Australian Human Rights Commission

Peace of Mind:

Navigating the Ethical Frontiers of Neurotechnology and Human Rights

October 2025

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The Australian Human Rights Commission acknowledges the Traditional Custodians of Country throughout Australia, and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders – past and present.

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Navigating the Ethical Frontiers of Neurotechnology and Human Rights

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Commissioner foreword

At the heart of human rights lies a commitment to respect for human dignity, reason and conscience that is universal and enduring.

These principles not only form the foundations of international human rights law but should also guide how we assess the ethical and social implications of emerging technologies. This is especially true in the context of neurotechnology – an area that challenges us to think deeply about what it means to be human, and the extent to which we are prepared to let technology augment or change this.

Neurotechnology refers broadly to devices, systems, and procedures that interact with the human nervous system to access, interpret or influence its activity. While 'brain-computer interfaces' may be the more familiar term in news and media, neurotechnology encompasses a broader suite of tools, including neuroimaging and neuromodulation technologies.

These tools can be used for a variety of purposes. Some are already transforming lives by, for example, enabling speech or mobility for individuals who experience barriers due to neurological or physical conditions. Others promise to expand human capabilities in ways that, not long ago, were confined to science fiction – such as enhancing concentration in education settings or monitoring alertness in high-risk occupations.

The promise of neurotechnology is immense. But so too are the risks. That duality is the focus of this report. While this Final Report is the culmination of a multi-year project examining the human rights impacts of neurotechnology, it is not intended as the final word on this topic. Instead, it is an invitation to an ongoing conversation about how we can embrace the benefits of neurotechnology while ensuring that its development and use are grounded in a firm commitment to human rights.

A technology capable of decoding brain activity or influencing thought processes is, by its nature, deeply personal and profoundly powerful. It raises critical questions: Who owns our neural data? How do we protect freedom of thought if cognitive surveillance is possible? How can we ensure meaningful consent, especially for people who might face extra challenges in being heard, like children or people with disabilities? These are not speculative concerns. They are questions we must address now as neurotechnology starts to move from the laboratory into our homes, schools, workplaces, and even courtrooms.

This report adopts a human rights-based approach to answering those questions. It considers the ways that neurotechnology could impact rights such as freedom of expression, the right to privacy, and freedom of thought. It also explores the potential impacts in different areas of our lives, and the ways that different groups within our community – including children and people with a disability – might experience these impacts differently.

One core message emerging from our work is the importance of "human rights by design" – embedding human rights protections at every stage of a product's life cycle. This builds on the well-known concept of "safety by design" and focuses on not only responding to harms after they occur but anticipating and preventing them.

Equally important is recognising that regulation and innovation are not opposites. To the contrary, well-designed regulation can promote innovation by building public trust, offering legal clarity, and establishing ethical guardrails. Guardrails are not barriers, but rather enablers. They give researchers, developers and investors the confidence that their work will be used in ways that align with our shared values.

Australia is well placed to be a leader in neurotechnology – not only in technical innovation, but also in ethical and rights-respecting innovation. Achieving this will require continued collaboration between government, industry, civil society, regulators, and the broader community. It will also require further investment in both the technology and the frameworks that support its ethical and responsible use.

The Australian Human Rights Commission is proud to be the first National Human Rights Institution to have led a dedicated project on neurotechnology and human rights. Over the past two years, we have heard from a wide range of experts, stakeholders and individuals with lived experience. Their insights have shaped this Final Report, which builds upon our previous background paper – 'Protecting Cognition' – and contributes to the growing international dialogue around neurotechnology and human rights.

In particular, I would like to thank the individual members of our Expert Advisory Group, chaired by Dr Alan Finkel, for contributing their expertise and enthusiasm to this work.

Ultimately, this report reinforces the need to ensure that technological progress does not come at the expense of our most fundamental rights and freedoms. It is about remembering that the power of neurotechnology lies not just in what it allows us to do – but in how we choose to use it.

As we look to the future, we must ensure that human dignity remains at the centre of our digital lives. Only then can we unlock the full potential of neurotechnology, whilst also retaining our peace of mind.

Dr Lorraine Finlay
Human Rights Commissioner

1. Introduction

As Australia's National Human Rights Institution (NHRI), the aim of the Australian Human Rights Commission (Commission) is not only to protect and promote human rights today, but to identify the challenges of tomorrow. This has been the impetus behind the Commission's work on neurotechnology, which aims to proactively address the challenges and opportunities of this emerging technology from a human rights perspective.

What is neurotechnology?

There are a range of definitions of neurotechnology that have been used in this emerging field.[1] For the purpose of this report, the Commission has adopted the definition set out by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a leading voice on the international application of neurotechnology:

> ... devices, systems, and procedures—encompassing both hardware and software—that directly measure, access, monitor, analyse, predict or modulate the nervous system to understand, influence, restore, or anticipate its structure, activity, function, (speech, motor). Neurotechnology combines elements of neuroscience, engineering, material science, and computing, among others.
>
> Neurotechnology spans medical and non-medical applications and includes tools that measure, infer, and influence nervous system activity, whether through direct interaction with the nervous system (both invasive and non-invasive) or by interfacing it with devices and systems. Of note, both open-loop (e.g. fixed-parameter brain stimulation) and closed-loop systems (e.g. state dependent stimulation) introduce complex ethical issues.[2]

Neurotechnology, like many technologies, has potential for both positive and negative implications for human rights. What is important is to make the benefits available, while ensuring that the technology operates in an environment that has appropriate guardrails to prevent misuse. The purpose of this report is to build awareness of the opportunities to help create an innovative environment, that simultaneously promotes and protects human rights.

Neurotechnology is developing rapidly, as organisations seek to deploy products that can be used to mitigate the impacts of disease and injury, improve workplace safety and learn more about the human brain. However, while pursuing innovation, Australia must be sure that robust safeguards are in place so that unintended harms do not occur.

To help mitigate risk, this report considers how neurotechnology may interact with human rights, legal frameworks, environments and groups of people across Australia. Although there are many other areas of rights protection that neurotechnology may impact, this report discusses those that are most relevant now. As the technology evolves, the focus of rights protection may also change in respect of neurotechnology. What is important, is that when discussions about neurotechnology take place, so too do discussions about human rights.

In the race to advance cutting edge technologies that promise to improve the lives of others, organisations can focus too narrowly on how the product will be used at its best. A risk here is that people may fail to properly consider how human rights may be impacted. Neurotechnology must be human rights centred to ensure that people can enjoy the benefits without being at risk of harm – only then can they have peace of mind.

2. About the project

The global neurotechnology market is advancing at a rapid pace with organisations trialling several products which allow neural data to be used for everything from monitoring worker fatigue to allowing people who have lost the ability to speak to generate synthesised speech and use computers via thought alone. This technology will have a myriad of applications beyond what is currently being tested, with significant financial backing from some of the wealthiest individuals and organisations in the world (e.g. Elon Musk, currently the world's wealthiest person, is the founder of Neuralink).

As investment and development increases so too does necessary human rights scrutiny of neurotechnology. In 2023 the Commission became one of the first NHRIs to focus specifically on this area as it began a two-year project on neurotechnology and human rights. Since beginning its inquiry, the Commission published Protecting Cognition: Background Paper on Neurotechnology and Human Rights (Background Paper) in March 2024. Later in mid-2024 the Commission partnered with the University of Melbourne Law School to host the *Neurotechnology and Human Rights: Opportunities, Challenges and the Pathway Forward Symposium.* Throughout the last two years the Commission has heard from over 100 people through roundtables, consultations, interviews and feedback sessions.

Although the Commission is one of the first NHRIs to publish a report on neurotechnology and human rights, there has been growing engagement with this topic around the world.

Global policy initiatives

Human rights and ethical concerns have led to several initiatives across the globe, including:

- UNESCO has published an initial report on the risks and challenges of neurotechnology for human rights.[3] In 2023 it produced a follow up report, and in 2024 it released its draft recommendation.[4] It is expected that the recommendation will be adopted in late 2025.
- The UN Human Rights Council adopted a resolution to commission a report on neurotechnology and human rights. The report was released in September 2024.
- The United Nations International Children's Emergency Fund (UNICEF) produced both a background paper and final report on neurotechnology and children.
- The Organisation for Economic Co-operation and Development (OECD) released a policy toolkit on neurotechnology to support their Recommendation on Responsible Innovation in Neurotechnology.[5]
- The Special Rapporteur on the right to privacy published presented a report to the 58th session of the Human Rights Council calling for the regulation of neural information.[6]

This report seeks to build on these initiatives by exploring the intersection between human rights and neurotechnology in Australia. The final report makes 18 recommendations to ensure that innovation does not come at the expense of human rights.

2.1 Human rights approach to neurotechnology

Article one of the Universal Declaration of Human Rights states that:

> All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood.

This report draws on that enduring principle to guide the development and governance of neurotechnology – a rapidly evolving field with profound implications for human dignity, autonomy, and equality. As neurotechnology advances, it is essential that decisions regarding its integration into society are shaped by a commitment to upholding and promoting the rights and dignity of all people.

The broader international human rights framework also provides that human rights are:

- **Universal:** They apply to all people.
- **Indivisible:** All rights have equal status – meaning that no right is more, or less, important than another.
- **Interdependent and interrelated:** The improvement of one human right can facilitate the advancement of other rights. Equally, the deprivation of a right may negatively impact other rights.

International human rights law is grounded in legal obligations that states voluntarily undertake, primarily through treaties. These treaties articulate a broad spectrum of rights, set minimum standards, and establish mechanisms for accountability and redress.

Australia is a party to seven core international human rights treaties (in addition to a range of other treaty obligations):[7]

- the International Covenant on Civil and Political Rights (ICCPR)
- the International Covenant on Economic, Social and Cultural Rights (ICESCR)
- the International Convention on the Elimination of All Forms of Racial Discrimination (CERD)
- the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT)
- the Convention on the Rights of the Child (CRC)
- the Convention on the Rights of Persons with Disabilities (CRPD).

Despite these commitments, Australia does not have a comprehensive national human rights act. Instead, human rights protections are dispersed across a patchwork of federal, state, and territory laws, common law principles, and constitutional provisions. Key federal statutes - such as the *Age Discrimination Act 2004, Disability Discrimination Act 1992, Racial Discrimination Act 1975,* and *Sex Discrimination Act 1984* - offer important protections against discrimination, but do not fully enshrine Australia's human rights obligations in domestic law.

This report examines the intersection of neurotechnology and human rights within the international framework and Australia's domestic legal context. It explores how neurotechnology may affect individuals in certain environments or based on attributes such as age, gender, disability, or race. These attributes influence how people access and experience neurotechnological developments.

While the report is structured around these factors, a truly rights-based approach to neurotechnology recognises the complex, overlapping ways in which identity, experience, and systemic inequality interact. This plays out in key areas, such as consent, where multiple factors can affect power, autonomy and human rights.

For instance, while the report discusses the rights of people with disability in a dedicated section, this should not be interpreted as endorsing a siloed view. Rather, it reflects the current limitations in the field and the need for clarity in a developing area. The Australian Human Rights Commission aims to progress a human rights-based understanding of disability – one that rejects deficit-based models and instead views disability as a social construct shaped by environmental, attitudinal and institutional barriers.

This report is a starting point. As the field of neurotechnology evolves, so too must our frameworks for understanding and addressing its human rights implications. Future work must build on this foundation with deeper intersectional analysis and inclusive dialogue that centres on the dignity and rights of all people.

While Australia has human rights obligations arising from ratification of key human rights treaties,[8] businesses also have a responsibility to respect human rights as reflected in international guidelines.[9]

The United Nations Guiding Principles on Business and Human Rights (UNGPs) are the global standard in preventing and addressing business-related human rights abuses – comprising 31 principles contained within the three overarching pillars of 'protect', 'respect' and 'remedy'.[10] These obligations apply to all States and business enterprises – regardless of their size, sector, location, ownership and structure.[11]

The OECD Guidelines for Multinational Enterprises on Responsible Business Conduct (Guidelines) acknowledge that the development and use of technology will have a profound impact on human rights.[12] Under the Guidelines, businesses have a responsibility to avoid causing or contributing to human rights harms in respect of their commercial activities and to seek ways to prevent such harms.[13] The Guidelines apply to multinational enterprises, which may operate across multiple jurisdictions with differing regulations and protections for human rights.

There is a clear ethical and business case for organisations operating in Australia to comply with both the UNGPs and Guidelines. Helping to prevent and mitigate adverse human rights impacts builds public trust in companies. Given the risks associated with neurotechnology (as discussed throughout this report), adherence to the principles contained in both the UNGPs and Guidelines should be a priority for neurotechnology companies. Adherence will promote human rights and allow the Australian neurotechnology industry to stand out in global markets as being safe and responsible.

A human rights approach to neurotechnology integrates human rights into all aspects of law, policy and decision making.

The PANEL principles provide a useful framework for translating this into practice.[14]

Participation: Ensure participation in decision making of stakeholders affected by neurotechnology, including the public, affected groups, civil society, experts and decision makers.

