certain behaviours, such as steering their paths by thought alone.[48]
- Invasive BCIs can also be used to control the actions of laboratory animals such as mice. While a mouse was engaging in a task, such as eating food, a BCI recorded its neural data. That data was then used to reactivate and stimulate the same parts of the brain that were previously recorded. This caused the mouse to eat again – even if it did not want to eat.[49]
- Researchers have found ways to use BCIs to implant artificial memories or images into a mouse's brain – generating hallucinations and false memories of fear.[50]

These are just a few examples of the increasing sophistication of neurotechnology. However, they also demonstrate that neurotechnologies inevitably raised significant concerns regarding possible human rights violations.[51] For example, if mice can be controlled, could the technology be used to manipulate human thoughts and actions?

Neurotechnology, especially when used in conjunction with AI, draws into question the traditional boundaries placed around an individual's internal thoughts and processes. There is a growing body of literature and international policy which considers the need to ensure that human rights frameworks protect the mind of an individual.

It is likely that neurotechnologies will only become more pervasive and embedded in the everyday lives of individuals over the coming decade.[52] While it is important to harness the benefits of neurotechnologies, there must also be greater scrutiny of the legal, ethical and safety implications of its development and deployment.

Government, academics, policymakers and civil society are starting to work towards protecting the human mind from the human rights risks. However, despite significant discourse in this field there are divergent opinions.

2.1 Protecting the human mind

There are three broad approaches to protecting the human mind from the adverse impacts of neurotechnologies according to the relevant literature.

The first school of thought claims that it is necessary to create novel human rights which specifically protect the brain. This is on the basis that existing fundamental rights and freedoms are insufficient to protect against the misuse of neurotechnology. When traditional rights and freedoms were introduced, the ability to monitor, store and alter neural activity was science fiction, barely conceivable as being real. Accordingly, new rights may be necessary due to the impact of neurotechnologies.[53] The proposal of novel rights has generated lively debate as many question their necessity, effectiveness and if it might lead to 'rights inflation'.[54]

The second school of thought provides that adaptive interpretations and applications of existing rights and freedoms are required to protect the brain. Those proposing such an approach generally agree with the view of the first school of thought, that existing rights and freedoms in their current form and application offer inadequate protection. However, these advocates believe it is preferable to further interpret existing human rights law to ensure protection from the misuse of neurotechnologies. There are certainly existing rights, provided for by international human rights law and various regional bodies, which can be positioned to address neurotechnologies, with the right to privacy, the right to freedom of thought, and the right to bodily integrity being clear examples.[55]

The final group considers that no novel rights or new interpretations are necessary to protect the human mind. This position is largely outdated and rarely raised.[56]

2.2 Neurorights

'Neurorights' is an umbrella term often taken to encompass several rights related risks to the human mind.[57] There is no consensus across civil society or academia on the exact content of these rights or their mode of application (i.e. if they should be embedded as new human rights or via further interpretation of existing rights).[58] Several bodies are considering ways in which international neurorights can best protect the human mind, most notably the United Nations Advisory Body to the Human Rights Council's inquiry into neurotechnology and human rights.

While existing human rights already protect against the misuse or abuse of neurotechnologies in certain ways, novel 'neurorights' raise questions about the sufficiency of these existing rights.[59]

The question of whether it is best to introduce novel neurorights or to adapt existing human rights requires careful consideration. One key risk of introducing new rights is that it may contribute to the phenomenon of 'rights inflation' which threatens to dilute the core idea (and universal nature) of human rights.[60]

It has previously been suggested that existing treaties do not offer the robust and comprehensive human rights protection that a neurotechnological world requires. Instead, they advocate that today's era calls for a novel protective framework of neurorights.[61]

Given the profound ways in which neurotechnology can change the way people live, there has been great attention paid to how the boundaries of the brain and mental lives of people can be protected.

The Universal Declaration of Human Rights (UDHR) provides a set of agreed fundamental rights and freedoms to guide how all humans should treat others and be treated. Since its adoption in 1948, it has been followed by binding international human rights instruments, such as the International Covenant on Civil and Political Rights (ICCPR), which has been adopted by 173 countries, covering 90% of the world's population.[62]

Since 1948, technology has redefined how humans live and interact with one another. While much of this usage has led to improvements in quality of life, the widespread adoption of digital technologies also brings significant challenges, including challenges to human rights.

Neurotechnology poses an especially novel risk to human rights as it can leap the boundary between the external world and the internal human mind, invading our private emotions, thoughts and memories. The brain is what makes us who we are as individual human beings. While neurotechnologies present many opportunities for scientific and medical breakthroughs, human rights must be protected, as this technology poses special risks because of its interaction with the human brain.

The real challenge of this technology will be how to create frameworks and guardrails to protect against human rights violations – responding to the current risks posed by the technology, and forward thinking and flexible enough to adapt as the technology improves.

The neurorights of mental integrity and mental privacy are partly protected by international and regional instruments such as the:

- ICCPR
- American Convention on Human Rights (ACHR)
- European Convention on Human Rights (ECHR)
- Charter of Fundamental Rights of the European Union (CFR)[63]
- Model Law on Neurorights for Latin America and the Caribbean.[64]

This has been further built upon by projects to determine the prospective scope of establishing human rights in respect of thoughts, emotions, and other mental states, both now and in the future.[65] These projects have been initiated by organisations such as the:

- United Nations
- Inter-American Juridical Committee
- Committee on Bioethics of the Council of Europe
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- Organization for Economic Co-operation and Development (OECD).[66]

The significant attention being focused on neurotechnology and human rights is largely in response to the novel challenges the technology poses.[67] In one publication by Dr Allan McCay, an expert on neurotechnology and Deputy Director of the Sydney Institute of Criminology, several pertinent legal and ethical questions are posed:

> What if a person commits a criminal act by using the implanted microchip. Who would be responsible for the criminal violation? So, if another person somehow manages to control the electronic device to commit a violation, how would the courts address the legal issues? In essence, how do we regulate human mental capacity?

> There are other questions that can come up when implementing this technology. For example, could solicitors one day be instructed to use a microchip to enhance their mental capabilities? Could the courts force known offenders to use special microchips, so their brain activities are monitored and controlled by a government agency?[68]

There has been serious consideration of the application of neurotechnology in the criminal justice system. Academics have questioned whether the police may use neurotechnology to analyse neural data and make inferences about suspects and witnesses (such as truthfulness) in their investigations. Some have gone further and raised concerns that neurotechnologies may be used in sentencing and post-imprisonment conduct:

> For example, a closed-loop device could be used to monitor the brain of an offender and intervene upon it in order to avert an angry outburst that might precipitate an offense.[69]

Issues such as these have led to a global discussion on protecting the human mind from neurotechnology:

- Chile has worked to introduce protections into its national legal system via constitutional amendment.[70]
- Spain has included 'neurodata' specific sections in its Digital Rights Charter.[71]
- The United Nations, Inter-American Juridical Committee and the Council of Europe are all exploring whether existing human rights and freedoms provide sufficient legal protection from neurotechnologies.[72]
- UNESCO has published an initial report on the risks and challenges of neurotechnologies for human rights.[73] In 2023 it produced a follow up report.
- The UK ICO recently published a paper on neurotechnology.
- The UN Human Rights Council has adopted a resolution to commission the Human Rights Council to produce a report on neurotechnology and human rights.
- There has also been a suite of ethical guidelines produced by different bodies globally which act as 'soft law' to complement legislative frameworks.[74]

While there is much discussion surrounding different neurorights, it is illustrative to consider mental privacy and mental integrity in further detail.

Mental privacy

Vint Cerf, Vice President and Chief Internet Evangelist at Google, once stated that 'privacy may actually be an anomaly'.[75] In a world of heightened data collection and surveillance, it seems possible that this statement will increasingly reflect reality as neural data becomes the next piece of personal data to be harvested by organisations seeking to monetise it.

Mental privacy refers to the right to private thoughts, feelings, memories, emotions and neural data.

There is already significant commentary and calls for legislative reform about how to protect personal information online,[76] which may well extend to a consideration of the protection of neural data.

Neural data will likely give companies, governments and other actors the ability to make inferences about users of neurotechnologies. This could extend to their predisposition to neurological and psychiatric conditions or future behaviour.[77] Such insights would, in the future, put those with access to the neural data in a powerful position to manipulate people either through direct intervention through neurotechnologies or by utilising the neural data to push people subversively towards certain decisions.

It is well known that algorithms can make inferences about people, and suggest content they are most likely to engage with.[78] While problematic, this issue will be exacerbated if such tailored content or 'nudges' are made on the basis of neural data in the future. It has been argued that such breaches of mental privacy could result in manipulation or even physical harm to users.[79]

There is also a risk that a person utilising neurotechnology could have their device hacked.[80] This raises the emerging possibility of a neurotechnological device being co-opted to access or alter the device or neural information of a user.[81] The risk of 'hijacking' a neurotechnological device could lead to users being exploited, threatened or harmed. Greater security and protection of private neural information would go far in addressing such risk.

While there is no recognised express right to mental privacy, a person's feelings, thoughts and mental states may obtain implicit protection under the rights to:

- privacy
- freedom of thought
- freedom of expression.