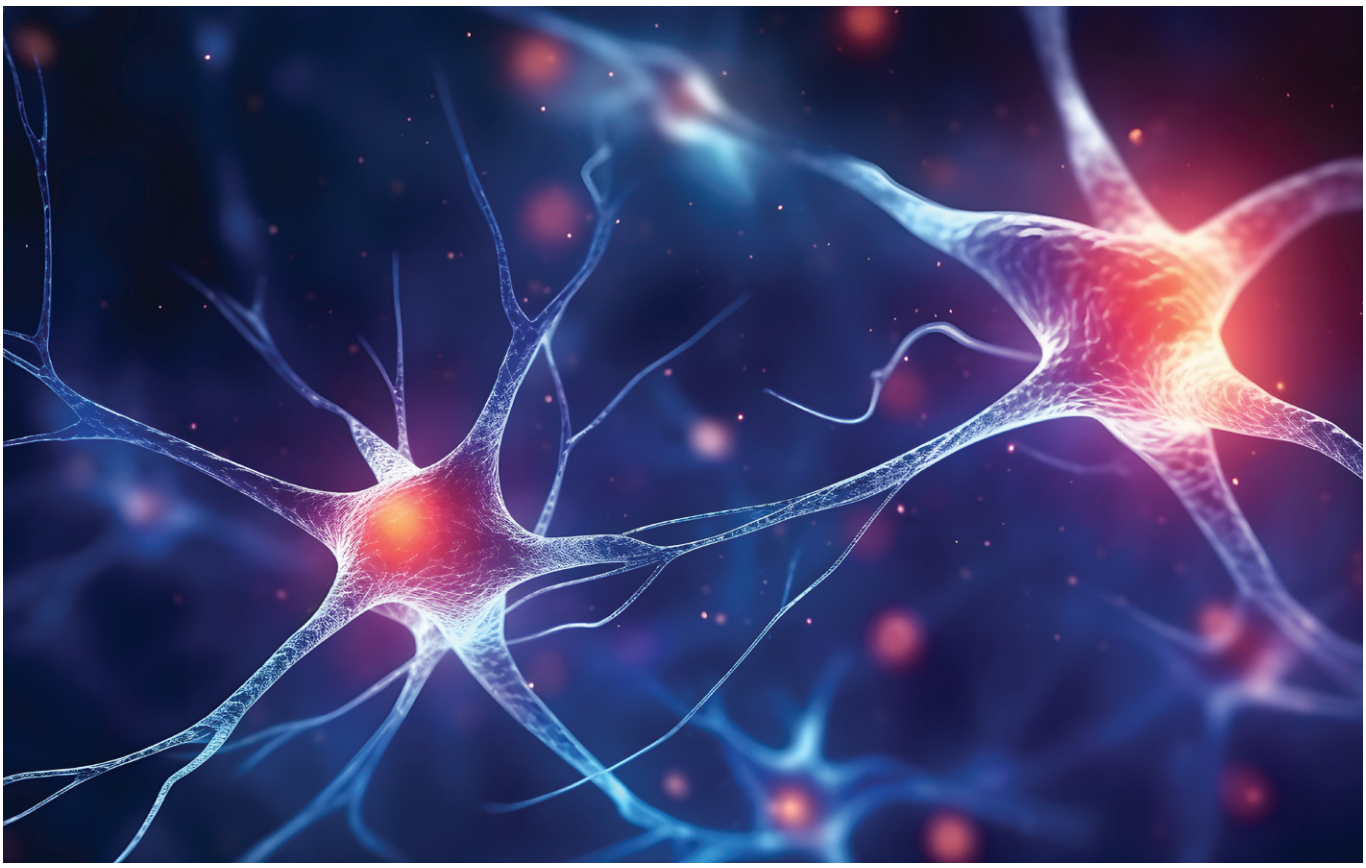
Accountability: This requires effective monitoring of compliance with human rights standards by government and non-state actors, and mechanisms to enforce rights.

Non-discrimination and equality: Anti-discrimination law principles should be applied to the development and use of neurotechnology, considering especially the needs of people who are in vulnerable situations.

Empowerment and capacity building: The community needs to understand the impact of neurotechnology on their lives and have knowledge of, and access to, a review process and/or remedy.

Legality: The law should recognise that human rights are legally enforceable, including in the use of neurotechnology.

There is increasing recognition that new and emerging technologies need to be human rights centred – this ensures that human rights are given attention in the design and development stages. It is an approach that aims to prevent harms from occurring in the first place and access to remedy if harms do eventuate.



2.2 Overview of the final report

The final report is divided into 15 chapters. The first three chapters provide background and context to both the final report and the project itself.

Chapters 4, 5 and 6 examine the interaction of neurotechnology with existing human rights frameworks in respect of:

- Expression
- Privacy
- Thought.

Chapters 7 and 8 consider the challenges posed by Australia's legislative environment regarding:

- Criminal justice
- Consumer rights.

Chapters 9, 10 and 11 pay attention to the environments where neurotechnology is most likely to be initially adopted, specifically considering the:

- Workplace
- Military
- Online environments.

Chapters 12, 13 and 14 then consider how certain groups may be disproportionately impacted by neurotechnology, notably:

- Children and young people
- People with disability
- Older people.

The final substantive chapter provides concluding remarks – explaining how Australia can continue to innovate in this field while protecting human rights.

Neurotechnology in combination with the associated fields of neuroscience, medical regulation and neuroethics is a broad topic requiring substantive consideration. This report is not a comprehensive analysis of every conceivable impact on neurotechnology and human rights – for example, the impact of medical devices regulation is not considered in depth. Rather, the final report is just one part of a longer discussion on human rights and neurotechnology. It seeks to highlight key human rights issues, while acknowledging that more research, consultation and work is needed to build upon this foundational document. The Commission welcomes and supports further work to this end.

2.3 Consultation process

A human rights approach prioritises a broad, inclusive process of consultation. The Commission's consultation process adopted this approach. All consultations were conducted in accordance with Chatham House rules.

The Commission consulted with a wide range of stakeholders throughout this project. The Commission received written submissions, held roundtable meetings, consultations and conducted interviews with people with lived experience, industry, civil society, regulators, legal experts and academia.

(a) Expert Advisory Group

In early 2024 the Commission established an Expert Advisory Group for this project. Chaired by Dr Alan Finkel, the group consisted of a diverse group of experts who advised the Commission on the project's strategy and outcomes. Members of the Expert Advisory Group include:

- Roland Everingham, Special Counsel (Wotton Kearney)
- Sophie Farthing, Head of Policy Lab (Human Technology Institute)
- Dr Alan Finkel, Former Australian Chief Scientist
- Dr Allan McCay, Co-director of Sydney Institute of Criminology, Academic Fellow (University of Sydney Law School), and President of the Centre for Neurotechnology and Law
- Professor Nicholas Opie, Professor Nicholas Opie, Founding Director (Synchron) and Chief Executive Officer (Ultra Bionics)
- Emeritus Professor Jeffrey Rosenfeld AC OBE, Neurosurgeon (Monash University, The Alfred Hospital, Australian Defence Force (Retired))
- Veronica Scott, Partner (Pinsent Masons)
- Dr Michelle Sharpe, Barrister (Victoria Bar)
- Professor Tania Sourdin, Former Law School Dean and President of Academic Senate (University of Newcastle)
- Professor John Tobin, Lecturer and Co-director of Human Rights Law (University of Melbourne)
- Dr Michael Wildenauer, Senior Fellow, Lecturer and Director (Royal Children's Hospital, University of Melbourne)
- Susannah Wilkinson, Director of Generative AI (Digital Change) (HSF Kramer)

The Commission thanks all members of the Expert Advisory Group for their valuable insights and feedback in shaping the final report. All views expressed within the final report, and associated project documents, are the Commission's.

(b) First phase of consultations

From March 2023 to June 2023, the Commission conducted initial consultations exploring the ways that neurotechnology would impact people and their human rights. The feedback and input attained through these consultations helped frame the Commission's priorities and strategic engagement.

(c) Second phase of consultations

In the second half of 2023, the Commission held further consultations. Across 2023, 47 participants gave feedback in discussions with the Commission, while a further 22 provided written input. The crucial insights provided during the first two rounds of feedback helped to inform the Commission's Background Paper.

(d) Symposium on neurotechnology

In June 2024, the Commission held the *Neurotechnology and Human Rights: Opportunities, Challenges and the Pathway Forward Symposium* in partnership with the University of Melbourne Law School. 53 people attended the symposium in-person while a further 34 engaged online.

The one-day event included presentations from:

- **Dr Greg Watkins, Senior Research Engineer (Cochlear):** Presented on the Cochlear Implant, the life-changing benefits experienced by most patients and explaining both how the devices work and raising some of the ethical concerns which may impact neurotechnology.
- **Robert Fitzgerald, Age Discrimination Commissioner (Australian Human Rights Commission):** Discussed how the rights of older people may be impacted by neurotechnology.
- **Stephane Doyen, Co-founder and Chief Data Scientist (Omniscient Neurotechnology):** Provided an industry insight into the efforts of Omniscient Neurotechnology and their work on brain mapping.
- **Carly Kind, Privacy Commissioner (Office of the Australian Information Commissioner):** Presented on the privacy dimensions affecting neurotechnology and what that might mean for regulators.

- **Dr Allan McCay, Co-director of Sydney Institute of Criminology, Academic Fellow (University of Sydney Law School), and President of the Centre for Neurotechnology and Law:** Focused on the ways that neurotechnology could be adopted by the criminal justice system.
- **Julie Inman Grant, Australia's eSafety Commissioner (eSafety Commissioner):** Provided a unique insight into how neurotechnology, especially when integrated into other digital spaces, requires careful considerations in respect of online safety.
- **Frederic Gilbert, Associate Professor (University of Tasmania):** How the field of neuroethics is developing across the globe – providing an important international perspective.

The Symposium provided attendees with an opportunity to join breakout sessions on the impacts and challenges of neurotechnology. A significant focus was placed on these breakout discussions, which allowed for a cross-fertilisation of ideas and responses.

The breakout discussions focused on disability, consumer rights, criminal law, safety, children's rights and broader human rights. Participants were prompted with set questions provided by a moderator in each room to stimulate conversation.

Lorraine Finlay (Human Rights Commissioner, Australian Human Rights Commission), Michelle Sharpe (Barrister, Victoria Bar), Armin Alimardani (Senior Lecturer, University of Wollongong), Adrian Carter (Associate Professor, Monash University) and a representative from the eSafety Commissioner (eSafety) moderated the breakout discussions and subsequently provided feedback on what was discussed in their respective breakout groups. The responses attained through this process have been integral in framing the final report.

(e) Final phase of consultation

Following the Symposium, the Commission continued to seek feedback and input from identified stakeholders as it prepared this final report. This stage involved speaking to regulators for expert feedback, academics, industry, law experts and civil society. The Commission also conducted several interviews with a small group of individuals who have been impacted by implantable neurotechnology.

In Australia there is a small group of people who have received implantable brain computer interface (BCI) devices capable of controlling other devices (such as computers, smart TVs etc). The Commission conducted interviews with recipients (or family members) of the Stentrode BCI (developed by Synchron). Three qualitative semi-structured interview sessions took place in which eight people were present (excluding Commission staff). Most interviewees were family members who attended on behalf of a family member who had passed away, or where a recipient of the Stentrode was unable to freely communicate due to the impacts of a disease.

A constraint of this consultation is the small sample size (due to there being few recipients in Australia), the inability to consult people with other implanted devices and that second hand feedback was provided by family members who survived their loved ones. These interviews allowed the final report to centre its work and recommendations on the human rights of those affected by neurotechnology both now and into the future.

2.4 Innovation agenda

Australia, like many countries across the world, is grappling with how to respond to the challenges and opportunities presented by new and emerging technologies. Driven by an innovation agenda to support the growth of a domestic technology industry, several financial and non-financial initiatives are underway in Australia to build capacity in this emerging industry.

The effort to grow a domestic technology industry has been supported by several regulatory initiatives aiming to place guardrails in place to support innovation, while minimising risk. These range from Australia's efforts to regulate artificial intelligence, strengthen social media laws and reform privacy legislation. From 2016 to 2020, Australia's public investment in neurotechnology totalled $350 million USD.[15]

Neurotechnology is by no means a fringe technology, with the global devices market currently valued at approximately $13.5 billion USD by some analysis.[16] The Regulatory Horizons Council predicts this will grow to $17.1 billion USD by 2027.[17] Australia's own Cochlear Limited (an ASX top 50 company) is already a market leader with a market cap of $17.42 billion AUD alone.[18]

Neurotechnology is an emerging technology which will likely become critical in several applications from health and wellbeing, military application, workplaces and more. There are already several highly successful Australian-based neurotechnology companies, and with research growing daily – there will be many more to come. Australia is well placed to invest in neurotechnology and establish itself as a market leader in the development and deployment of human rights-centred neurotechnology.

2.5 Technology focus

During the earliest stages of consultation, stakeholders raised concerns not only about neurotechnology, but also about pharmaceuticals that interfere with neural activity. The impacts of pharmaceuticals are an important issue with very real human rights consequences for people. The Commission's final report is an analysis of human rights in respect of neurotechnology – as opposed to pharmaceuticals. Pharmaceuticals which interfere with neural activity would benefit from dedicated research, analysis and consultation. This topic is beyond the scope of this report.

In Australia, the *Therapeutic Goods Act 1989* (Cth) governs products defined as therapeutic goods, which can include medicines, medical devices and biologicals. *The Therapeutic Goods (Medical Devices) Regulations 2002* (Cth) regulates medical devices from the perspective of the physical safety of a user. Therapeutic Goods Administration (TGA) is the authority responsible for evaluating, assessing and monitoring products that are defined as therapeutic goods.[19] This report does not consider medical regulation as a primary focus. The Commission would welcome further analysis by experts in this field.

Throughout the report medical neurotechnologies are used as examples and case studies – despite most of this report focusing on non-medical applications. Inferences can be drawn from the challenges and opportunities presented in medical applications and predicatively applied to non-medical applications. A key difficulty of focusing on an emerging technology is that it requires analysis without having a variety of examples to draw from. By looking to examples in the medical field the Commission has been able to anticipate future concerns and opportunities.

3. What is neurotechnology?

There is a range of definitions of neurotechnology used in this emerging field.[20] In this report, the Commission has adopted the definition set out by UNESCO as a leading voice on the international application of neurotechnology:

> ... devices, systems, and procedures—encompassing both hardware and software—that directly measure, access, monitor, analyse, predict or modulate the nervous system to understand, influence, restore, or anticipate its structure, activity, function, (speech, motor). Neurotechnology combines elements of neuroscience, engineering, material science, and computing, among others.
>
> Neurotechnology spans medical and non-medical applications and includes tools that measure, infer, and influence nervous system activity, whether through direct interaction with the nervous system (both invasive and non-invasive) or by interfacing it with devices and systems. Of note, both open-loop (e.g. fixed-parameter brain stimulation) and closed-loop systems (e.g. state dependent stimulation) introduce complex ethical issues.[21]

Deep brain stimulation

PRACTICAL USES

Since 1997, deep brain stimulation has been eliminating tremors associated with Parkinson's disease via electric impulses to the basal ganglia of the brain.[22]

Brain implants are not a fundamentally new technology and have been used in medical procedures for some time.

Cochlear implants

PRACTICAL USES

Cochlear implants are used to mimic the functioning of a functional inner ear. The implants replace the function of 'damaged sensory hair cells inside the inner ear to help provide clearer sound than what hearing aids can provide.'[23]

Cochlear systems contain two parts:

- External sound processor
- Surgically implanted device that is placed under the skin and attached to an electrode array that is placed in the inner ear.[24]

In combination, these parts bypass certain areas of the ear – sending the sound directly to the auditory nerve.

Cochlear implants have been used to provide functional hearing to an estimated 1 million people worldwide.[25]

3.1 Brain-computer interfaces

At the core of many neurotechnology are BCIs.[26] BCIs are devices that connect an individual's brain to a computer or device (e.g. a smartphone or a dedicated signal processor) external to the human body. BCIs facilitate communication between the brain and an external device – either transmitting neural data or possibly altering neural activity.[27]

This can generally operate by implantation inside a person's skull (often via a burr hole or blood vessel) or via a non-implantable wearable device.[28] A non-implantable BCI will generally sit on an individual's head (e.g. helmets and headbands). Wearable BCIs currently dominate the consumer neurotechnology market.[29]

Implantable BCIs are often delivered via surgery inside a person's skull and placed directly on the surface of the brain, or by having penetrating electrode(s) which pierce the surface of the brain.[30] These electrodes can send neural data to a computer for analysis and decoding, or electrically stimulate neural cells in the brain. Other implantable devices, such as deep brain stimulation, are surgically implanted deep within structures of the brain to deliver electrical stimulation to targeted regions.

Stentrode

PRACTICAL USES

Australian founded company, Synchron, works on minimally invasive implantable BCI devices, and is an endovascular BCI leader.[31] Synchron is developing the 'Stentrode' which can be inserted into the brain via blood vessels and used for controlling computers and addressing neurological impairments such as paralysis.[32]

In July 2022, Synchron was the first company to utilise an endovascular BCI approach in the United States (US). This technology will have significant implications for the scalability of neurotechnology as this approach does not require open-brain surgery.[33]

3.2 Other technologies interacting with neurotechnology

As technologies (such as artificial intelligence) evolve and interact with neurotechnology, the potential applications expand and become more complex – and so too do the challenges.

The use of these technologies is allowing people to do things they otherwise couldn't:

> **... this trial was going to give him freedom to search the Internet, to play games, to control the TV. It was extremely important for his well-being and mental stability.**

> **... he could still cheer for Collingwood on the TV.**

It has even allowed one early patient to use their device and thought alone to tweet the following on X (formerly twitter):

> **hello, world! Short tweet. Monumental progress.**[34]

(a) Artificial intelligence

The integration of artificial intelligence (AI) within neurotechnology will help to provide insights into brain activity and human behaviour.[35] Algorithms may be used to 'translate' brain signals into instructions to automate a device. For example, this can allow neural information to operate a BCI-driven prosthetic limb.[36]

Recent work has shown how neurotechnology and large language models (LLMs) can turn brain activity into words.[37] In an experiment, AI was capable of 'translating' private thoughts into readable language by analysing functional magnetic resonance imaging (fMRI) scans (which measure the flow of blood to different regions of the brain).[38]

Brain activity and written language

PRACTICAL USES

As part of an experiment, participants listened to a recorded story while undergoing fMRI scans. While most of the words were out of place, the basic meaning of the passage was preserved.

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.[39]

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.[40]

(b) Neuroimaging

Neuroimaging is a technique often used to produce images of the brain's structure and neural activity.[41] Commonly this technique is used to scan the brain using electroencephalography (EEG) and fMRI.[42] Commonly EEG's are used to monitor and diagnose conditions such as epilepsy – meanwhile fMRI is often used to map brain activity and functions.

EEG and fMRI

PRACTICAL USES

EEG measures the electrical activity of the brain through the skull, via electrodes placed on the scalp. It provides a method to decode and comprehend the brain's electrical signals.[43] It is very low resolution, with each electrode recording the combined activity of hundreds of millions of neurons. This method is increasingly commonplace, as it is affordable and provides easy access to neural information.[44]

fMRI allows for the measurement of cerebral blood flow as a marker of brain activity.[45] Its resolution is higher than EEG, but the equipment is far larger and more expensive.[46]

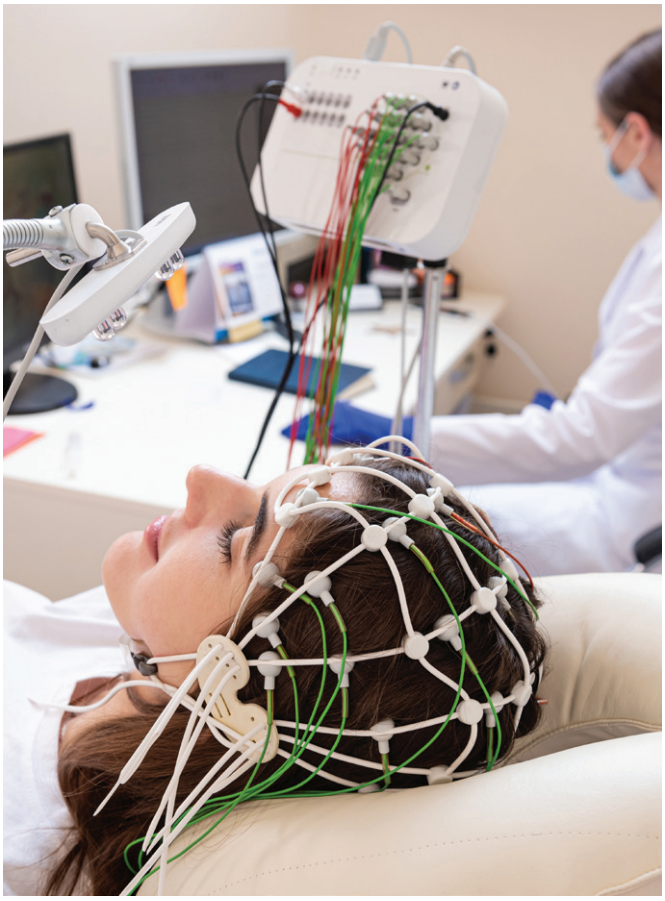
(c) Neurostimulation and neuromodulation

Neurostimulation and neuromodulation will generally be used to activate and regulate neuronal activity in the brain and nervous system. Both procedures may be conducted either by invasive or non-invasive means. Neurostimulation is commonly used for chronic pain management – while neuromodulation can also address issues related to movement.

Neither technique is 'writing' instructions to the brain – but rather sending electrical or magnetic signals to modulate neural activity.[47]

(d) Neurofeedback

This technique seeks to alter electrical waves to create a healthier pattern. Neurofeedback therapy is usually non-invasive, providing users with a measurement of their brainwaves recorded by EEG in real time– allowing them to better monitor and regulate their mental state.[48] Neurofeedback may be used to address anxiety, depression and sleep patterns.[49]



4. Freedom of expression

The right to freedom of expression is critically important for participation in society and a necessary precondition for the protection and promotion of other rights and freedoms.[50] For example, free expression is required to exercise the right to vote and take part in public affairs.[51] The ability to freely communicate is also essential to promote the right to the highest standard of health,[52] as people need to be able to seek, receive and impart information about their health, symptoms and treatment options in order to make informed decisions and advocate for appropriate healthcare services.

While much of this report considers the human rights challenges associated with neurotechnology, this chapter specifically considers how neurotechnology can provide opportunities for rights fulfilment. This chapter focuses primarily on medical devices that can enable or improve communication.

Freedom of expression

The right to freedom of expression is recognised as a fundamental human right and has been described as constituting 'the foundation stone for every free and democratic society'.[53]

It is enshrined in a range of international and regional human rights instruments, including art 19 of the Universal Declaration on Human Rights (UDHR) and art 19 of the International Covenant on Civil and Political Rights (ICCPR).[54]

At its most foundational level, free expression requires the ability to communicate with others through a variety of means – including audio-visual, electronic and internet-based modes of expression.[55] This reaffirms that those communicating via BCI-enabled devices would have their right to free expression promoted under art 19 ICCPR.

However certain impairments make it increasingly difficult, if not impossible, for some people to communicate. Examples include forms of paralysis which can be associated with Motor Neuron Disease (MND) or Amyotrophic Lateral Sclerosis (ALS). Neurotechnology promises to restore or improve communications for people experiencing paralysis (or impairment which impedes communications) by removing communication barriers.

As recently noted by Dr Tom Oxley, CEO of Synchron:

> BCIs preserve and extend a fundamental human right: the freedom of expression. We take our autonomy for granted, until it is gone. This is a pivotal moment [the successful use of a large language model and Synchron's BCI] at the convergence of powerful technologies that can restore lives.[56]

Interviews conducted by the Commission showed that people with lived experience of having an implant, or living with someone who had an implant, often emphasised the important role that neurotechnology played in communication. Interviewees reported that neurotechnology provided a way to express themselves when diseases like MND or ALS impacted their ability to communicate:

> **It's just it's given him a way of expressing himself. He can write things to me, which are fascinating to read.**

> **That ability to have real interaction with people, because that's what [the implant] was bringing back.**

> **He was very concerned that he would lose his voice and not be able to communicate with his family.**

> **I think the stent gave [anonymised name] freedom.**

> **I think from a human rights point of view that's the absolute number one take away from our conversation today. It gave [anonymised patient] independence right to the end.**

One pioneering user of an implant used his BCI to write a book detailing his perspective and journey – having been the first to be implanted with the Stentrode.[57] Writing about his experiences throughout this journey, Graham Felstead regarded the device with gratitude describing it as 'telepathy':

> Usually they [people using telepathy] were presented through the skill of magicians to convince the viewer they could read your mind, that is until they revealed the trickery. … But now telepathy has become a reality manifested in the application of a brain neural interface system to a computer, best encapsulated by the term 'Technopathy'.[58]

While the examples used in this chapter demonstrate the potential for neurotechnology to promote freedom of expression for people who would otherwise be restricted from enjoying this right by illness or injury, the technology also has potential risks for freedom of expression. There may be developments in the future which pose additional and unforeseen risks to free expression.

4.1 Access to information

Article 19(2) ICCPR provides that all people have the right to seek and receive information – embedding a right to access to information. Access to information is critically important to remain connected with community, health and wellbeing, civic participation and much more. Enabling people experiencing paralysis to access information means they are better positioned to enjoy and enforce their rights autonomously and confidently.

Neurotechnology is allowing people to access information by enabling people to continue to use the internet. Consultation with interviewees reflected this – with several people indicating that despite paralysis, those utilising an implant were able to continue searching the web, read the news, watch TV and more. This provides people with a way to seek and receive information autonomously via their BCI – whereas previously they may have had to rely upon the assumptions of people supporting them.

> **The trial [of an implanted device] was going to give him freedom to search the Internet, to play games, to control the TV. It was extremely important for his well-being and mental stability.**

Neurotechnology provides a unique opportunity for rights fulfilment – as it can remove previously impenetrable communication barriers to access information and express oneself.

4.2 Restrictions

The right to freedom of expression is not absolute, and its exercise carries with it special duties and responsibilities. The right may be subject to certain restrictions, however any restrictions must be provided for by law and may only be imposed for one of the grounds set out in art 19(3) ICCPR; namely 'for respect of the rights or reputations of others' or 'for the protection of national security or of public order or of public health or morals'.[59]

Any such restrictions must also meet strict tests of necessity and proportionality. This requires that any proposed restriction pursues a legitimate aim, is proportionate to that aim, and is no more restrictive than is required for the achievement of that aim.[60]

In particular, the UN Human Rights Committee has highlighted that,

> when a State party imposes restrictions on the exercise of freedom of expression, these may not put in jeopardy the right itself. The Committee recalls that the relation between right and restriction and between norm and exception must not be reversed.[61]

It is possible that where Government law or policy denies, or places insurmountable barriers to accessing neurotechnology that is essential for some people to freely communicate, this could constitute a restriction on freedom of expression. Not only should governments support human rights-centred innovation in neurotechnology, but decision-makers must also be conscious where they seek to prohibit or reduce access to the technology of the impact this may have in limiting human rights benefits.