Mental integrity

Where the right to bodily integrity protects against interference with one's body, the right to mental integrity protects against interference with one's mind.[82] Some argue that the mind is already protected by way of the brain being contained within the body, and propose that an additional protection for the mind would be superfluous.[83]

However, neurotechnology can enable interference with the mind, without interfering with the body. For example, non-implantable BCIs may interfere with brain activity and behaviour in intrusive ways, severely violating one's right mental integrity. However, because non-implantable BCIs are often wearable and non-intrusive, they may not violate the right to bodily integrity despite having serious impacts on a person's mind.[84]

Unlike the right to mental privacy, the right to mental integrity has been recognised by various human rights instruments.

Article 17 of the Convention on the Rights of Persons with Disabilities (CRPD) states that:

> Every person with disabilities has a right to respect for his or her physical and mental integrity on an equal basis with others.

Further, article 5(1) of the ACHR states:

> Every person has the right to have his physical, mental, and moral integrity respected.

Article 8 of the ECHR states:

> Everyone has the right to respect for his private and family life, his home and his correspondence.
>
> There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.

Jurisprudence of the European Court of Human Rights has recognised the right to mental integrity alongside the right to bodily integrity within article 8 of the ECHR.[85]

The Charter of Fundamental Rights of the European Union (CFR) article 3(1) states:

> Everyone has the right to respect for his or her physical and mental integrity.[86]

Despite being recognised by multiple instruments, the exact scope of the right is unclear. However, the EU Network of Independent Experts on Fundamental Rights (set up by the European Commission) has determined that the right to mental integrity pursuant to article 3(1) CFR is a broad right.[87]

3. Human rights impacted by neurotechnology

Although there are a diversity of existing human rights which will be affected by neurotechnologies, this background paper focuses on three key rights: the right to privacy; freedom of thought, conscience and religion or belief; and the right to equality and non-discrimination.

3.1 Right to privacy

Neurotechnologies challenge what is 'private' in terms of the mind.

The right to privacy is a cornerstone human right. As noted by the Office of the Australian Information Commissioner (OAIC), it also underpins freedoms of association, thought and expression, as well as freedom from discrimination.[88]

The right to privacy developed over centuries. For example, in the fourth century BCE, Aristotle drew the distinction between the public sphere of politics and the private sphere of domestic life. Thousands of years later, the 'fourth industrial revolution' is characterised by rapid technological development.[89] These changes have arguably reinforced the central importance of the right to privacy.

The right to privacy, in respect of neurotechnology – because of the ability to examine neural data – has become of such interest that the UK ICO recently published a paper ICO Tech Futures: Neurotechnology on the risk to privacy.

Human rights instruments

Article 12 UDHR states:

> No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honor and reputation. Everyone has the right to the protection of the law against such interference or attacks.

Similarly, article 17 ICCPR states:

> No one shall be subjected to arbitrary or unlawful interference with his privacy, family, home or correspondence, nor to unlawful attacks on his honour and reputation.
>
> Everyone has the right to the protection of the law against such interference or attacks.

The right to privacy is also protected in many other international instruments.[90] The UN Human Rights Council also indicates that privacy is of increasing importance in a digital age where:

> Digital tools can be turned against them, exposing them to new forms of monitoring, profiling and control.[91]

Mental privacy will be of ever-increasing concern as neurotechnologies and related technologies (such as AI) improve, and organisations and governments are better able to commercialise the collection, maintenance and usage of neural data.

Risks to privacy

Neural data is more sensitive and valuable than all other categories of personal data because of the unprecedented ability to access internal thoughts.[92] The collection of neural data may, in the future, make it possible to track, analyse and predict the actions and attitudes of individuals about anything from political leaning, sexual orientation or health status.[93] This makes the risk to privacy of the utmost concern.

Neurotechnology products record vast quantities and varieties of neural data which may be accessed, collected, stored and used/exploited without genuine consent.[94]

The usage of such neural data could range from marketing companies using 'nudging' techniques to steer users towards certain products, employers seeking to monitor employee concentration in the workplace or more recently schools seeking to ensure children are paying attention and learning in class. The risks become more serious when considering the usage of neural data by governments – especially those with poor human rights records.

It has also been suggested that the decoding of neural data will one day be able to reveal additional information such as, for example, someone's sexual orientation, leading to possible discrimination and prejudicial treatment.[95] It is also possible that other personal information, such as political affiliations or religious commitments, could be inferred from neurotechnologies in coordination with other technologies. Sexual orientation is used below as an example of the risks.

The 2020 update of the Global Legislation Overview of the State-Sponsored Homophobia Report concluded that there were 67 Member States with provisions criminalising consensual same-sex conduct, and six UN Member States that continue to impose the death penalty for consensual same-sex conduct.[96] This is in addition to the many countries where individuals continue to face persecution and violence on a daily basis because of their sexual orientation or gender identity.

If mental privacy is not protected, the technology could one day lead to a widespread ability to identify, isolate and even kill people based on an assessment of their perceived sexual orientation.

Further, the potential inaccuracy of such neurological tools (particularly in their early development) does not reduce the risk of persecution and violence against individuals who might be targeted by this technology – whether on the basis of sexual orientation or other characteristics.

Although the collection, maintenance and usage of neural data raises ethical questions in isolation, there are concerns about how this information will be used in tandem with other forms of personal data. For example, the gathering of seemingly small and innocuous pieces of personal data (browser history, location, purchase history etc) can, accumulatively, provide a detailed profile of an individual – dubbed the 'mosaic effect'.[97]

Many wearable devices, such as smart watches, now record bodily functions and are openly accepted by consumers. While this allows for the collection of information such as heart rate, geolocation and movement, with the inclusion of neural data this will also allow sensitive personal information to be extracted or inferred about a person on an unprecedented scale.[98] Although only a very small percentage of brain scans can currently be decoded, the rapid advancement of AI (and other forms of technology and data) will likely see this increase.

Privacy models

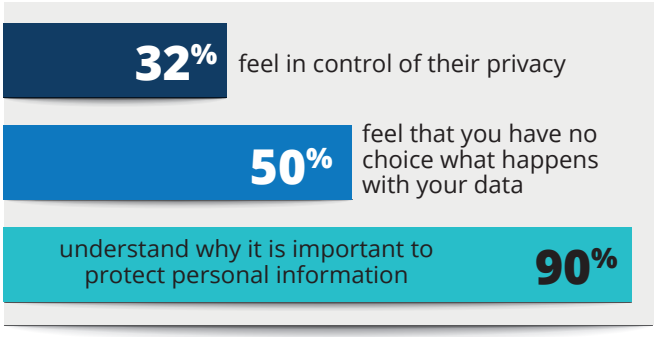
When considering neural data, a privacy model which places the onus on individuals to be responsible for the protection of their data, and to make informed decisions, is insufficient due to the heightened importance of that information.

The Commission's concern is predicated upon several matters:

- the 'privacy paradox'
- lack of competition/alternatives which are more data secure
- the illusion of choice
- power imbalances.

The 'privacy paradox' refers to the phenomenon that, despite understanding the privacy risks of a product or service, those risks have no obvious influence upon an individual's behaviour.[99] Namely, individuals will still engage with privacy-adverse products and services even where they are highly aware of the risks. Even though there will be very few people who understand the privacy risks associated with neurotechnology (given its complexity and emerging penetration into consumer markets), this does not mean that those who do understand the risks and still utilise neurotechnology do not care about their privacy.

For example a recent comprehensive survey conducted by the OAIC found that 9 in 10 people have a clear understanding of why it is important to protect personal information.[100] Yet only 32% said they feel in control of their privacy, and half of those surveyed believed that if they want to use a service, they have no choice but to accept what the service does with their data.[101] This data serves to highlight that people care about their privacy, but they feel unable to appropriately protect it when using technology.



Even when aware of privacy risks, and disapproving of those risks, individuals are often unwilling (or unable) to stop using appliances or services which threaten their privacy.[102]

This reluctance, or inability, to avoid products or services which threaten privacy may be partly the result of ineffective competition. The Australian Competition and Consumer Commission (ACCC) considers that where there are few (or no) comparable alternatives available, or consumers feel compelled to use the service because their social or work networks are using them, consumers may feel compelled to accept undesirable terms of use.[103] These undesirable 'take-it-or-leave-it' terms can involve the unwanted collection and use of consumers' data.[104]

Effective competition, in combination with effective regulation of privacy and data collection, may encourage organisations to compete based on the level of privacy and data protection they offer. This may become a catalyst for the introduction and adoption of more privacy-focused and security-focused business models that reflect consumers' data preferences, rather than the preferences of large organisations.[105]

A lack of competition may leave individuals with very little ability to 'choose' neurotechnology services and products without risking privacy.