5. Right to Privacy

The right to privacy is a cornerstone right that underpins freedoms of association, thought and expression, as well as freedom from discrimination.[62] It also underpins human dignity, safety and self-determination. Yet what is considered 'private' can be difficult to define and protect. Chief Justice Gleeson once stated:

> There is no bright line which can be drawn between what is private and what is not. Use of the term 'public' is often a convenient method of contrast, but there is a large area in between what is necessarily public and what is necessarily private.[63]

Human right to privacy

Article 12 UDHR states:

> No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour 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.

Technology has heightened the importance and complexity of privacy protections in the 21st century, as without it 'digital tools can be turned against [people], exposing them to new forms of monitoring, profiling and control'.[64]

It is within this environment that the Australian Government has promised to reform the *Privacy Act 1989* (Cth), with the Attorney-General stating that it has '... not kept pace with changes in the digital world'.[65] Despite years of consultations and input from legal experts, civil society, human rights advocates, academia and many more the full suite of proposed reforms have yet to be implemented. In late 2024 modest reform was passed which made some important changes, but it was nowhere near the reform that was agreed to and promised by Government. Unless necessary reforms are progressed with greater urgency, the right to privacy remains vulnerable in digital spaces.

Neurotechnology exacerbates this vulnerability as the technology challenges what is private and what is not, as it can reveal information not previously accessible. This has serious implications for informational and physical privacy.

Interviewees expressed their concerns about privacy – raising legitimate questions about how their neural data is treated by third parties:

> **I don't know if you've both got iPhones, but every time they send an update you've got to go searching to find out what they've turned on for privacy. You don't want to send all the stuff [neural data] everywhere.**

5.1 Risks to privacy

Vint Cerf, Vice President and Chief Internet Evangelist at Google, once stated that 'privacy may actually be an anomaly'.[66] It is possible that in an age of neurotechnology this statement could come to fruition.

Neurotechnology can record vast quantities of neural data that may be accessed, collected, stored, shared and used or exploited without genuine consent.[67] Neural data is highly sensitive and valuable because it can provide unprecedented insights into human thought processes and functions.[68] The collection of neural data may, in the future, make it possible to track, analyse and predict the actions, emotions and attitudes of individuals – potentially before the individual is even conscious of these things themselves.[69]

It has also been suggested that as neural data becomes better understood, it may one day be possible to reveal additional information such as sexual orientation, religious beliefs or political affiliations. This could lead to discrimination and prejudicial treatment.[70]

The use of neural data could range from marketing companies using 'nudging' techniques to steer consumers to purchase certain products, employers monitoring worker concentration levels or school children being assessed on their attention and learning in class.[71] It is possible that political advertisers could one day utilise neural data to manipulate democratic processes. By collecting the neural information of voters in real time, political parties may one day be capable of isolating exactly what issues will change the vote of an individual voter and then tailor their messaging to ensure that each individual voter is told exactly what they want to hear.

Data sharing

Although this chapter primarily focuses on consumer devices, neurotechnology will also have potentially beneficial applications in medical settings.

During consultations, a number of experts raised the potential benefits of allowing the neural data of patients to be shared between private companies, particularly in terms of enabling innovation within the medical field and improving patient safety.

If medical companies share this type of information, they could potentially better understand neural data and increasingly map the brain of patients.

While this may improve health outcomes and assist both medical advances and private enterprise, the Commission also heard that such information-sharing poses serious risks to people's privacy. Given the risks to privacy (as noted in this chapter), neural data requires strict privacy protections.

5.2 *Privacy Act 1988* (Cth)

The *Privacy Act 1988* (Cth) (Privacy Act) is the foundational privacy legislation in Australia. It regulates the collection and handling of information that falls within its remit. Currently, the Privacy Act does not provide any express protection for neural data.

The Privacy Act is principle and risk-based legislation that emphasises a technology-neutral and flexible framework for regulating how entities collect, use and disclose regulated information. This means that it should be adaptable to changing technologies and environments, including neurotechnology.

The Privacy Act was recently amended by the *Privacy and Other Legislation Amendment Act 2024* (Cth) (Privacy Amendment Act). However, the Privacy Amendment Act contained only a fraction of reforms committed to by the Australian Government in the *Government Response to the Privacy Act Review Report*. Although these initial reforms are considered a first tranche, the Commission has previously called for the Australian Government to set out a timeline for the outstanding reforms.[72] These reforms are needed to ensure both that the privacy laws in Australia are fit for purpose in the digital age and that neural data is protected.

Recommendation 1:

The Australian Government set out a clear timeline for when each 'agreed' and 'agreed in principle' amendment to the Privacy Act will be introduced in future tranches and prioritise the passage of these reforms.

(a) Informed choice

Australia's approach to privacy currently places the onus on individuals to be responsible for the protection of their data. Individual notice and consent are foundational in this regime and are intended to empower individuals to make choices and exercise control over their own information.

This model has serious limitations as it requires information handling practices to be accessible, current and understandable. The length and language of collection notices and privacy policies make them notoriously difficult for people to understand. To protect the rule of law, it is essential that ordinary people and businesses can understand data collection laws – as it is always more difficult to comply with relevant laws if you cannot understand them.

The Consumer Policy Research Centre has estimated that it would take an ordinary person approximately 14 hours to read the privacy policies associated with sites and apps they visited during a 24-hour period.[73] This makes it nearly impossible for people to understand:

- what types of information are being collected
- who is collecting the information
- who the information will be shared with
- for what purpose the information is used and shared
- how the information may be used.[74]

As part of future reforms to the Privacy Act, the Australian Government has committed to addressing the complexity and accessibility of collection notices and privacy policies.[75] However this reform was not included in the first tranche of amendments that were recently legislated.

It is important that people can understand risks to privacy and make informed decisions about their neural data. Potential reforms to the Privacy Act could reinforce the importance of consent by legislating the requirement that lawful consent must be voluntary, informed, current, specific and unambiguous.[76]

Ensuring informed choice is particularly important as the potential power imbalance between neurotechnology companies and end-users is significant. Individuals could face a difficult choice between accessing the benefits of the technology at the cost of their neural data privacy or preserving their privacy by forgoing access to the technology altogether.

While sharing data can facilitate innovation, providing access to the benefits of neurotechnology should not be contingent on an individual consenting to sale or commercial exploitation of their neural data.

Given the importance of neural information, it is crucial that people have a clear understanding of how their data may be used. A recent report

by the NeuroRights Foundation found that of 30 analysed neurotechnology companies producing consumer products, only one had limitations on how neural data is accessed,[77] while 24 could sell such data.[78]

Recommendation 2:

Neurotechnology companies create plain-English privacy policies and collection notices.

(b) Personal and sensitive information

The meaning of neural data and how it interacts with the Privacy Act has yet to be judicially tested. As noted in the Background Paper, a key consideration will be whether neural data is classified as 'personal information' or 'sensitive information'.[79] Whether information is personal or sensitive will determine the level of protection afforded under the Privacy Act. Sensitive information is afforded greater protection under the Privacy Act and, unless an exception applies, requires consent for collection and processing.[80]

Personal information

LEGAL

'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.[81]

The Australian Government has agreed in principle to amending the definition of personal information.[82] The word 'about' will be replaced with 'related to' to clarify that personal information is expansive and includes technical and inferred information.[83]

This amendment was not included in the Privacy Amendment Act.

Reform to the definition of personal information should be supported by a non-exhaustive list of information that may be considered personal information to assist entities in identifying what types of information could fall within the definition.[84] Relevantly, for the purposes of neural data, the Australian Government's 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.[85]

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 neurotechnology may be considered personal information under the Privacy Act if it is information about an identified or reasonably identifiable individual.

Sensitive information

LEGAL

'Sensitive information' means, at the time of writing:

> (a) Information or an opinion about an individual's:
>
> i. racial or ethnic origin;
>
> ii. political opinions;
>
> iii. membership of a political association;
>
> iv. religious beliefs or affiliations;
>
> v. philosophical beliefs;
>
> vi. membership of a professional or trade association;
>
> vii. membership of a trade union;
>
> viii. sexual orientation or practices; or
>
> ix. criminal record,
>
> that is also personal information.
>
> (b) health information about an individual;
>
> (c) genetic information about an individual that is not otherwise health information;
>
> (d) biometric information that is to be used for the purpose of automated biometric verification or biometric identification; or
>
> (e) biometric templates.[86]

The Australian Government has agreed in principle to amend the above definition to include 'genomic' information. Consistent with changes proposed to the definition of 'personal information', the word 'about' will be replaced with 'related to'.

Reforms will also hopefully clarify that sensitive information can be inferred from information that is not sensitive.[87]

These amendments were not included in the Privacy Amendment Act.

The information collected, used and disclosed by neurotechnology may also meet the current definition of 'sensitive information' under the Privacy Act. For example, in certain circumstances it may be considered health information.[88]

Whether neural data would be classified as 'personal' or 'sensitive' information under the current definitions needs to be clarified to ensure the human right to privacy is not diminished by legislative uncertainty. This clarity will also provide certainty to companies to ensure they can innovate with clear legal guardrails surrounding the collection, use and processing of neural data.

However, it is unlikely this issue will receive judicial consideration or direct parliamentary attention soon. Australia is now at risk of falling behind international developments in this space.

Privacy initiatives are being advanced overseas to provide protection for neural data. For example in the US, Colorado signed House Bill 24-1058 to define and protect neural data[89] and California has now amended the *California Consumer Privacy Act 2018* to extend existing consumer protections to an individual's neural data.[90]

There is also significant work being done in the United Kingdom (UK). The UK Information Commissioner's Office (ICO) has already published a report on the privacy risks associated with neurotechnology. It is expected that in the coming year it will produce guidance for how the privacy risks associated with neurotechnologies can best be addressed.

Other legislative initiatives

- Brazilian discussions have taken place seeking to protect neural data via the Brazilian General Data Protection Law (see e.g. Bill 522/2022). Further, constitutional amendments protecting mental integrity and algorithmic transparency are also underway (see e.g. 29/2023). Rio Grande do Sul has amended its constitution to incorporate neurorights.[91]
- Spain has included 'neurodata' specific sections in its Digital Rights Charter.[92]
- Chile has worked to introduce neural protections into its national legal system via constitutional amendment.[93]
- In Argentina draft amendments to the Criminal Procedure Code addressed neurorights – expressly guaranteeing mental privacy and ensuring the protection of neural data.[94]
- Columbia's Chamber of Representatives has already discussed laws to protect personal data. These laws would protect human rights and considers neural data as sensitive data.[95]
- In 2023 Ecuador considered a draft bill seeking to address the ethical applications of neurotechnology.[96]

With privacy legislation and regulator activity advancing in other jurisdictions to protect neural data, and ambiguity existing in the current Australian legislative landscape, serious consideration must be given to how neural data is protected at law in Australia. The Special Rapporteur on the right to privacy has even recommended that States should:

> Promote the regulation of neurotechnologies and the processing of neurodata. It is essential that each country develop a specific regulatory framework for neurotechnologies and neurodata, given their potentially profound impact on privacy, human dignity and fundamental rights.[97]

As a starting point, guidance should be developed to explain how neural data is treated under the Privacy Act.

Recommendation 3:

The Australian Government resource the Australian Human Rights Commission and Office of the Australian Information Commissioner to produce guidance on the treatment of neural data and neurotechnology under the Privacy Act.

(c) Fair and reasonable

The Australian Government has agreed in principle to amend the Privacy Act to require that the collection, use and disclosure of personal information be 'fair and reasonable in the circumstances'.[98] If enacted, this would create a positive obligation on entities subject to the Privacy Act to consider the foreseeable risks and impacts caused by information handling.

This obligation could provide a baseline protection of neural data where it is considered personal information. This test would be supported by certain legislated factors including consideration of:

- the kind, sensitivity and amount of personal information being collected, used or disclosed
- the risk of unjustified adverse impact of harm, among other considerations.[99]

A recent Office of the Australian Information Commissioner (OAIC) survey found that nine in 10 people have a clear understanding of why it is important to protect personal information.[100] Yet only 32% felt 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]

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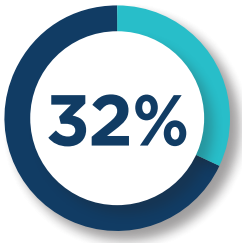


felt in control of their privacy

believed that if they want to use a service, they have no choice but to accept what the service does with their data

The existing model of privacy protection does not acknowledge the substantial power imbalance between companies and individual users – especially where mental augmentation offers the potential for improving quality of life for consumers or patients.

The proposed introduction of the 'fair and reasonable' test could go some way to addressing these issues. This test would apply regardless of (or in addition to) requirements for consent, meaning that organisations would not be able to use consent obtained through complex and lengthy privacy policies and collection notices, or a bundled collection notice, as a 'shield' for excessive data collection or repurposing.

Given the benefit this reform offers in the protection of neural information it is disappointing it was not included in the recent Privacy Amendment Act. With no express roadmap for this reform it is unclear when, if at all, Government will introduce the 'fair and reasonable' test as a legal requirement.

(d) Privacy impact assessments

The fair and reasonable obligation may be further supported by privacy impact assessments (PIA) for data processing activities with high privacy risks.[102]

High privacy risk

LEGAL

A high privacy risk activity is one that is 'likely to have a significant impact on the privacy of individuals'.[103]

The Australian Government has agreed in principle that OAIC should provide guidance that:

> articulates factors that may indicate a high privacy risk, and provides examples of activities that will generally require a Privacy Impact Assessment to be completed. Specific high-risk practices could also be set out in the Act.[104]

A PIA is an assessment that can identify privacy impacts a project might have on individuals, and sets out recommendations for managing, minimising or eliminating those impacts. This is a well-developed method to address the privacy-related impacts of new technologies.

Currently, Commonwealth government agencies are required to complete a PIA for all high privacy risk projects.[105] The proposed reform would require private sector entities to also conduct a PIA for activities with high privacy risks.[106] While an onerous obligation, it is an important initiative to protect the privacy of people using devices. Feedback throughout this project highlighted that PIAs place a significant burden on small-to-medium sized clinical trials seeking to develop medical devices. While PIAs should be required due to the privacy risks inherent in neurotechnology trials, support and guidance for these organisations should be offered to help these organisations navigate their privacy obligations.

It is likely that a significant portion, if not all, neurotechnology products will have a significant impact on the privacy of an individual. Accordingly, if this reform is introduced, companies will be required to conduct PIAs for their activities prior to the commencement of projects.[107]

While PIAs are an important safeguard, a more holistic approach would be for neurotechnology companies to conduct human rights impact assessments (HRIA) which would capture privacy risks in addition to broader human rights concerns. When used properly HRIAs build safeguards into the product at all stages and work as a risk management tool for companies – reducing liability while protecting rights.

5.3 A statutory tort

The Privacy Amendment Act created a statutory tort for serious invasions of privacy that are intentional or reckless.[108] The tort is confined to invasions either by intrusion upon seclusion or misuse of private information.[109]

This was based on the Australian Law Reform Commission's (ALRC) Report 123, which considered how Australian law should be reformed to prevent and remedy serous invasions of privacy. The essential elements of the tort are:

- the invasion of privacy must be either by intrusion into seclusion or by misuse of private information
- it must be proved that a person in the position of the plaintiff would have had a reasonable expectation of privacy in all of the circumstances
- the invasion must have been committed intentionally or recklessly – mere negligence is not sufficient
- the invasion must be serious
- the invasion need not cause actual damage, and damages for emotional distress may be awarded
- the court must be satisfied that the public interest in privacy outweighs any countervailing public interests.[110]

It is currently judicially untested if the misuse of neural data would allow a plaintiff to bring a cause of action under the tort. However, it is possible that companies that develop and deploy neurotechnology and those that collect, hold, use and disclose neural data may face a greater exposure to liability.

Neurotechnology companies, and organisations that interact with such devices or neural data, will need to ensure that they have sufficient privacy safeguards in place if they wish to avoid potential liability under this new cause of action.

6. Freedom of thought

All people have a right to 'develop thoughts autonomously, free from "impermissible" external influence'.[111] The human right to freedom of thought, conscience and religion or belief may be uniquely vulnerable to the risks presented by neurotechnology. The right contained in art 18 ICCPR is 'far reaching and profound' and captures freedom of thought on all matters and personal convictions.[112] Freedom of thought is considered part of an individual's *forum internum* (internal realm) and is non-derogable, which means that it cannot be suspended even during times of public emergencies.[113]

Human right to freedom of thought, conscience and religion or belief

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

> 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 the immense importance of freedom of thought, international human rights law on the scope and limitations of the freedom are underdeveloped and poorly understood.[114] Often described as a 'forgotten freedom',[115] the challenges and opportunities posed by neurotechnology cast an unprecedented light on the freedom.[116]

While interviewees primarily reported positive experiences. People did raise questions about what happens to neural information:

> **I wanted to know who owns the information, because it is really the person's thoughts... You know who is it going to? Is it the company that put the piece of equipment in the person's brain? ... I think it should belong to the person cause its theirs.**

The UN Special Rapporteur on Freedom of Religion or Belief has noted that freedom of thought is underdeveloped and that:

> Further clarity on the legal concept and scope of freedom of thought is desirable in helping to respect, promote and fulfilled this fundamental right.[117]

Equally, there has been support for countries to update or adopt legal and policy safeguards to prevent the violation of this right.[118] It is widely accepted that contemporary legislative regimes are unprepared for emerging neurotechnology and the implications it will have for freedom of thought and other rights.[119]

Recommendation 4:

The United Nations Human Rights Committee provide guidance on freedom of thought and neurotechnologies through the adoption of a general comment on article 18 of the International Covenant on Civil and Political Rights.

6.1 Four pillars of free thought

The Special Rapporteur on freedom of religion or belief (whose mandate also extends to freedom of thought) has reported that freedom of thought includes four key pillars:

- freedom not to disclose thoughts
- freedom from punishment for thoughts
- freedom from impermissible alteration of thoughts
- an enabling environment for freedom of thought.[120]

Freedom to not reveal thoughts protects all people from being compelled to reveal their thoughts,[121] which confirms that mental privacy is a foundational element of free thought.[122] Neurotechnology can decode neural activity or draw inferences from neural data in a way that reveals how a person feels or how they are internally reacting to something. Without privacy safeguards in place, this core pillar will be undermined in a critical way that threatens both freedom of thought and the right to privacy.

The second pillar protects people from being **punished for their thoughts** – be they real or inferred.[123] People are free to think about whatever they wish given that any limitation on thoughts, conscience and beliefs are impermissible.[124] This protection applies to both actual thought and inferred thought.[125] This distinction is critically important in respect of neurotechnology which is not capable of 'mind reading' per se, but is capable of inferring emotions and internal reactions based on neural data.

The freedom also protects people from **impermissible alteration of thought.**[126] There are three types of impermissible alterations that may violate freedom of thought:

- coercion
- modification
- manipulation.[127]

Protection against coercion is enshrined in art 18(2) ICCPR which protects against 'coercion which would impair [the] freedom to have or to adopt a religion or belief [of choice]'. This would protect people from being subject to the nonconsensual use of neurotechnology devices that may alter thought or neural patterns or behaviours.

Modification is more relevant to neurotechnology as it protects people from changes to a person's 'thoughts' via direct alteration of brain function.[128] Deep brain stimulation is already used to modulate brain activity in medical settings – where this is not done with full and informed consent, there may be a breach of human rights law.

Finally, manipulation refers to active engagement and control of psychological processes, as opposed to modification which directly alters biological function.[129] Neuromarketing, for example, uses neural information to provide highly tailored and exploitative advertisements (discussed below) poses a particular risk as it exceeds mere persuasion and reaches the level of engaged manipulation of a person's thoughts and decisions.

The fourth pillar enables an **environment for free thought** as States have a positive duty to support freedom of thought.[130] One key way this can be achieved is by ensuring access to information (also discussed above in respect of free expression) to support critical thinking. In this respect, neurotechnology presents an opportunity for rights promotion as some devices can enable people with disability to access information online where they may be experiencing impairments such as paralysis. As noted by the Committee on the Rights of Persons with Disabilities:

> without access to information and communication, enjoyment of freedom of thought [...] for persons with disabilities may be seriously undermined and restricted.[131]

6.2 Neuromarketing

Neural data can be used to identify patterns in individuals' mental states, behaviours, attention and focus.[132] These factors can profoundly influence behaviour,[133] as their data can provide 'more objective and truthful measures about a customer's preferences'.[134]

Neurotechnology could play a critical role in the deployment of 'neuromarketing' strategies. Neuromarketing is the measurement of neural signals to better understand consumers, and accordingly 'inform creative advertising, product development, pricing and other marketing areas'.[135]

This novel form of neurotechnology-informed microtargeting allows marketing organisations to use large volumes of personal online data in conjunction with collected neural data to examine the links between emotional responses and consumer behaviour.[136] Companies may use the gathered data to 'nudge' individuals towards certain behaviours, including purchasing goods and services that they do not need or even truly want.[137]

The Special Rapporteur on freedom of religion or belief has raised serious concerns about the targeting and tailoring of messaging across platforms and the impact it has on freedom of thought.[138]

The use of neuromarketing in political advertising is a particularly disturbing example of how neurotechnology can impact freedom of thought. Neurotechnology can provide intimate insights about an individual – such as which party a person may vote for in an election. This may allow for neuromarketing by political-inclined bodies to personalise and target advertising in a manner which undermines not only the right to develop thoughts free from interference, but may also undermine democracy.

The Constitutional Court of Spain has previously ruled that the constitutional principle of 'ideological freedom' was threatened by political microtargeting that could '...modulate, or even manipulate, political opinions'.[139] People need to be able to think freely and make informed decisions when voting,[140] and neuromarketing presents an impermissible alteration of thought which is at odds with the right to free thought.

Recommendation 5:

The Australian Government legislate to prohibit the use of neuromarketing for political advertising, polling research and other consumer purposes.

6.3 A novel approach to human rights

There has been much discussion surrounding how to best protect human rights from the adverse impacts of neurotechnology. In particular, whether new human rights focused directly on protecting the human mind (e.g. right to mental privacy, cognitive liberty etc) should be created, or if it is better to interpret and adapt existing rights in response to new technology.

The call for new rights – often called neurorights – is predicated on the basis that existing rights are insufficient to protect against the misuse of neurotechnology. When traditional rights were created, the ability to monitor, store and alter neural activity was science fiction. Now that the technology exists, questions are emerging about how effective these instruments are, and if new rights are required.[141]

Alternatively, existing rights can be interpreted and adapted to provide better protection for the human mind. The human rights framework is designed to be adaptable to circumstances and enduring – this allows it to respond to new and emerging technologies.

At the international and transnational level, these debates appear to be settling in favour of interpreting and adapting existing rights. Given this context, and this report's focus on the practical steps that Australia should take, the broader discussion of neurorights is outside the scope of this report.

7. Criminal justice implications

The potential applications of neurotechnology in the criminal justice system attracts considerable interest. In future years, neurotechnology may play an increased role in Australia's criminal justice system, as it may be used by law enforcement, prosecutors, defendants and courts during investigations, trials and sentencing.

Determining whether and in what circumstances neurotechnology should be used in criminal justice settings is incredibly difficult. This requires targeted consultation, research and consideration in a standalone report. This chapter provides some initial observations of relevant risks and benefits and recommends that the Attorney-General request that the ALRC conduct an inquiry into the use of neurotechnology in the criminal justice system.[142] Until expertise and time can be put towards examining the opportunities and risks of neurotechnology in the criminal justice system, it will be necessary to introduce a moratorium. This is a necessary requirement to ensure that the rights of people in the criminal justice system are not unduly impacted.

Recommendation 6:

The Attorney-General refer to the Australian Law Reform Commission an inquiry to consider the potential application of neurotechnology in the criminal justice system, and examine in what circumstances (if any) it can be appropriately used. Until this work is completed there should be a moratorium on the use of neurotechnology in the criminal justice system.

7.1 Criminal Investigation

Neurotechnology may have a range of applications during criminal investigations, including as a form of lie detection and as a tool to allow for memory recovery.

(a) Lie detection mechanisms

The UN has stated that the use of neurotechnology as a form of lie detection is particularly concerning, and claimed that neurotechnology is already being used for this purpose.[143] Under international human rights law all people charged with a criminal offence have a right not to be compelled to testify against themselves or to confess guilt.[144] This means there can be no direct or indirect physical or psychological pressure to secure a confession or testimony.[145] The use of neurotechnology as a means of lie detection may threaten this human right if alleged offenders are pressured into complying with neurotechnological tests.

Lie detector mechanisms (such as polygraph testing) have been used by authorities since the 1940s.[146] However, there is well established scepticism surrounding their use due to their reliance on physiological responses to determine guilt. Neurotechnology could allow law enforcement to question people and attempt to detect falsehood by monitoring neural data and associated processes.