The traditional model of privacy regulation places great emphasis on informed 'choice' as an effective safeguard for data and privacy.[106] However, the privacy paradox and numerous behavioural studies demonstrate that placing the onus on individuals to protect their own data is insufficient.[107]

Such a model also does not acknowledge the substantial power difference between large companies and individual consumers – especially where mental augmentation may vastly improve quality of life for consumers or patients. Even where an individual understands how their data will be used, this power imbalance remains, as 'one party controls the design of applications and the other must operate within that design'.[108]

Even where individuals do not genuinely understand how their data is being used (as will increasingly be the case as consumer neurotechnologies are more widely adopted), people will still generally disapprove of its misuse. Individuals have been shown to have a very strong negative reaction when confronted with the difference between:

- how their data is actually being used and
- their perception of how it is being used.[109]

This is particularly the case where the difference becomes explicit and too contrasting.[110] For example, many consumers willingly shared data on Facebook, however when the use of that data by Cambridge Analytica came to light, there was public outcry, with Facebook being required to appear at hearings before both the US congress and UK Parliament.[111]

The privacy paradox, illusion of choice and power imbalances may all contribute to individuals being unable to utilise neurotechnology without relinquishing their privacy.

The Consumer Policy Research Centre in its In whose interest? Why businesses need to keep consumers safe and treat their data with care (Working Paper) put forward two alternative approaches to protecting data in Australia.

The Working Paper canvasses the creation of a duty of care or best-interest duty, which would operate similarly to fiduciary duties in the finance sector to hold businesses accountable for how they collect, share and use consumer data.[112]

The Working Paper also advocates for a Privacy Safety Regime which:

> … utilises concepts from product intervention powers and product safety interventions, proposing options that would allow governments and regulators to stop or limit obviously harmful uses of data as well as a process for regulators to proactively restrict and test new harmful practices as they evolve.[113]

It is an open question as to which alternative approach would be most effective or how such a model would protect privacy in an age of technology – but one which may require careful consideration moving forward.

3.2 Freedom of thought, conscience and religion or belief

Neurotechnology will potentially challenge what it means to have freedom of thought and agency over our own lives. The application of neurotechnologies have the potential to decipher and alter perceptions, behaviours, emotions, cognition and memory – all fundamental aspects of what makes people who they are.[114]

This has the potential for the technology to manipulate people's beliefs, motivations and desires.[115] This has led to disquiet about the possibility of novel forms of sophisticated 'mind control' in the future – highlighting the need to better protect freedom of thought. As is noted by UNESCO when discussing freedom of thought in this context:

> It is noteworthy that freedom of thought is not to be understood here merely in the traditional sense that people should be free to express their opinions or beliefs (*forum externum*), but in the literal sense of the freedom to think by themselves without being monitored by others (*forum internum*).[116]

While there is a well-articulated field of discourse on the freedom of thought, it appears that neurotechnology has not been given express consideration.[117]

Article 18(1)-(2) ICCPR state:

> Everyone shall have the right to freedom of thought, conscience and religion. This right shall include freedom to have or to adopt a religion or belief of his choice, and freedom, either individually or in community with others and in public or private, to manifest his religion or belief in worship, observance, practice and teaching.
>
> No one shall be subject to coercion which would impair his freedom to have or to adopt a religion or belief of his choice.

Despite article 18(2) expressly stating that a person shall not be subject to coercion which impedes their ability to adopt a belief, there is nothing in the UN Human Rights Committee's General Comment on Article 18 that would extend to considering this in respect of neurological interference to coerce a decision – nor any mention of technological means of doing so.[118]

With an increasing understanding of the brain, it is possible that neurotechnologies in coordination with other technology (geotracking, data gathering etc) may one day be capable of not only coercing or manipulating a person's decisions, but also discerning their internal thoughts or beliefs. It is concerning that, despite the protection in Article 18, this could lead to persecution based on a person's belief.

3.3 Right to equality and non-discrimination

Emerging technologies (such as AI and FRT) already pose a serious risk to equality and non-discrimination, as bias and discrimination can be entrenched in algorithms.

In addition to the risk of algorithmic bias within neurotechnologies themselves, there is also the risk that neurotechnology may deepen social and economic divides in a way that violates the right to equality and non-discrimination.

Particularly, article 25 UDHR stipulates:

> Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family.

Article 2 also states:

> Everyone is entitled to all the rights and freedoms … without distinction of any kind such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status.

To prevent deepening inequality, the right to equal access to mental augmentation has been proposed by the Neurorights Foundation and the Neurotechnology Ethics taskforce.[119]

While neurotechnology devices can restore and improve brain function, these products can be expensive and limited only to those who can afford them (in particular those which are implantable and used for medical devices, as opposed to cheaper non-implantable consumer-focused products).[120] This limits access to potentially life-changing enhancements.

However, it is also worth noting that there are more affordable non-implantable consumer-oriented neurotechnology products, which are priced within a range of $300 AUD to $800 AUD.[121]

While these products must be accessible, they must also be commercially viable to reach the broadest market – a balance between the public health benefit of the technology and its commercial viability is necessary.

The cost of access to neurotechnology may deepen the equity gaps in society. For example, people with disability have higher rates of poverty[122] and may be disproportionately impacted by price. As an example, after an implanting company shut down, and its software was no longer accessible, some users incurred an approximate cost of $40,000 USD to replace their ATI-made neurostimulator implant that was rendered obsolete.[123]

Inherent bias created by the cost of more expensive products (especially those which require implantation) may cause companies to operate under a *social media business model*, which allows free services in exchange for collection and use of data. There is the potential for neurotechnology companies to similarly advertise discounted products if customers consent for them to use their neural data. Already vulnerable communities may be faced with making decisions effectively to compromise their right to privacy to access beneficial technology.

If people are priced out of neurotechnological products and services, the data collected will exclude them and any future changes made based on this data will likely be biased. As medical intervention with neurotechnology is still developing, reforms and upgrades may be made to the technology predicated on such biased data – favouring those who can afford neurotechnologies and disenfranchising those who cannot.

Harvard Researchers have discussed how algorithmic bias will be evident in any form of AI as it impacts medical data. Bias must be acknowledged and mitigated to ensure that it does not exclude, oppress or denigrate vulnerable populations.[124]

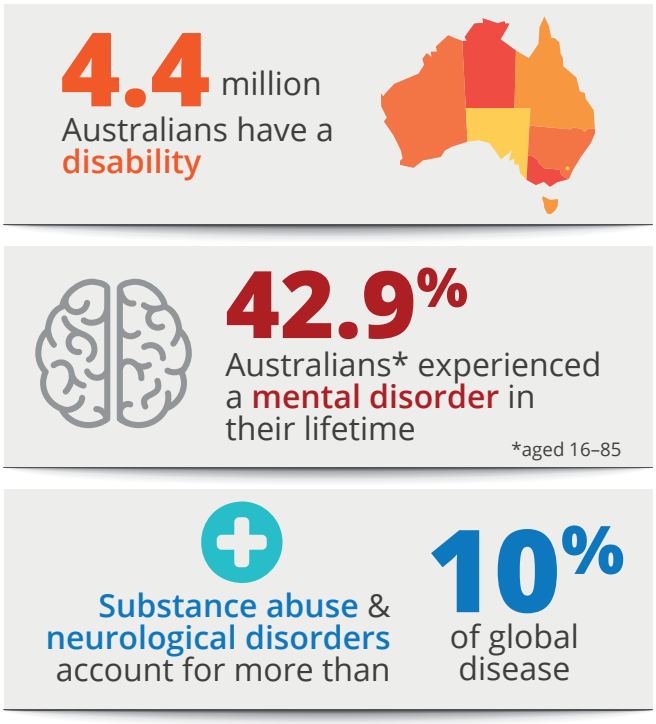
The UK ICO raises the prospect that data will largely be harvested from neurotypical people, leaving neurodivergent customers with potentially biased and ill-equipped products.[125] Discrimination may also take place if devices are not trialled on groups of people who are representative of the general population.[126] If algorithmic bias arises, affecting the use of AI in neurotechnologies, it may become embedded in neural devices. This is particularly so where neurotechnologies are used on children, people with neurological disorders or socially marginalised individuals.[127]

Regulations should be in place to ensure that researchers and companies are actively working to prevent the integration of bias into future products, services or upgrades. This can be assisted by ensuring there is regular discussion about possible biases in data collection, that researchers themselves are from diverse backgrounds, and that there is broad awareness of both potential data biases and how to prevent or mitigate data bias. This will go far in protecting the right to equality and non-discrimination.

4. Applications of existing and upcoming concern

While there are a myriad of human rights challenges associated with neurotechnology, the background paper has sought to discuss, at a high-level, a small number of the applications of neurotechnology which may raise complex human rights questions in Australia both now and into the future.

4.1 People with disability



It is estimated that approximately 4.4 million Australians have a disability,[128] with a further 42.9% of Australians aged 16–85 having experienced a mental disorder in their lifetime.[129] Substance abuse and neurological disorders account for more than 10% of global disease – with the two most common mental disorders being anxiety and depression.[130] However medical neurotechnology offers greater possibility to treat and prevent many of these conditions.