On the most basic level, operators of neurotechnology claim to be able to detect the presence of concealed information through the monitoring of brain waves. This is done via technologies such as EEG, fMRI, positron emission tomography (PET) and single-photon emission computed tomography (SPECT) – a method otherwise known as 'brain fingerprinting'.[147] This involves brain-based lie detection where officials monitor whether the regions of the brain involved in lying are activated during questioning.[148]

This same approach applies in conducting the 'guilty knowledge test', which involves the detection of 'guilty knowledge' or recognition evidence related to a crime.[149] For example, police in Dubai are alleged to have already acquired

neural devices which have been used in their investigations to determine if a suspect has a guilty mind.[150] Authorities claim this information can be used to determine a person's involvement in a case.[151]

Neuroimaging as a mechanism to determine guilt

PRACTICAL USES

United States: In 1999, Dr Lawrence Farwell administered 'brain fingerprinting' in conducting the 'guilty knowledge test' to determine whether the serial killer J. B. Grinder raped and murdered Julie Helton.[152] After agreeing to do the test, it detected that specific details of the crime were recorded in Grinder's brain, with a statistical confidence of 99.9%. Grinder later pled guilty to rape and murder and was sentenced to life without parole.[153]

In addition to monitoring falsehoods, neurotechnology could be used to reduce the ability of people to lie. For example, 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.[154]

This means that a person will have a reduced ability to detect and protect themselves from making risky decisions (e.g. divulging the truth because they have a guilty conscience, despite the risk of being convicted).[155] This can be detected by law enforcement through the slowing of reaction time whenever a response is untruthful.[156]

While being able to detect lies and reduce the ability of people to lie has obvious benefits from the perspective of law enforcement, the use of neurotechnology during a criminal investigation can also have severe consequences for accused people's rights.[157]

The right to remain silent and not to self-incriminate is a right afforded to anyone charged with a criminal offence.[158] This right is found in art 14.3(g) ICCPR, domestically enshrined in state legislation (e.g. *Evidence Act 1977 (QLD)*) and the common law.[159] This ensures that the prosecution cannot use evidence '... obtained through methods of coercion or oppression in defiance of the will of the accused'.[160]

The right to remain silent not only protects against direct pressure but also indirect pressure, which may arise in informing an accused of the consequences of refusing to undergo questioning via neurotechnology. For example, if an accused was offered the opportunity for a reduced sentence or some level of immunity in exchange for consenting to the use of neurotechnology during questioning by police, it would be difficult to argue that any consent given was entirely voluntary.[161]

Considering the imbalance of power in a criminal investigation and the indirect pressure that might attach by virtue of the consequences of refusing to consent to the use of neurotechnology during questioning, this could foreseeably have serious implications for the right to remain silent and not self-incriminate.[162]

In *R v Murray,* Justice Sinclair of the District Court of New South Wales found that the sole purpose of evidence from a lie detection test in that particular case – where it was being tendered by the accused as exculpatory evidence – was to bolster the credibility of the accused as a witness, which was a matter for the jury to assess.[163] The use of polygraph testing is specifically regulated in New South Wales (NSW) through the *Lie Detector Act 1983 (NSW)* which, among other things, renders lie detection evidence inadmissible in court and prohibits its use to determine honesty in employment settings. Utilising neurotechnology in criminal investigations may provide law enforcement with greater accuracy of information when conducting investigations. This could have benefits to victim survivors of crime and reduce the number of wrongful convictions via exculpatory evidence (if the technology is accurate and sufficiently reliable). However, given neurotechnology's ability to overtake a jury's role in assessing witness credibility and determining truth – in conjunction with grave risks to the right to silence, it is preferable to err on the side of caution.

The Commission's preliminary view is that a moratorium on the use of neurotechnology in criminal investigations should be imposed until the ALRC has published the findings of the recommended inquiry. Additionally, until that time, information gained via neurotechnology should be inadmissible at trial.

7.2 Memory recovery

Having an accurate timeline and recollection of events has always been vital to the success of a criminal investigation. Due to issues like acute shock or the extended time between the event occurring and witness testimony, it can be difficult to determine whether the original memory has deteriorated, or the testimony is potentially mistaken.

There have been numerous attempts to enhance eyewitness testimony – from administering drugs during questioning, hypnosis and guided meditation. However, such methods carry an increased risk of creating false memories, ultimately going against the purpose of using such processes in the first place.[164]

Non-invasive neurotechnology may allow for memory recovery where TMS is administered in areas of the brain responsible for memory retrieval (e.g. the temporal lobes and hippocampus).[165]

The concern in using neurotechnology is that memories will be recovered via an intrusion into a person's mental privacy and integrity, when they might otherwise be forgotten.[166] Technology such as TMS stimulation upon the brain could reveal 'unwanted or even traumatic memories' that a person could not recall through their own volition. 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.

Through its ability to intervene in individuals' thought processes, there is a real risk of breaching the right to privacy and freedom of thought as protected by arts 17 and 18 ICCPR.[167] The protection of the mind and mental integrity is also alluded to in the right to security of the person in art 19.1 ICCPR which provides that everyone has the right to 'hold opinions without interference'.[168] The UN Human Rights Committee notes that security of the person includes 'freedom of injury to the body and the mind, or bodily or mental integrity'.[169]

There is also a risk that if neurotechnology is forcibly used to extract information from suspects they may breach the prohibition of torture, cruel, inhuman or degrading treatment or punishment. The UN Human Rights Advisory Committee has observed that any misuse of the technology to this degree would represent a violation of art 7 ICCPR.[170]

Prohibition of torture, cruel, inhuman or degrading treatment or punishment

Article 7 ICCPR is an absolute right which provides that:

> No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment. In particular, no one shall be subjected without his free consent to medical or scientific experimentation.

The prohibition of torture, cruel, inhuman or degrading treatment or punishment is an absolute right which means it cannot be limited for any reason.[171] It is also non-derogable, meaning that it cannot be temporarily suspended or restricted during times of emergency.[172]

Ultimately, while neurotechnology may prove to have beneficial applications in ensuring accurate eyewitness testimony, the extreme intrusion on privacy and potential for malicious application ultimately lead to the conclusion that it should not be used in criminal investigations for memory recovery.

7.3 Trial processes

All people have a human right to a fair trial and due processes of law.[173] A key protection under international human rights law is that 'everyone charged with a criminal offence shall have the right to be presumed innocent until proved guilty according to law'.[174] Additionally, there is a right not to testify against yourself or to confess guilt.[175] Both of these rights require that no direct or indirect physical or psychological pressure be exerted by authorities to secure a confession or testimony.[176] There is a serious risk that the use of neurotechnology in criminal justice settings may result in these rights being undermined.

Neurotechnology has the potential to influence the development of long-established criminal jurisprudence.

To determine that a person has committed a criminal offence it is necessary in most cases (with the exception of strict liability offences)

to establish that they had the requisite mental state, or mens rea, at the time they committed the crime.[177] The idea 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'.[178]

Neurotechnology directly interferes with the offender's mind, blurring the lines between sole responsibility and 'third party' involvement. This can have significant implications with respect to the application of current legal tests relating to criminal responsibility and establishing intention.[179] With looming availability of neurotechnology for consumer use, it is possible that the legal implications will be considered by an Australian court in the near future. It is important that courts are informed about the associated risks of neurotechnology in order to ensure consistency and protect human rights.

In 2022 the Australasian Institute of Judicial Administration published 'AI Decision-Making and the Courts: a Guide for Judges, Tribunal Members and Court Administrators.' This publication provides a comprehensive coverage of current issues to do with AI.[180] A similar guide focused on the possible challenges and opportunities that neurotechnology presents for Australian courts and tribunals would be a useful initiative. Protecting human rights should be a key component of any guidance. The human rights to equality before the law and to a fair trial are vital safeguards for the rule of law.[181] The use of neurotechnology must not impede the right to be equal before the court and the presumption of innocence protected by art 14 of the ICCPR.[182]

Equality before the law

Article 14 of the ICCPR provides that 'all persons shall be equal before the courts and tribunals'.

> Additionally, art 14(2) goes on to state that 'everyone charged with a criminal offence shall have the right to be presumed innocent until proved guilty according to law'.

7.4 Sentencing

Neurotechnology also promises to extend to post-trial applications as part of the sentencing process. In particular, the technology may be used by the judiciary to assist in the risk assessment process that factors into sentencing, and as also potentially offering alternatives to incarceration.

(a) Risk assessment

Risk assessments are crucial in both sentencing and parole decision making. Predictions of the risk that an offender may present to the community upon release could significantly impact the type of sentence, sentence length or non-parole period that is imposed as well as decisions as to whether or not to grant parole and the conditions of any parole. Parole is the conditional release of a prisoner under supervision prior to the maximum term of their sentence.

Currently judges hand down a sentence having regard to all considerations relevant to sentencing, giving due weight to each item.[183] Similar assessments regarding parole are state specific.[184]

The use of technology in sentencing is not new. Tools such as the Correctional Offender Management Profiling for Alternative Sanctions (COMPAS) are still used in the US to predict the risk of recidivism, despite recognised findings of racial bias within its algorithm.[185] In Australia, tools such as the Violent Extremism Risk Assessment Version 2 Revised (VERA-2R) are used to assess future risk when considering the imposition of a continued detention order for terrorist offenders following completion of their original sentence.[186] Risk assessment tools, such as Static-99R, are also used in Australia to estimate the future risk of reoffending amongst people convicted of sexual offences.[187]

Considering the importance of risk assessments in the sentencing process, neurotechnology offers additional ways to assess risk. An offender's brain scan (via fMRI) could be used to determine whether they have biological markers of human behaviours that correlate to behavioural traits – including those that may indicate a heightened risk of reoffending. This is known as 'neuroprediction'.[188] For example, research has indicated that lower activation in the dorsal anterior cingulate cortex (a region of the brain associated with error processing and impulse control) appeared to be associated with a higher chance of recidivism.[189]

Relying on biomarkers as a determinant of behaviour raises serious ethical issues. It has long been considered that human behaviour is not a result of biological factors alone, but rather an interplay between biology, psychology and environmental factors.[190] Accordingly, using neurotechnology as a factor in determining a person's chance of reoffending may not be an accurate representation of such a risk.[191]

Another concern is the risk of discrimination and stigmatisation of groups of people because neurotechnology identifies that they have biological markers that indicate a higher risk of criminal activity.[192] This type of assessment and subsequent categorisation of people may breach human rights to be treated equally before the law and to non-discrimination.

Likewise, there are indications that formally linking neural data to a tendency to commit crimes may result in a self-fulfilling prophecy.[193] Recent studies suggest that receiving genetic risk information such as genetic tendency for obesity, can influence a person's behaviour and physiology, changing their overall risk profile.[194]

Using neurotechnology in this way is reminiscent of an outdated biological determinism that is an anathema to human rights. However, it may also provide important insights when making decisions about parole or sentences. Neurotechnology-informed risk assessment poses serious risks and should only be used in criminal justice settings after specific research. The proposed inquiry by the ALRC in recommendation 6 would provide an appropriate pathway for such consideration.

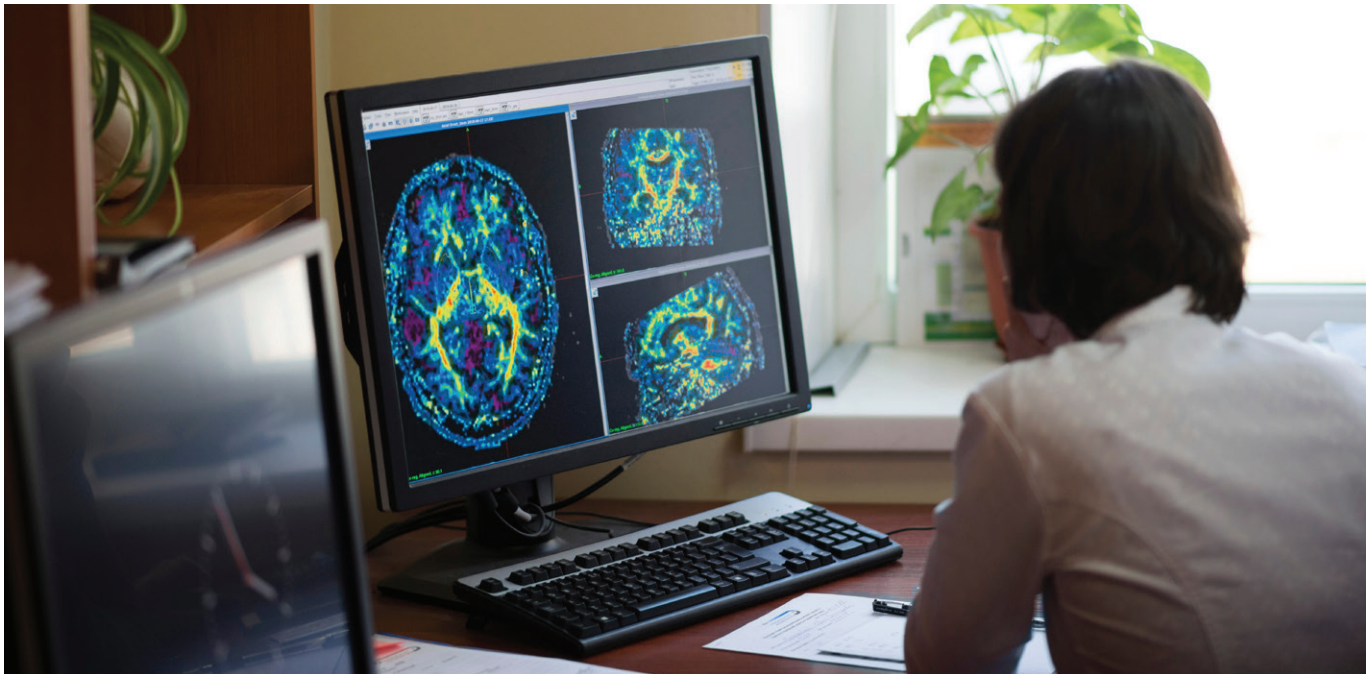
7.5 Sentencing options

Neurotechnology could offer sentencing options that are more rehabilitative than punitive.[195] Non-consensual medical treatment could, however, violate medical ethics and human rights.

In the Netherlands, a judge can impose a 'post-prison mandated mental health treatment' for offenders.[196] Neurointerventions may be offered as a form of court-mandated mental health treatment.[197] Such neurointerventions are not acting as a 'biological fix'.[198] Instead, they are used (for example) to identify neural precursors that trigger feelings of aggression and then stimulate the brain to calm the person down. This may allow a person to make rational decisions after obstructive influences, such as aggression, are no longer present.[199]

The use of neurotechnology as a sentencing option raises issues of whether full and informed consent can be obtained. This is especially so in cases where consent to the use of neurotechnology could be used transactionally for sentence reduction or an earlier parole – despite the offender's preference not to be the subject of a neurointervention in the absence of such incentives.[200]

The use of neurotechnology in sentencing options may offer some offenders a desired option – whereas others may be unduly pressured into accepting it. There are likely opportunities and serious challenges in respect of sentencing which should form a significant part of the recommended ALRC led inquiry.



8. Consumer rights

The consumer market is set to be the next frontier for neurotechnology. Originally developed for medical purposes, neurotechnology is being used for purposes beyond their original design, such as gaming, entertainment and wellness.[201]

Direct-to-consumer (DTC) neurotechnology can be purchased 'without the intervention of research, clinical, or medical professionals' around the world.[202] While the definition of DTC neurotechnology is not settled,[203] these devices are often non-invasive and wearable.[204]

New forms of DTC devices are already in development. For example, Apple has patented next generation earbuds, fitted with electrodes to monitor brain activity. [205] Meanwhile Meta's forthcoming smart glasses, will likely be equipped with a neural interface that allows people to operate the device through hand movements.[206]

Oxyzen Smart Headband

PRACTICAL USES

BrainCo's Oxyzen Smart Headband claims that its product improves mental health through advanced neurofeedback – providing a tool 'for enhancing mindfulness and overall quality of life'. The product claims to allow users to monitor and measure their mindfulness, calmness and awareness. With wearable health tracking technologies, such as smart watches, becoming commonplace – it isn't difficult to imagine a future where neurofeedback headbands are also used by consumers.

DTC neurotechnology can have broad applications, such as gathering neurofeedback which can be used to predict behaviour, personality traits, and may even be used as a new form of biometric identification.[207] Devices may also be used for 'training' purposes to improve focus and attention, memory, and support relaxation, meditation and sleep.[208] Increasingly, these technologies are being used to enable alternative control of external devices, including gaming joysticks and drones.

Do-it-yourself Neurotechnology Kits

PRACTICAL USES

New forms of DTC neurotechnology have reached consumer markets. Companies such as Upside-Down Labs,[209] Neuphony,[210] and Backyard Brains[211] offer devices that people can build themselves with an 'at-home' kit. These products can include designs for 3D-printed headsets, hardware components such as electrodes, as well as software development kits and programming codes.[212]

These devices can range in price from as little at $15 to more than $500.[213] They can enable people to use target specific electrodes to measure signals from the brain, eyes, muscles and heart.[214]

There are, however, considerable risks associated with this kind of consumer product, including the potential for devices to be faulty, used incorrectly or excessively, with harms ranging from burns to unknown longer-term side effects on the brain.[215] Additionally there are ethical concerns raised about the use of these products, such as Backyard Brains 'RoboRoach' (which allows users to control the direction a cockroach walks), which may involve accessing or interfering with the minds of insects, animals, or even one day other people.

As neurotechnology gains ground in the consumer context, it is important that legal frameworks are prepared to respond to ensure consumer safety and the protection of human rights.

8.1 Consumer privacy

As noted earlier, neurotechnology poses a serious risk to privacy. User reluctance, or inability, to avoid privacy-averse products or services may be impacted by ineffective competition. The Australian Competition and Consumer Commission (ACCC) has indicated that where there are few, or no, comparable alternatives, users may feel compelled to accept undesirable terms of use.[216] These undesirable 'take-it-or-leave-it' terms can involve the unwanted collection and use of consumer data.[217]

Most Australians highly value privacy protections when choosing products or services, with 70% of people surveyed by the OAIC saying it is extremely or very important to them.[218] These factors 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.[219]

As emerging neurotechnology is initially commercialised, it may operate in a commercial environment with little competition. Technology companies that are first to reach consumer markets often have an increased ability to set terms and conditions – and sometimes do so with less regard for the privacy needs and rights of end-users. This creates challenges for users of neurotechnology who seek to protect their neural information. Neurotechnology companies should be incentivised to ensure sufficient privacy safeguards are in place.

8.2 Pivoting away from medical regulation

Historically, many forms of neurotechnology have fallen within the field of medical technologies and have been subject to strict medical-device regulation.[220] However, there is a growing potential for medical neurotechnology to be pivoted towards consumer markets.

Interviewees explained that they were concerned about how this technology may be used in less beneficial ways in consumer markets:

> **That if it lands in the wrong hands, or in the profitable gaming industry … it is crucial that it is safeguarded.**

Shifting markets may result in blurred divisions between what constitutes 'medical' and 'consumer' neurotechnology – and accordingly raise questions about which regulatory regime applies.[221]

For example, non-invasive transcranial direct current stimulation (tDCS) devices can be used in clinical and research settings to treat conditions such as depression.[222] Other tDCS devices are marketed and sold directly to consumers, and may also advertise therapeutic benefits, such as treating depression.[223] The former sometimes falls within the scope of the Therapeutic Goods Act 1989 (Cth) (TG Act).[224] The latter may fall under the TG Act, [225] or may alternatively engage the Australian Consumer Law (ACL).[226] Regulators and other policy agencies operating in consumer or medical spaces will need to carefully consider where the regulatory burden falls for neurotechnology that straddle both fields.

8.3 Neurotechnology Safety Agency

The development and deployment of neurotechnology will likely pose a range of risks to consumers in the years to come, while also offering potential benefits. However, the Commission is not convinced that the ACL regulatory framework for the safety of general consumer goods is well-suited to addressing neurotechnology products.

Specific types of products are regulated by specialist product safety regulators, which provide a tailored approach. Some consumer goods, such as road vehicles, medical devices, electrical goods, require oversight by specialist agencies due to their technical complexity and risk to consumers.[227] This also allows for the technical expertise and ongoing focus needed to manage the risks associated with specific products.

Given the potential for neurotechnology to monitor and intervene in neural activity, the unknown risks, technical nature of the products and possibly profound impact to society – a specialist agency should be tasked with overseeing consumer neurotechnology products.

Recommendation 7:

The Australian Government ensure there is specialist regulatory capacity to oversee consumer-oriented neurotechnologies by establishing a Neurotechnology Safety Agency. This agency should:

- **Establish effective safety standards.**
- **Provide guidance to businesses on required information for consumers on device operation, potential indicators of faults, and avenues to report faults. Where businesses have sole access or control over operational or device data, they should report identified faults to the regulator and consumer in a timely manner.**
- **Have regulatory powers to protect against misleading and deceptive conduct.**

(a) Safety

The safety risks associated with consumer neurotechnology may be significant.[228] Poorly designed or constructed devices, or the improper use of the technologies may result in various harms, including skin burns, elevated stress, and in extreme cases may even have the potential to cause cognitive damage.[229] Additionally, individuals may not be able to effectively understand the possible safety risks and associated harms without the advice or supervision of medical practitioners. [230]

Given the novelty, complexity and varied nature of different types of neurotechnology, establishing a specialist regulatory framework for neurotechnology may allow for the development of relevant and effective safety standards.

(b) Consumer guarantees

The ACL provides a consumer guarantee of 'acceptable quality' which requires products be capable of fulfilling the purposes for which they are supplied. Products must also be acceptable in appearance and finish, free from defects, and safe and durable. [231]

The ACL also requires goods to be 'fit for purpose'.[232] Effectively this means that the product's advertised purpose and consumer's reason for buying that product should align.

To address this, a Neurotechnology Safety Agency could require businesses to provide clear and accessible information to consumers about:

- the nature and operation of devices
- possible risks and limitations of devices
- potential indicators of faults
- avenues for consumers to report faults.

Further, where companies have sole access or control of data, they should be required to report this to consumers and the regulator in a timely manner.

(c) Misleading and deceptive conduct

The ACL prohibits businesses from engaging in 'misleading or deceptive conduct'. [233] Companies must ensure that any claims they make about a product's value, benefits, qualities or performance are:

- clear
- accurate
- reasonable.[234]

However, enforcing misleading and deceptive conduct provisions may be difficult in the case of consumer neurotechnology. Consumers will likely face significant barriers to assessing the validity of business' claims,[235] due to gaps in technical knowledge and lack of control of device data. Experts have further commented that because the 'technology is so new and novel…proving the falsity or misleading nature of claims may be difficult, or even impossible'.[236] Accordingly a specialist framework would hold businesses to account and ensure their products do not mislead or deceive consumers.

8.4 Neuromarketing and consumer choice

Neurotechnology, by revealing distinctive information about an individual's unique brain structure and nervous systems, may provide unprecedented access to the 'cognitive states and inner worlds of consumers'. [237] This presents very real risks to human rights and may fundamentally affect human dignity as set out in art 1 of the UDHR. Neuromarketing is an example of commercially driven neurotechnologies that pose potential risks to human rights.

Neural data can be used to identify patterns in individuals' mental states, behaviours, attention and focus. [238] These factors can profoundly influence consumer behaviour,[239] as their data can provide 'more objective and truthful measures about a customer's preferences'.[240]

Neurotechnology will play a critical role in the deployment of 'neuromarketing' strategies. Neuromarketing is the measurement neural signals to better understand consumers, and accordingly 'inform creative advertising, product development, pricing and other marketing areas'.[241]

Companies may also use the gathered data to 'nudge' individuals towards certain behaviours, including purchasing goods and services that they do not need or even truly want.[242] For example, a neurotechnology gaming device may detect the moments where a user is most engaged in a game, or in a heightened state of emotion, and use this as an opportunity to offer an in-app purchase.[243]

Accordingly, bioethicists have raised the alarm about the potential dangers of allowing commercial entities knowledge, and by extension power, over 'intimate dimensions of consumers' physical, mental and social lives'. [244]

Australians are already concerned about how their data is being used. 84% consider targeted advertisements based on sensitive information (health, racial or ethnic origin etc) to be unfair and unreasonable. Meanwhile, 69% believe that tracking, profiling and targeted advertisements based on personal information is not fair and reasonable.[245]

The ability of neuromarketing strategies to influence individuals is highly concerning and may not comply with international human rights law.[246] Freedom of thought is protected under art 18 ICCPR, and allows people to 'develop thoughts autonomously, free from "impermissible" external influence'.[247] The right to freedom of thought is 'far-reaching and profound; it encompasses freedom of thought on all matters'.[248] As provided for under arts 18.2 and 17 ICCPR, 'no one shall be compelled to reveal [their] thoughts'.[249]

Although the use of neuromarketing may not itself compel a consumer to reveal their thoughts, users may inadvertently consent to neural information being collected and used for marketing purposes.

The use of neuromarketing may also have particular implications for democracies as freedom of thought underpins the ability of people to think freely and make informed decisions when voting.

The ability of neurotechnology to monitor and understand neural information allows the technology to provide intimate insights into an individual's democratic preferences – such as which party a person may vote for in an election. This may allow for neuromarketing by politically-inclined bodies to personalise and target advertising in a manner which undermines not only the right of an individual to develop thoughts free from interference, but potentially democratic institutions themselves.

It is for these reasons that the Commission has called on the Australian Government to prohibit the use of neuromarketing in recommendation 5.

9. Employment

In the coming years neurotechnology could be widely adopted in the workplace.[250] Wearable devices may be increasingly adopted to monitor concentration, fatigue and the emotional state of workers.[251] Neural surveillance can allow employers to have insight into a worker's cognitive state – such as level of attention,[252] mind wandering and effort withdrawal.[253]

Considering the rapid development of neurotechnology, more advanced measures could be utilised to understand workers' minds and alter their work performance.[254] While many neurotechnologies are still in development, early-stage devices are already being used during the workday.[255]

MN8 neural monitoring

PRACTICAL USES

In 2022 Emotiv, a bioinformation company, revealed its MN8 product for attention management.[256] Located in a seemingly standard set of earbuds, MN8 contains two electrodes sitting in either bud allowing employers to monitor workers' attention and stress levels in real time.[257]

Former President of Emotiv, Oliver Oullier, presents a hypothetical of how the product works.

> **A data scientist wearing the MN8 has spent several hours videoconferencing with her team and is now reviewing code. The system has used her alpha-brain-wave activity to index the attentive state in her brain. The proprietary algorithm sees that her attention is flagging, so it sends a message to her laptop: "Christina, it's time for a break. Do you want to take a short walk or do a five-minute guided meditation to reset your focus?"[258]**

MN8 promises that it can evaluate cognitive loads, compare workers across an organisation and assist in workload management. Concerningly, it has been claimed that Emotiv's products can also be used to inform decisions about firing, promotions and retention in workforce management decisions.[259] It is unclear the exact number of workers currently using these kinds of products in the workplace.

9.1 Work health and safety

An argument for implementation of neurotechnology in Australian workplaces could be made if it were established that such technologies were reasonably necessary to eliminate risk to the health and safety of workers. However, technology is not a panacea to risks in the workplace. A holistic, worker-focused approach is required to keep workers safe.

All workers in Australia must be safe when they go to work. This has been recognised in international human rights law and is one of the International Labour Organisation's five fundamental principles and rights at work.[260] The obligation to provide safe workplace is also recognised in Australian domestic law.