Benefits

There are numerous positive examples of neurotechnologies being used to improve the lives of people with disability. For example, medical neurotechnology has been used to restore the vision of a user who had been completely unable to see for over 16 years, allowing them to discern shapes and letters again.[131] Similarly, cochlear implants have also been used to restore functional hearing to an estimated 1 million people worldwide.[132]

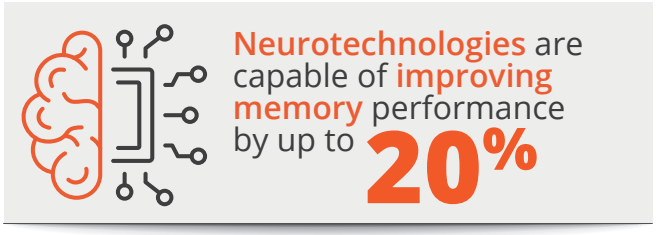
People with paralysis are experiencing quality of life improvements thanks to neurotechnology. The technology has been developed to allow devices to decode speech from brain activity, allowing people to communicate with the external world.[133]

One research participant and recipient of a neurotechnological product, Mr Copeland, highlights the potential of the technology. Mr Copeland was left a paraplegic after a car accident. He has since become the first person to control a robotic arm and recover his sensations of touch though implantation in the cortex of the brain.[134] Mr Copeland described the neuroprosethetic device as:

> Very intuitive to control, … I don't have to strain, it really is just as easy as thinking move and grasp; in that way, it is kind of an extension of myself, but I also see it as a tool that I'm controlling that is separate from myself.[135]

This has allowed Mr Copeland to play video games, fight in a 'lightsabre' duel and even shake hands with former President Barack Obama.[136]

Neurotechnology can also lead to greater understanding of how memories are stored. This has led to neurotechnologies that are capable of improving memory performance by up to 20%.[137] For patients suffering conditions such as Alzheimer's disease, stroke or head injuries, this is a promising treatment.



While the medical capabilities of neurotechnologies can benefit people with disability, people with disability are also most at risk. Neurotechnology may create a power imbalance between those seeking treatment or improvement of life and those that develop, deploy and maintain the products. Such imbalances raise further questions around true, informed and ongoing consent.

Negatives

Despite the potentially positive impacts of medical neurotechnologies for people with disability, several pertinent risks arise when engaging with the technology:

- What processes are in place to ensure that neurotechnology users, who often receive implantable BCIs, are supported for the life of the device?
- Will medical devices be funded by the National Disability Insurance Scheme (NDIS) or other schemes?
- Will there be an increased disparity between those who can afford/utilise devices and those who cannot?
- How will updates be transmitted to the implanted BCI?
- What will happen to BCIs as they become replaced by more advanced BCIs?
- How can users be protected in the event of a neurotech company's dissolution?
- Can genuine informed consent truly be obtained?

The physical health risks of implantable BCIs are well noted and physical harms are already being realised. One example is Second Sight, which provided visually impaired users with a form of artificial vision to help them see again.[138] With over 350 patients globally, this neurotechnology product initially assisted many people. However, in 2019–2020 Second Sight discontinued its product and nearly went insolvent. This resulted in some users literally having their implants 'turned off' as their artificial vision 'went dark'. While some report that the implants still worked, at this stage there is little indication that users can have the devices fixed if it malfunctions.[139]

Difficulties may also arise when an implantable device is removed. NeuroVista was a company which made a device which signalled to users when an epileptic fit was about to occur, allowing users to take measures to avoid or minimise the impact.[140] In 2013, NeuroVista ran into financial difficulties and began removing the implantable devices. One user spoke of her sense of deep trauma and grieving after having the device forcibly removed (as the device did not belong to her), claiming she would have done anything to keep it – she even attempted to re-mortgage her house to buy the device to evade removal.[141] The device had allowed her to live confidently and happily, but after its removal she stated:

> I have never again felt as safe and secure … nor am I the happy, outgoing, confident woman I was … I still get emotional thinking and talking about my device … I'm missing and it's missing.[142]

The removal, decommissioning or end of life of an invasive BCI raises issues under article 25 CRPD to the enjoyment of the highest attainable standard of health rights – especially where removal results in disability or physical or mental injury returning or being experienced in a heightened manner undesirable to the user.[143] Further, it is probable that first use cases fitted with BCIs will be monitored to develop and train future models and associated algorithms. This may enliven issues under article 15.1 CRPD which requires a user's consent to medical or scientific experimentation.[144]

A key difficulty highlighted here is that users of implanted BCIs require significant and continued support for the life of the device, irrespective of the economic viability of the product itself. This may leave people with limited support if they are left with redundant technology in their heads, with little means of seeking remittance or support.

Informed consent and impaired decision making

Article 12 CRPD recognises that people with disability enjoy legal capacity on an equal basis with others in all aspects of life. Article 12 directs State Parties to ensure that all measures relating to the exercise of decision-making capacity provide for appropriate, effective and necessary safeguards. It is critical that this be applied in the context of neurotechnological treatments.

International treaty bodies and experts, such as Special Rapporteurs, continue to recommend targeted and concrete measures to reduce and eliminate medical coercion and forced psychiatric treatment. It is imperative that the provision of neurotechnological treatments aligns with human rights obligations.

Generally speaking, inappropriate expectations about a product or device have been identified as a genuine impairment to informed consent.[145] Users of BCIs may also have pre-existing cognitive impairment which can adversely impact their ability to provide initial and continuing informed consent. More concerning is the proposition that, by way of the implantation process, associated cognitive changes may disrupt such informed consent processes.[146] A person should be supported to make informed decisions, consistent with article 12.

In the exercise of informed consent, power asymmetries at play in the context of medical decision-making need to be addressed.[147] Power imbalances can affect users as active right holders.

Informed consent is especially important in this context as it allows people to choose whether or not to engage with neurotechnology. Consent may be illusory when people with disability must make a choice that is starkly binary: either consent to the conditions set, or do not receive the technology.

The issues surrounding consent are further complicated by the question of whether neurotechnical procedures are classified as medical treatment or mental health treatment – as differing laws apply to the two applications. Where treatment is for 'mental health' purposes, it is more readily permissible for treatment to be provided on an involuntary basis.[148]

Many people who are considered 'neurodivergent', or someone with disability, may not consider neurological treatment necessary or desirable. The medical profession should respect their needs and desires. It should not be assumed that all people with disability are in need of treatment, or wish to be treated.

In addition to being provided with the necessary supports in decision-making, any treatment provided to people with disability/mental health disorders should align with a recovery-based model and preferably be provided in a community setting. The Special Rapporteur on Health has previously recommended concerted efforts continue to be exercised globally to shift mental health care away from the predominant medical model.[149]

People with disability must not be presumed to lack decision-making ability on the basis of having a disability. All people should be provided with the appropriate supports to exercise their legal capacity, and a person's decision-making ability must be considered in the context of available supports. In practice, this would mean that a person is considered to have decision-making capacity if they can exercise that capacity with the provision of supports. Supported decision-making is encouraged to support people with disability to make, communicate and participate in decisions that affect their lives.[150]

Given the risks associated with informed and impaired decision-making, stringent risk assessments must be conducted before implantation or usage of neurotechnical devices to minimise the harms discussed throughout this background paper (noting that there are also other potential harms not discussed here that should also always be taken into account).

Where a device is implanted, surgery should not be performed unless an individual is aware of the possible consequences of implantation. Legislation relating to the exercise of decision-making capacity in the context of treatment provision must include necessary safeguards. Where possible less invasive means of implantation should be utilised where the same goals can be achieved.

These examples show that there are serious risks associated with the medical usage of neurotechnology for people with disability (especially those with implanted devices). However, people with disability will also face similar risks (noted throughout this discussion paper) especially in relation to bias and privacy, regardless of their use of medical or consumer-oriented neurotechnologies.

4.2 Children and young people

Young people and children may be especially vulnerable to any side effects of long-term use of neurotechnologies as their minds are still developing. The best interests of children must be central to any use of neurotechnology, in alignment with article 3 of the Convention on the Rights of the Child (CRC).

Education

Neurotechnologies may be used in the education sector with the aim of improving concentration in class and academic performance.

One example of this was a trial conducted in China where primary school children were required to wear non-implantable BCI headsets which recorded concentration levels during class.[151] The collected neural data was stored on a teacher's computer and later shared with parents.[152]

The UK ICO notes that there is increasing interest in the use of neurotechnology in the education sector. It further notes the likelihood in the long-term (five to seven years) of the higher education sector using BCIs to monitor student concentration and stress levels, and to further improve cognitive processes to boost student performance.[153]

Education is not the only application of neurotechnology for children. Virtual and augmented reality systems can also be supported by brain control for educational and entertainment purposes.[154] With the advent of immersive technologies, it can be expected that the interaction of children with neurotechnologies will only increase.

The rights of children

Online privacy and safety measures in respect of neurotechnology should be developed in accordance with article 3 of the CRC, which requires that the 'best interests' of the child be a primary consideration in all actions concerning them. This is one of the four guiding principles of the CRC and should be a primary consideration in digital environments.[155]

When considering the best interests of the child, regard should be had to 'all children's rights, including their right to seek, receive and impart information, to be protected from harm and to have their views given due weight', in addition to ensuring transparency over the criteria applied to determine best interests.[156] Where rights are limited to protect children from online harms, limitations must be lawful, necessary and proportionate. Maximising children's privacy and securing their personal data is itself a 'crucial means of acting in their best interests'.[157]

Children's privacy should not be construed narrowly to relate only to data protection measures; and should recognise the importance of children's autonomy and choice over their private lives. As detailed in part 4 of General Comment 25, digital service providers, which would extend to providers of neurotechnology, should be offering services which are appropriate for children's evolving capacities. The risks involved with children's engagement with neurotechnology depend heavily on their age and stage of development and includes a greater deal of independence from parents at increasing ages. Designing 'age appropriate' neurotechnology should draw upon the best and most up-to-date research available to accommodate any child regardless of their age or capacity.[158]

A best interests approach may require implementation of clear boundaries to prevent practices that both infringe upon children's rights and are contrary to their best interests, including by curtailing routine and indiscriminate digital surveillance measures.[159]

Protecting children's rights in online spaces and virtual worlds is a complex and multifaceted challenge that requires a combination of legal, technological, educational and parental approaches. Key strategies should be designed as a shared responsibility involving governments, technology companies, parents, children and society as a whole. It requires a proactive and multidisciplinary approach to ensure that online spaces remain safe and enriching environments for children to explore and learn while protecting their well-being and rights.

Neuromarketing and children

The rise of targeted marketing and the negative impacts such advertising can have on children is well reported – such as increasing problems such as obesity, early alcohol consumption or smoking cigarettes or e-cigarettes.[160]

The Special Rapporteur on the right to privacy estimated that:

> The online advertising market for children could be worth 1.7 billion by 2021, with more than 72 million pieces of data collected for each child by online advertising companies before the child reaches the age of 13.[161]

However, the use of neurotechnologies to collect neural data which can be sold and used by companies to advertise to children could one day allow microtargeted advertising on a scale and impact not yet seen, with serious effects on children and young people as their minds and sense of self develops.

Neuromarketing is a technique which can involve embedding subliminal stimuli with the intention of eliciting a desired response (e.g. someone choosing one product over another) without people consciously being aware.[162]

The UN Committee on the Rights of the Child's General comment No. 25 (2021) on children's rights in relation to the digital environment states:

> Practices that rely on neuromarketing, emotional analytics, immersive advertising and advertising in virtual and augmented reality environments to promote products, applications and services should also be prohibited from engagement directly or indirectly with children.[163]

4.3 Immersive technologies

New and emerging immersive technologies (such as those being capable of facilitating the emergence of renewed virtual worlds like the metaverse, virtual reality, augmented reality, haptic devices etc) provide organisations with increased opportunities to accumulate and utilise the personal information of users – including neural data.[164] The risk of invasions of privacy, safety and security for people in such immersive technologies (inherited from underlying technologies or emerging from the new digital ecology) may be wide-sweeping,[165] including:

- the management of massive data streams
- pervasive user profiling activities
- unfair outcomes of AI algorithms
- mental health implications
- safety of physical infrastructures and human bodies[166]
- cyberbullying
- assaults, sexual exploitation and abuse
- violent extremism.[167]

The personal data involved in immersive worlds will likely be 'more granular and unprecedentedly ubiquitous to build a digital copy of the real world'.[168] This is especially the case as technologies in the metaverse may collect and process data such as brain wave patterns.[169]

It is likely that there will be an increase in the use of neurotechnology to connect brain waves to gaming and metaverse experiences to allow for immersive experiences for users.[170] Neuro feedback, as an example, could provide organisations with real-time information about users' brain activity, which is collected while users engage in virtual experiences and interact with different stimuli. BCIs could be used to collect data related to neural activity, such as electroencephalogram (EEG) signals. EEG can be used to monitor brainwaves and potentially detect patterns related to emotions, thoughts and cognitive states.

The UK ICO has noted that neurotechnology is being used for games which allow players to operate drones remotely via neurotechnology.[171] It is expected that there will be greater uptake of such technology for gaming in the medium term (four to five years), with more significant uptake in the use of neurotechnology of modulating technologies aimed at gaming.[172]

4.4 Military applications

As with many new and emerging technologies, military forces around the world are beginning to pay close attention to neurotechnologies. Military applications of neurotechnologies can broadly fall into three categories:

- BCIs
- neurotechnical enhancement
- neurotechnological systems for deception, detection and interrogation.[173]

The application of this technology could be used for a range of purposes, including treating personnel for physical and psychiatric injury, enhancing a combatant's effectiveness by improving cognitive and emotional capacities, or even permitting neural remote control of weapons.[174]

The experimental use of such technologies has increased in the past decade.[175] For example, the Defence Advanced Research Projects Agency (DARPA), a research agency of the United States Department of Defence, has a number of current programs being conducted within its neuroscience research portfolio.[176]

The UK Ministry of Defence has claimed that brain interfaces could allow for the manipulation of the physical world by thoughts alone – such as opening a door handle to an aircraft from anywhere in the world.[177] Lieutenant Colonel of the United States Air Force, Brian Moore has even predicted that BCIs have 'the potential to revolutionise military dominance much the same way nuclear weapons have done'.[178]

The application of such technology in warfare is concerning, but so too is its use on military personnel. In military settings, there will be particular concerns surrounding consent and vulnerability in adopting neurotechnologies due to the hierarchical nature of military service.[179]

These issues are of direct relevance in Australia with the Australian Army previously trialling BCI technologies in 2022.

4.5 Crime and criminal justice applications

The application of neurotechnology in the criminal justice system has attracted considerable academic interest as it raises a range of ethical and legal concerns. The application of the technology may range from enhanced interrogation, non-consensual admissions of guilt and new forms of 'lie detection' technologies, among others.[180] This may result in adverse human right outcomes for individuals accused of crimes ranging from minor infractions, political dissidence and even murder.[181]

Lie detection

Lie detector mechanisms, specifically polygraph testing, have been in use in the detection of falsehood since the 1940s.[182] Considering recent technological advances, and scepticism towards traditional polygraph tests, there is consideration as to whether the involvement of neurotechnology as a means of lie detection is an effective alternative.

The 'guilty knowledge test' is a technique which relies on the measurement of brain activity to determine if a subject is lying. Also known as 'brain fingerprinting', operators can currently detect the presence of concealed information through the monitoring of brain waves via EEG signals.[183] With the development of neurotechnology, transcranial magnetic stimulation (TMS) or transcranial direct stimulation (TDS) can cause changes in brain activity, altering a person's physiological responses. Through such stimulation, operators can disrupt two of the four categories of cognitive processes required for deception: information management and risk management.[184] Administration of TDS and TMS has demonstrated differences in the subject's ability to detect and protect themselves from making riskier decisions, which in this case would be divulging the truth when they may have a guilty conscience.[185]

Another measure to detect falsehood upon stimulation by TDS and TMS was the slowing of reaction time whenever a response was untruthful.[186] The aim with this technique is for informed authorities to be able to detect this delay in response and question the subject further based on the presumption that they are concealing knowledge about the matter.

One of the most pressing issues in using such technology during a criminal investigation is its impact on the privilege to remain silent and not to self-incriminate.[187] This principle does not apply to material that 'exists independently of the will' of the subject including blood samples, fingerprints and documents acquired pursuant to a warrant.[188] However, seeing that neurotechnology has the ability to directly alter the way a witness or suspect provides evidence, which would usually require their cooperation and will to do so, this has serious implications for their right to silence.

Memory recovery

The retrieval of accurate eyewitness testimonies during criminal justice proceedings is an ongoing matter of concern. Considering the difficulty in obtaining reliable testimony from witnesses who are in acute shock, in addition to the malleability of memories, turning to neurotechnology to enhance memory retrieval may sound appealing.

Vedder and Laming observe that non-invasive neurotechnology can also have applications in memory recovery where TMS is administered in areas of the brain responsible for memory retrieval, such as the temporal lobes and hippocampus.[189] It primarily acts by reducing the occurrence of false memories and conceptual labelling, allowing for a more literal recall of events.[190] The fact that TMS is non-invasive and has relatively short-term effects contributes to the idea that this may be a promising mechanism to be used in a criminal justice context.

Neurotechnology can also have a role in the retrieval of long-term memories where the event in question occurred decades ago. Current methods of memory retrieval, such as cognitive interviews and hypnosis, impede the accuracy of the information recalled or require a highly trained interviewer to have any useable effect. In Canada, a patient had undergone neurosurgery for the treatment of morbid obesity by suppressing their appetite using DBS electrical impulses.[191] Neurosurgeons discovered that a positive side effect of the surgery was that the patient could recall autobiographic memories of events occurring more than 30 years ago.[192] These memory retrieval effects were said to be persistent as this was an invasive procedure involving an implant.[193] In allowing such neurotechnology to

intervene in individual thought processes, there is a real risk of breach of the right to mental privacy and freedom of thought.[194] The concern around this notion is that memories will be recovered via an intrusion into a person's mental privacy and integrity, when they would otherwise be forgotten.[195] Likewise, considering the malleability of long-term memories, the permissibility of memory recovery technology could open doors to malicious application of this kind of intervention, including memory alteration.

Criminal responsibility

The inclusion of neurotechnology in the criminal justice system may also have significant implications for the manner in which cases are heard, even altering the tests used in court.

In determining whether a person is criminally responsible for the crime committed, in most cases, with the exception of strict liability offences, they must have the requisite mental state, or *mens rea*, at the time they committed the crime.[196] The premise behind this principle is that 'it is generally neither fair nor useful to subject people to criminal punishment for unintended actions or unforeseen consequences unless these resulted from an unjustified risk'.[197] Due to direct intervention with the offender's mind, the lines between sole responsibility and 'third party' involvement are blurred when neurotechnology is involved which can have implications as to how the current legal tests apply.

For example, when it comes to crimes committed due to an impulse where the offender cannot physically resist committing the offence, BCIs could be installed to alert the offender of an impending impulse to offend.[198] This may have implications when it comes to a court's consideration of the *mens rea* element, but precisely how it would be interpreted remains an open question. Where the offender is aware that they may commit a crime, but actively ignore warnings, could criminal responsibility be traced back to the moment they ignored the implant's notification or turned off the BCI?[199] Alternatively, does the notification by the implant indicate that these impulses exist separate from a conscious intent to commit the crime? Similarly, where this BCI malfunctions, the court will have to consider this as an external influential factor either in the analysis of *mens rea* or as a mitigating factor during sentencing.[200]

Sentencing

Neurotechnology may also potentially extend to applications in the period after adjudication, as part of the sentencing process or even as an alternative to incarceration. A key perceived advantage when compared to conventional sentencing options is that neurotechnology may provide a greater focus on rehabilitation by reducing the risk of reoffending.[201] Forms of rehabilitation such as cognitive behavioural therapy and education programs are favoured over more biological approaches such as neurotechnology, which can be highly invasive in nature.[202] However, the conventional solutions may fail to consider the 'extensive interplay of the environment and biology and the plasticity of the brain in response to environmental influence' and that more effective forms of rehabilitation may ensure public safety.[203]

By reducing tendencies which lead to a pattern of criminal behaviour, these interventions do not act as a 'biological fix'.[204] Examples of such mechanisms include neurotechnology which identifies neural precursors that trigger feelings of aggression and then stimulates the brain to calm the subject down, allowing them to make rational decisions after obstructive influences, such as aggression, are no longer present.[205]

In the Netherlands, a judge can impose mandated mental health treatment after incarceration where the period of treatment carries from four years or as long as the judge deems necessary.[206] Neurotechnology may be offered as part of such mandated mental health treatment in an effort to aid the process for rehabilitation and eventual

reintegration into society. This approach has been referred to as 'neuroprevention' by experts Ruiz and Muñoz in a recent article.[207]

When offering neurological interventions in place of conventional sentencing or incarceration, it may be questionable whether full and informed consent can be provided. Especially in cases where the consent to the use of neurotechnology could be used transactionally for sentence reduction or an earlier parole period, it could be argued that the offender is formally consenting to treatment despite their preference not to.[208] However, there is debate as to whether 'coercion' of this kind is enough to invalidate consent. Analogising to a patient suffering from a severe illness, consent would not be considered invalid in circumstances where a patient is choosing between lifesaving treatments, despite the severely limited options and invasive nature.[209]

Offenders need to agree to such interventions voluntarily as they involve an invasive biological intervention compared to traditional psychotherapies, which are undertaken collaboratively with the patient, and other medical correctives.[210] However, in a study published in 2019 surveying participants convicted of sexual offences, the participants believed that their freedom of choice would not be compromised on account of potential coercion of legally motivated treatment.[211] Participants highlighted that there would need to be requirements for 'thorough explanation[s] of the purpose, risks and benefits of the treatment options', and 'adequate time to process this information' so that they could receive medical advice.[212] The treatment offered should therefore be the least invasive neurointervention, ensuring that the treatment prescribed is not disproportional to the severity of the crime committed.

5. Legal concerns

The novel nature of neurotechnologies present a myriad of legal questions which must be considered. This background paper seeks to highlight a few pertinent areas where neurotechnology may challenge existing legal frameworks.

5.1 Privacy

The *Privacy Act 1988 (Cth)* (Privacy Act) is the foundational piece of privacy legislation in Australia. Currently the Privacy Act has no express protection for neural data or mental privacy.

However, the Privacy Act is principle-based legislation which emphasises a technology-neutral and flexible framework for regulating how entities collect, use and disclose personal information. This means that it is adaptable to changing technologies and environments, including emerging neurotechnology. This would create legal obligations that address the collection, use or disclosure of personal information in this technology.

'Personal information' is, at the time of writing, broadly defined within the Privacy Act as:

> Information or an opinion about an identified individual, or any individual who is readily identifiable:
> (a) whether the information or opinion is true or not; and
> (b) whether the information or opinion is recorded in a material form or not.[213]

What is personal information will vary, depending on whether a person can be identified, or is reasonably identifiable, in the circumstances. Information collected, used and disclosed by neurotechnologies may be considered personal information under the Privacy Act if it is information about an identified or reasonably identifiable individual.

The information collected, used and disclosed by neurotechnologies may also meet the definition of 'sensitive information' under the Privacy Act as in certain circumstances it may be considered health information.[214] Sensitive information is subject to a higher level of protection under the Privacy Act.

Privacy Act 1988 (Cth) reforms

The Australian Attorney-General's Department has recently undertaken a review of the Privacy Act, which would see it updated and fit-for-purpose in respect of an increasingly digitised world.

At the time of writing the Government has committed to progressing consideration of reforms to Australia's privacy framework under five key areas of focus:

- bringing the Privacy Act into the digital age
- uplifting protections
- increasing clarity and simplicity for entities and individuals
- improving control and transparency for individuals over their personal information
- strengthening enforcement.[215]

These reforms will hopefully create a stronger framework overall, including where neural data is captured by the Privacy Act.

One aspect of the proposed reforms is amending the definition of personal information, which the Government has agreed to in principle.[216] This includes changing the word 'about' in the definition of personal information to 'relates to' to clarify that personal information is an expansive concept

that includes technical and inferred information.[217] This would be supported by a non-exhaustive list of information that may be personal information (where it also satisfies the definition of personal information) to assist entities to identify the types of information that could fall within the definition.[218] Relevantly for the purposes of neural data, the Privacy Act Review Final Report states that the list could include:

> One or more features specific to the physical, physiological, genetic, mental, behavioural, economic, cultural or social identity or characteristics of a person.[219]

These changes may better protect mental privacy because a broader range of neural data would be more clearly captured as personal information, reducing uncertainty about when neural data is covered by the Privacy Act.

The Government has also agreed in principle to the inclusion of a statutory tort for serious invasions of privacy that are intentional or reckless in the Privacy Act.[220] The Commission provided input on this issue and noted the need for the tort to include negligent acts of privacy invasion, in addition to the need for the tort to be non-restrictive.[221] Whether such a tort could be used to protect mental privacy and neural data is an open question.

It has also been agreed in principle by the Government that the Privacy Act should be amended to require that the collection, use and disclosure of personal information must be 'fair and reasonable in the circumstances'.[222] This would create a positive obligation that requires entities captured by the Privacy Act to consider the foreseeable risks and impacts to individuals caused by information handling through neurotechnology at the beginning of a project. Accordingly, this may provide a baseline protection of neural data and mental privacy where it is considered personal information. This test would be supported by certain legislated factors (including but not limited to) consideration of the kind, sensitivity and amount of personal information being collected, used or disclosed and the risk of unjustified adverse impact of harm, among other considerations.[223]

The fair and reasonable obligation may be further supported by the agreed in-principle requirement for privacy impact assessments (PIA) to be conducted for activities with high privacy risks (any function or activity that is likely to have a significant impact on the privacy of individuals).[224] A PIA is a systematic assessment of a project, which can assist in identifying potential impacts that a project might have on individuals, and sets out recommendations for managing, minimising or eliminating those impacts.

Noting the potential of neurotechnology to have a significant impact on privacy, organisations which offer neurotechnology products or services may need to conduct a PIA prior to commercialising their product or service, consider their privacy risks and impact, and develop management and minimisation strategies to address those risks and impacts. This is a well-developed method to address the privacy-related impacts of new technologies which encourages entities to take a 'privacy-by-design' approach to their personal information handling. While the Privacy Act may not expressly protect neural data or mental privacy, it may do so implicitly. It is expected that if reforms to the Privacy Act are legislated, the protection of mental privacy and neural data may also be improved.

5.2 Consumer technology

Some of the biggest risks of neurotechnology will be realised as products are developed and deployed outside of therapeutic and medical fields and provided to consumers more broadly. The medical applications of neurotechnologies are quite stringently regulated in Australia (as noted below) and other countries. However, consumer products operate in an environment where existing consumer protections are not as effective at regulating consumer-oriented neurotechnologies compared to the types of targeted regulation and safeguards that are seen in the therapeutic and medical contexts.

The Commission is concerned that consumer-oriented neurotechnologies are not sufficiently regulated. Consumer products operate in an insufficient regulatory environment.[225] Given

the complexity of the technology and potential for harm, the Australian consumer regulatory space would benefit from a tailored response to consumer neurotechnologies (as discussed further below).

Human rights risks are likely to be amplified as neurotechnologies are adapted for broader consumer consumption without the necessary level of regulation in place.

Neurotechnological intellectual property, which may be developed for medical application, can be pivoted and adapted to a consumer market. For example, while some neurotechnologies allow users who are paralysed to operate computers, it isn't difficult to imagine this same technology being sold to gamers for hands-free gaming.

While the risks of products which are purely consumer-oriented are troubling, attention must also be paid to medical products which will be adapted for consumer products. Large-scale neurotechnological products will likely become commonplace in the not-so-distant future. For example, Neuralink received approval on 26 May 2023 from the US Food and Drugs Administration (FDA) to conduct its first tests on humans.[226] Although Neuralink's products are currently aimed primarily at assisting patients, it is possible this technology may also be pivoted to a consumer market in the future. For example, Elon Musk has posted about Neuralink's 'Telepathy' product in which he wrote that 'initial users will be those who have lost the use of their limbs'.[227] The statement leaves open that later users may be general consumers.

Irrespective of how the technology makes its way to consumers, neurotechnologies are becoming increasingly available for direct-to-consumer products for recreational or mental augmentation purposes.[228] Without the rigorous safeguards in place for medical purposes, the effects of these consumer products remain unclear.

For example, non-invasive neurotechnological products are rapidly proliferating outside of a targeted regulatory environment. One example is Apple's recent patent for AirPods capable of monitoring brainwaves.

Although non-invasive neurotechnologies will often be used for similar purposes as invasive BCIs, because they do not require medical implantation, they often fall outside of medical regulation in consumer settings.[229] This is especially true for neurostimulation commercial devices using TMS or transcranial direct current stimulation, for which the effects are not fully understood – and may cause adverse consequences for users.[230]

One risk to consumers is where neurological products overpromise on their capability to improve health and wellbeing, which can lead to negative outcomes for the individual. Further, the risks and obstacles of products must not be underestimated, or this too will lead to adverse outcomes.[231]

Equally, neural data collected by consumer products could be monetised and exploited by companies, employers or governments. The combination of neural data and other personal information collected online (from web browsing, smart phones, smart watches etc) might allow certain brain characteristics to be identified – such as attention or vigilance.[232] This may lead to 'neurotype' profiles being created about users to allow for 'neuromarketing' or other exploitative tailored digital targeting.[233] While the use of such information for marketing alone could be problematic, if taken a step further it quickly becomes disturbing.

In the future there may be consumer products which require implantation of non-therapeutic BCIs involving a medical procedure (e.g. surgery to insert an implant into the brain). This will require a surgeon to obtain informed consent regarding the procedure to insert the device, but not the operation and terms and conditions relating to the device once it has been implanted. In these circumstances consumers will need to be aware of key issues in deciding to implant a device – including service life, the availability of spare parts, changes in company ownership, retention, ownership and security of neural data and what will happen if the company responsible for the device has been deregistered. Significant decisions, such as this, ought not be left to template consumer-oriented contracts with fine print terms.

Medical regulation

There are already medical/therapeutic regulations which could usefully be applied to the development, testing and use of neurotechnologies in medical applications.

In Australia the *Therapeutic Goods Act 1989* (Cth) governs products defined as therapeutic goods, which can include medicines, medical devices and biologicals in Australia. The *Therapeutic Goods Regulations 2002* (Cth) intend to regulate medical devices from the perspective of the physical safety of a user. The Therapeutic Goods Administration (TGA) is the authority responsible for evaluating, assessing and monitoring products that are defined as therapeutic goods. The TGA regulate medicines, medical devices and biologicals to help Australians stay healthy and safe.[234]

It is possible that many neurotechnologies will start as medical products which hopefully fall within the ambit of Australia's medical regulations laws. However, questions remain about what happens which such products are pivoted away from medical applications to consumer markets (where less protection exists).

There certainly appears to be a regulatory gap between the protections applied to medical and consumer neurotechnological products which must be addressed.

Australian Consumer Law

The Australian Consumer Law (ACL) is contained in schedule 2 of the *Competition and Consumer Act 2010* (Cth) and will likely apply to consumer neurotechnologies not otherwise captured by specialist product safety regimes that regulate medical devices and therapeutic goods.

Certain protections of the ACL are only applicable to conduct in respect of 'consumers'.[235] Where an individual purchases neurotechnological product they may meet the statutory definition of 'consumer' provided the price of which is less than $100,000 AUD.[236]

The ACL includes consumer guarantees which are basic rights that businesses must meet when they sell products or services. These basic rights include ensuring a product sold to a consumer is of acceptable quality and fit for purpose.[237]

Acceptable quality means that a neurotechnological product:

- is safe, durable and free from defects
- has an acceptable appearance and finish
- does everything that similar products are commonly used for.[238]

However there are no set rules for deciding whether a neurotechnological product is of acceptable quality, or how long it should last.

To determine if a neurotechnological product meets acceptable quality, the following factors need to be considered:

- What kind of product is it, and how does it compare to similar products?
- What is it made of and how was it made, and how does this compare to similar products?
- How much did it cost, and how does it compare to products of a similar price?
- What maintenance may be needed to keep the product operating?
- Did the business or manufacturer make any claims about quality, or how long the product could last for?
- Did the business warn the consumer about any defects, or warn against the product's use in a certain manner?

- How old is the product, and how long do similar products normally last?
- Was the product sold new or second-hand?
- Has the product been used in a way it wasn't designed for?[239]

The fit for purpose guarantee is also highly relevant as this guarantee applies when:

- a consumer tells a business they want to use a product for a particular purpose
- the consumer buys the product based on the advice of the business
- the business advertises in any way that the product can be used for a particular purpose.[240]

Where a supplier or manufacturer fails to meet a guarantee, such as acceptable quality or fitness for purpose, the remedy may be repair, replacement or refund and/or compensation for damages and loss.[241]

Obviously, replacement parts and expertise need to be available for consumers to avail themselves of repairs. A concern when it comes to neurotechnology is the availability of these remedies if the supplier goes into liquidation (as discussed above in respect of people with disability). While there may be a consumer guarantee that replacement parts are available within a reasonable amount of time, a consumer might be left with a degrading piece of technology in their body on which they have come to rely but which may not be able to be repaired.

Further, under the consumer guarantees, suppliers of recreational services can exclude, limit or modify liability, when they do not meet the legal expectations to provide services:

- with due care and skill
- fit for any particular purpose
- within a reasonable time (when no time is set).

Such suppliers may only limit their liability for death or personal injury, including illness (mental or physical), but not for property loss.[242] Liability for reckless conduct by the supplier cannot be excluded.[243] Given the likelihood that neurotechnology may be used for recreational services that could, if not provided with due care and skill, cause mental harm, consumer guarantees are unlikely to be a suitable regulatory tool to regulate these products.

The consumer guarantees allows consumers to take action against suppliers to enforce their rights. However, litigation is expensive and complex which can be a barrier to justice, particularly when opposing a well-resourced business. Consumers would be unlikely to have the technical knowledge around neurotechnologies to confidently assert their consumer guarantees rights.

The ACL also prohibits businesses from engaging in misleading or deceptive conduct, and from making false or misleading representations.[244] To comply with the ACL requirements, neurotechnology suppliers need to ensure that they provide clear and accurate information to consumers through their marketing, product labelling, and in any other way they engage with consumers to promote and supply their products.

The ACL also contains the product safety provisions which apply to all consumer goods and product related services supplied in Australia. The ACL's primary regulatory powers for product safety are mandatory safety and information standards, compulsory product recalls and interim or permanent bans.[245]

The ACL regulatory framework for the safety of general consumer goods does not contain the full suite of tools needed to effectively regulate specific types of products because they require a tailored approach. Specific types of products are regulated by specialist product safety regulators, which can provide that tailored approach as well as in-depth technical expertise, and ongoing focus needed to manage the unique risks associated with specific products.

While the ACL does allow the relevant Commonwealth Minister to make a mandatory safety standard,[246] the safety regulation of consumer-oriented neurotechnologies is likely to need technical expertise in neuroscience, biometrics, and BCIs. A generalist product safety regime like the ACL may not be able to provide this type of expertise or ongoing focus to monitor compliance (as opposed to a general consumer goods like a trampoline). Given the potential for neurotechnology to monitor and/or intervene in neural activity and the inherently unknown risks of harm to the individual and likely profound impacts

to society at large, regulation would benefit from a tailored approach.

The ACL also contains liability provisions that apply to a manufacturer that supplies consumer goods in trade or commerce with a safety defect. A product has a safety defect if it does not meet the level of safety the public is generally entitled to expect. While the expected level of safety will vary from case to case, it is ultimately for a court to determine whether a product has a safety defect. The court will take various factors into account when determining whether a product has a safety defect, including:

- how and for what purposes the product has been marketed
- product packaging
- the use of any mark in relation to the product
- instructions and warnings for assembly and use
- what might reasonably be expected to be done with the product
- the time when the product was supplied.

There are however a number of statutory defences that are available to a manufacturer against a product liability action.[247] These defences make the safety defect provisions in the ACL unsuitable to protect consumers given the evolving nature of scientific or technical knowledge about neurotechnology.

5.3 Online safety

As neurotechnologies continue to develop, it is important to consider how these technologies (by themselves or in combination with other emerging technologies such as augmented, virtual, or mixed reality platforms and devices[248]) may be used as a vector for various types of online harm. For example, if bad actors were able to assume control of such technologies, they could be weaponised for child sexual exploitation, sexual assault, coercive control, or other forms of abuse.

Accordingly, companies developing neurotechnologies should take a Safety by Design approach to help identify and mitigate potential online safety risks early on.[249] Voluntary safety measures should be backed up by legislative requirements and regulatory oversight – in addition to being supported by education and awareness raising for the public.

The eSafety Commissioner

The eSafety Commissioner (eSafety) is Australia's independent regulator, coordinator and educator for online safety. eSafety's purpose is to help safeguard all Australians from online harms and to promote safer, more positive experiences online.

The Office of the eSafety Commissioner began operation in 2015, with the current iteration of its enabling legislation being the *Online Safety Act 2021* (Cth) (Online Safety Act) taking effect in January 2022. The Online Safety Act applies to a range of online service providers, including to metaverse platforms and the equipment used to connect to them (such as neurotechnologies).

eSafety approaches its work under the Online Safety Act through the three lenses of prevention, protection, and proactive and systemic change:

- Prevention – through education, awareness raising, and programs based on research, evidence, and consultation.

- Protection – through eSafety's investigations and content removal schemes for individuals who have experienced cyber-bullying, cyber-abuse, or image-based abuse (the non-consensual sharing of intimate images), or who have encountered illegal or restricted online content such as child sexual exploitation material or terrorist or violent extremist content.[250]
- Proactive and systemic change – through new mandatory industry codes and standards,[251] as well as a set of Basic Online Safety Expectations,[252] accompanied by reporting powers to drive greater transparency and accountability. eSafety also conducts horizon scanning and consults with experts and other important partners to identify emerging online safety risks and inform its approach to these challenges.[253]

eSafety encourages all companies designing, developing, or deploying any type of technology to take a Safety by Design approach, and offers a variety of practical tools to support companies of all sizes to do so.[254]

As neurotechnologies are increasingly integrated into online services and products such as games, social media, search engines, and internet-enabled devices, certain aspects may be covered by the Online Safety Act. This is particularly where there is a risk of child sexual exploitation, violent terrorist acts and violent extremism, and other forms of abuse within eSafety's regulatory remit.

However, the wide array of existing legislation and regulatory frameworks that might apply in some way to neurotechnologies will need to be reviewed to ensure they remain fit for purpose to prevent and mitigate a range of harms and potential human rights abuses which may be facilitated through neurotechnologies. This will require ongoing collaboration and dialogue with domestic and international government colleagues and with relevant stakeholder groups.

The Australian Government has committed to bring forward the independent statutory review of the Online Safety Act, which is anticipated to be completed in the current term of government. With the online environment constantly changing, an early review will ensure Australia's legislative framework remains responsive to emerging online environments and the technologies that interact or facilitate engagement.

5.4 Neurotechnology in the workplace

With the shift to remote work during the COVID-19 pandemic, the adoption of online monitoring tools by employers has become increasingly common. However, due to rapidly developing technology, constant monitoring of employees can be expanded from monitoring desktop activity to potentially assessing their emotional state and degree of concentration and alertness.[255]

While having advanced mechanisms to assess employee productivity is not a new concept, neurotechnology may provide employers with a more sophisticated mechanism to monitor their employees' mental patterns throughout their workday.

The UK ICO has estimated that neurotechnologies will be readily adopted into workplaces within four to five years.[256]

Surveillance via EEG assessment, which is a relatively accessible form of neurotechnology, can allow employers to have insight into an employee's immediate cognitive state such as level of attention,[257] mind wandering, and effort withdrawal.[258]

Considering the rapid development of neurotechnology, more advanced fMRI and BCI measures could also be utilised to go so far as to understand employees' minds and alter their work performance.[259] In fact, neurotechnology, in the form of transcranial direct current stimulation (tDCS), is already being used as an enhancement tool to combat fatigue during the workday.[260]

There can be potential benefits to such surveillance in assisting employees to understand their fluctuations in concentration levels and to help avoid accidents caused by a lack of concentration. This is especially beneficial in developing safety measures for occupations requiring high levels of attention over long periods of time such as truck driving and paramedicine.[261]

While there is an argument that heightened surveillance of employees during the workday will increase productivity, it may in fact have the opposite effect. Employees may be subject to such stress and pressure, that in the long run, it hinders their physical and mental health which, in turn, reduces the overall productivity of the workplace.[262]

Due to its nature and potential impact on individual rights and autonomy, the legal and ethical implications of such technologies continue to be a pressing concern.

Neurodiscrimination

Due to the employer's access to their mental patterns, employees can be put in a vulnerable position where their neurological levels of work productivity and concentration can be used to make judgements about them.[263]

This employer-employee power imbalance is especially relevant and concerning in the context of hiring, firing and promoting current employees. For example, employers could potentially neurologically track signs of early cognitive decline with the aim of using this information in decisions concerning redundancy, contributing to age and disability discrimination in the workplace.[264]

Further, in using neural data (acquired via neurotechnologies) to promote, hire and fire employees, employers are essentially relying on a judgement based on automated estimations of cognitive abilities, subject to the degree of human involvement. This can result in discrimination where there is a barrier limiting those who may not meet the neurological standards set by an employer, resulting in a lack of diversity and unequal opportunity in the workplace.[265]

While it is normal to have standards based on education and experience in a competitive workplace, mechanising such standards would mean overlooking numerous factors such as personality, levels of empathy, creativity and other qualities which may not be tangibly gauged by neurotechnology.[266]

Privacy concerns

The use of neurotechnology allows access to not just conscious but subconscious thoughts, meaning that employers will have access to thought patterns of employees which the employees themselves do not have control over. It is also considered that brain scans fall into the category of biometric data as they can be comparable to an individual's unique fingerprints.[267] Such intrusive monitoring may also reveal sensitive information such as an employee's underlying mental health conditions.[268]

This is a significant intrusion of an employee's right to mental privacy where employees will not have discretion to choose what information would be disclosed to their employer within their professional workplace relationship.[269]

At the international level, the Code on Protection of Workers' Data provides that if employees are to be monitored, they should be advised of such monitoring in advance as well as the nature of the data collected and the techniques used.[270]

One of the pressing issues, however, is that even if the details of such neurotechnology are disclosed to an employee, consent to such monitoring may not be 'full and informed' due to fear of losing their job or missing out on an opportunity for future employment.[271]

Australia's approach to workplace surveillance laws

When looking at the current laws in Australia regarding workplace privacy and surveillance it is clear that issues arising from neurotechnology were not within the contemplation of the drafters.

Currently, New South Wales (NSW), Victoria and the Australian Capital Territory (ACT) have all enacted legislation in relation to workplace privacy and surveillance.[272] It is of note that all three jurisdictions also have human rights charters which may be of relevance.

The use of neurotechnology in the surveillance of employees appears to be outside the ambit of the *Surveillance Devices (Workplace Privacy) Act 2006* (Vic), as these amendments to the *Surveillance Devices Act 1999* (Vic) were primarily aimed to address workplace monitoring in private areas.[273] It is unclear if neurotechnologies would fall within the ambit of the *Surveillance Devices Act 1999* (Vic).[274]

The *Workplace Surveillance Act 2005* (NSW) appears to have a wide ambit as to what could constitute 'computer surveillance'. The definition includes examples such as 'the sending … of emails and the accessing of Internet websites' which indicates that surveillance is directed to an employee's actions rather than their thoughts as accessed by neurotechnology.[275]

The *Workplace Privacy Act 2011* (ACT), mirroring the NSW Act, also adopts a broad definition of what a 'data surveillance device' consists of.[276] Again, considering the examples listed in its explanatory statement, it is likely that surveillance under ACT legislation is limited to activities such as the monitoring of email content and internet usage.

The Australian Law Reform Commission has previously recommended that Australia should move towards having a harmonised approach regarding surveillance legislation, which it considered would be best achieved by enacting Commonwealth legislation to replace existing state and territory laws.[277]

Further, to avoid the chances of technology falling outside of the ambit of such legislation, surveillance device laws should be 'technology neutral' to apply to neurotechnology and any other advancements which will inevitably arise in the rapidly developing world of technology.[278]

6. The road ahead

It is intended that this background paper will lead to further conversations about the human rights, ethical and legal questions raised by neurotechnology. Although it is not a comprehensive survey of every human right and potential application of the technology, this background paper aims to provide a high-level summary of neurotechnology and associated challenges as a new and rapidly evolving form of technology.

If Australia and the international community are to respond to these challenges, more must be done. Foremost, it must be decided if new neurorights need to be created to protect the human mind – or if we would be better placed to interpret and apply existing rights more broadly to cover the spectrum of challenges associated with neurotechnology. Given that there is little consensus in academia on the exact content of such rights, this is a fundamental first step which must be taken to ensure that human rights are at the forefront when it comes to safeguarding the brain.

Given the numerous potential applications of neurotechnologies and the breadth of people who will be impacted, an extensive regulatory gaps analysis is required to determine legislative shortcomings where harms may occur. Issues arising from neurotechnology were not within the contemplation of drafters at the time of that key laws were enacted in Australia. Where shortcomings are found, concrete recommendations must be made to address the challenges faced by society in this modern age.

Waiting too long to address the implications of emerging technologies may mean that it is even more challenging to subsequently address the implications and remedy harms that have occurred. Technology develops at a rapid pace, which government are unlikely to match. Accordingly, solid evidence-based work must be started early and pro-actively to ensure that Australia understands and is able to address the potential risks of neurotechnology as it enters the consumer market and becomes increasingly accessible.

The Commission predicts that neurotechnology will only become increasingly prevalent in our lives over the coming years. Action now will ensure we can harness the potential benefits whilst also mitigating the potential harms resulting from the widespread use of such technology before it is too late, and more people are adversely impacted. It is essential that human rights is kept at the forefront when considering this developing technology.

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