Article 7 ICESCR states that all people have the right to the enjoyment of just and favourable conditions of work. This means that there must be (among other things):

- safe and healthy working conditions
- equal opportunities for everyone to be promoted subject to only seniority and competence.[261]

Article 7 recognises workers' right to safe and healthy working conditions, which is necessary for the enjoyment of other rights such as the right to the health (by avoiding workplace accidents or disease).[262] This is especially important as the ILO estimates that nearly three million people die of work-related accidents and disease each year.[263]

In Australia, employers have a duty to ensure the health and safety of workers.[264] To meet this requirement, employers must eliminate or minimise risks to health and safety so far as is reasonable.[265]

Monitoring neural data could assist workers to understand fluctuations in concentration levels and help avoid accidents for occupations requiring high levels of attention over long periods of time (e.g. long-haul truck driving and paramedicine).[266]

LifeBand

PRACTICAL USES

LifeBand is a fatigue-tracking headband with embedded EEG sensors which can be worn by itself or as part of a cap or hardhat.[267] LifeBand collects neural data and, through algorithmic analysis within the SmartCap system, assesses a user's fatigue levels from 1 (hyperalert) to 5 (involuntary sleep).[268] When a user becomes dangerously drowsy, the system sends an alert to both the worker and the manager – allowing preventative action to be taken.

Globally, more than 5,000 organisations (primarily in mining, construction, trucking and aviation industries) are already using SmartCap to monitor fatigue levels.[269]

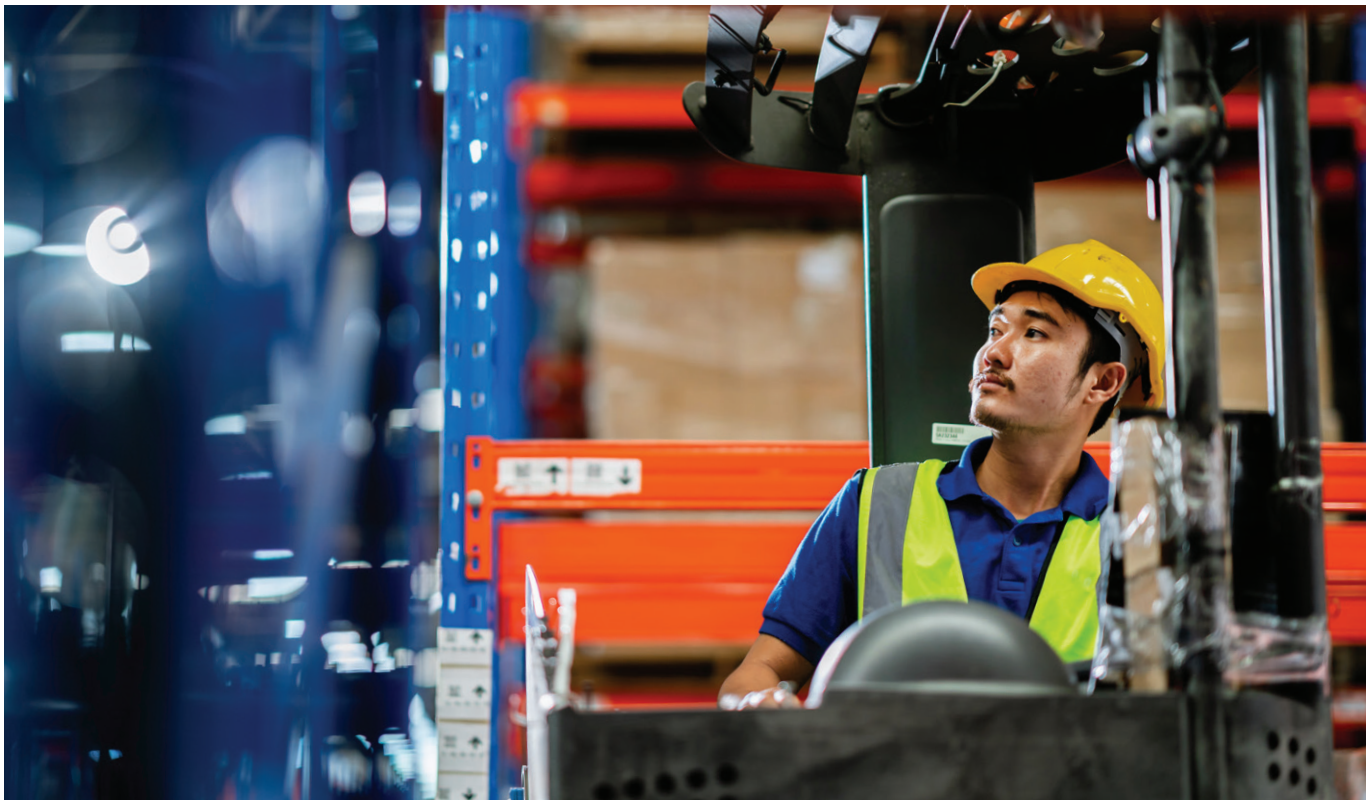
Some of Australia's largest mining companies are reportedly using SmartCap with truck drivers at Rio Tinto's Hunter Valley mines wearing the devices.[270]

While it has potential to enhance safety in the workplace, neurotechnology poses a variety of human rights risks, as explored throughout this report. Neurotechnology should not be considered a substitute for addressing the root-causes of fatigue-related (or other) workplace risks. Workplaces should only adopt such technology where strictly necessary to prevent serious harm or death and with clear measures in place that protect privacy and other workplace rights. Additionally, neurotechnology should only be introduced with consultation and consent from workers and trade unions. Where neurotechnology is used to address work health and safety risks, employers should not collect, store, access or utilise more information than is strictly necessary to address those risks. Employers must safeguard against use of incredibly sensitive neural information for other purposes.

Recommendation 8:

The Australian Government ban the use of workplace neurotechnology, other than for addressing the most serious work health and safety risks in high-risk industries.

Employers should consult with employees and their unions when they are considering the use of neurotechnology in the workplace.



9.2 Consent

The use of neurotechnology should not be mandated by employers. While existing Australian laws may permit employers to direct employees to use neurotechnology in some circumstances, the introduction of neurotechnology without worker consultation or consent would raise concerns from a human rights perspective. Workers should have a genuine opportunity to consent or refuse to use neurotechnology in their workplace.

Duty of obedience

LEGAL

Employers have an implied right at common law to direct their employees.[271] An implied duty of obedience requires an employee to comply with any lawful and reasonable direction given by a superior[272] or as contained in workplace policies or procedures.[273] A breach of this implied duty implies a breach of contract, which is misconduct that can form the basis of a valid reason for dismissal.

A direction will be lawful where it does not involve illegality and it 'falls within the scope of service of the employee'.[274] Courts have generally concluded that where a new technology is implemented as a new method or technique to perform workplace duties, it will likely be lawful depending on the context.[275]

Whether a direction is reasonable is a question of fact and balance that must be assessed against factors relevant to the employment relationship.[276] Whether or not an employer could reasonably and lawfully direct a worker to use neurotechnology remains to be seen, and will likely require judicial consideration of the specific circumstances in a case.

Where neurotechnology is used in the workplace, employers should provide employees with:

- comprehensive and accessible information about how the technology and collected data will be used[277]
- an objective assessment of the benefits they offer[278]
- who has access to that information (in accordance with relevant legislative obligations such as the Privacy Act)[279]
- information on the identifiable and foreseeable risks of use and how those risks might be mitigated.

As noted in UNESCO's draft recommendation on neurotechnology, workers should have a right to obtain access to comprehensible neural data collected about themselves.[280] This would help to ensure that consent is informed throughout the period of time that the neurotechnology is used and allow workers to consider the collected data and withdraw consent at any time (unless the use is required at law).

Even if these details are disclosed to a worker, consent to monitoring may not be 'full and informed' due to a worker's fear of losing their job or missing out on an opportunity for future employment.[281] Workers should not face negative consequences in their employment for reasonably refusing to use a neurotechnology (unless it is required by law).

9.3 Neurodiscrimination

Under Australian anti-discrimination law workers must have equal opportunity to be promoted (subject only to considerations of experience and competence). This means that hiring, firing and promotion must not be discriminatory.[282] If neurotechnology is adopted in workplaces, there is a risk that certain groups of people will be unfairly prejudiced, with the use of neurotechnology to inform workplace decision-making potentially resulting in breaches of anti-discrimination laws. For example, neurodivergent people may be at heightened risk of neurodiscrimination. Equally older workers may be disproportionately impacted as a result of age discrimination on the basis of neural data.

For example, neural data may indicate early signs of cognitive decline, or it could reveal that a worker is neurodivergent. Such information could inform employer decisions concerning dismissal, promotion or redundancy – contributing to workplace discrimination.[283] Australian state and territory anti-discrimination legislation prohibits discrimination on the basis of protected attributes such as disability, race and sex.[284]

While the legislative regime does not expressly reference neural data, it would likely apply where such information was used in a decision that violated anti-discrimination legislation. If an employer has access to neural data, they must not use that data in a way that contravenes anti-discrimination laws.

9.4 Workplace surveillance

The COVID-19 pandemic changed how many Australians worked – with millions of workers shifting from an office environment to their homes.[285] With less visibility of remote workers, some employers have increased their workplace surveillance.

The use of workplace neurotechnology takes surveillance to unchartered territory as it not only monitors activity but provides an insight into workers' brains.[286] Neurotechnology could enable workers to be monitored by their employers to assess things like emotional states and degrees of alertness and concentration.[287]

This could result in a worker's productivity being determined based on collected neural information.[288] Constant monitoring may create unnecessary stress on workers, which could negatively impact their physical and mental health.[289] This may result in the right to safe and healthy working conditions and the right to the highest attainable standard of physical and mental health being violated.[290]

Victoria, NSW and the Australian Capital Territory (ACT) have all enacted legislation in relation to workplace privacy and surveillance.[291]

Surveillance regime

LEGAL

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.[292] It is unclear if neurotechnology would fall within the ambit of the *Surveillance Devices Act 1999* (Vic),[293] but could be classified as 'data surveillance devices'.[294]

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.[295]

The *Workplace Privacy Act 2011* (ACT), mirroring the NSW Act, also adopts a broad definition of what a 'data surveillance device' consists of.[296] 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.

Existing laws recognise the need for monitoring worker performance, protecting property or ensuring work health and safety.[297] However, these needs 'must be balanced against workers' reasonable expectations of privacy in the workplace'.[298]

It is unlikely that the use of neurotechnology in the workplace would be captured by existing state and territory workplace surveillance legislation.[299] However, this remains untested at law. It is also unclear how workers would be protected at the federal level where there is no overarching worker employee surveillance legislation.

The ALRC has previously recommended that Australia should move towards a harmonised approach regarding surveillance legislation through Commonwealth legislation to replace existing state and territory laws.[300]

To avoid the chances of technology falling outside of the ambit of such legislation, surveillance laws should be technology neutral and apply to neurotechnology.[301]

Recommendation 9:

Recommendations 14-2 and 14-6 of the ALRC's Report 123 'Serious Invasions of Privacy in the Digital Era' should be implemented as a priority:

Recommendation 14-2:

Surveillance legislation should be technology neutral. It should regulate surveillance through the use of listening devices, optical devices, tracking devices, data surveillance devices, and other devices and systems.

Recommendation 14-6:

Workplace surveillance laws should be made uniform throughout Australia.

9.5 Workplace privacy

Employer access to neural data may have grave implications for workers' privacy. The harm is exacerbated if workers do not have discretion to choose what neural information is disclosed to their employer.[302]

Neural data is incredibly sensitive – for example, brain scans (a form of biometric information) can be as unique as an individual's fingerprint.[303] Access to neural data may also reveal sensitive information such as a worker's underlying mental health conditions.[304]

Code on Protection of Workers' Data

LEGAL

Internationally, the Code on Protection of Workers' Data sets out non-binding standards issued by the International Labour Organisation (ILO). The code provides that if workers are to be monitored, they should be informed in advance of the:

- reasons for monitoring
- time schedule of monitoring
- methods and techniques used
- data collected.[305]

The code requires employers to minimise privacy intrusions. It also provides that continuous monitoring should only be permitted to ensure health and safety or to protect property.[306]

Article 12.2 obliges workers' representatives (e.g. trade unions) to be informed and consulted before introducing electronic monitoring.

The Code on Protections of Workers' Data emphasises the important role of trade unions in negotiating and implementing electronic monitoring – such as neurotechnology in the workplace.[307] It is critical that employers do not sell the collected neural data of their employees.

Where employers collect, monitor, store or utilise the neural data of workers, they must ensure that they comply with any existing employer information obligations under the Privacy Act.

Lee v Superior Wood [2019] FWCFB 2946

LEGAL

Queensland company Superior Wood Pty Ltd introduced fingerprint scanners to record employee start and finish times. Mr Lee refused to utilise the fingerprint scanner and chose to manually record his start and finish times.[308]

Superior Wood introduced a workplace policy mandating the use of the fingerprint scanner – subsequently warning Mr Lee that failure to comply with the policy would result in termination. Mr Lee did not comply and his employment was terminated.[309]

Mr Lee brought an unfair dismissal application to the Fair Work Commission which at first instance found that the dismissal was not unfair as Superior Woods' direction (via the policy) was reasonable in the circumstances.[310]

On appeal, the Full Bench of the Fair Work Commission ruled that the dismissal was unfair because Superior Woods' direction requiring Mr Lee to consent to the fingerprint scanning was not a lawful direction as it infringed upon his rights under the Privacy Act.[311]

The Australian workplace regime is complex. The management of neurotechnology in the workplace may occur through contracts, workplace policy, modern awards or enterprise agreements.

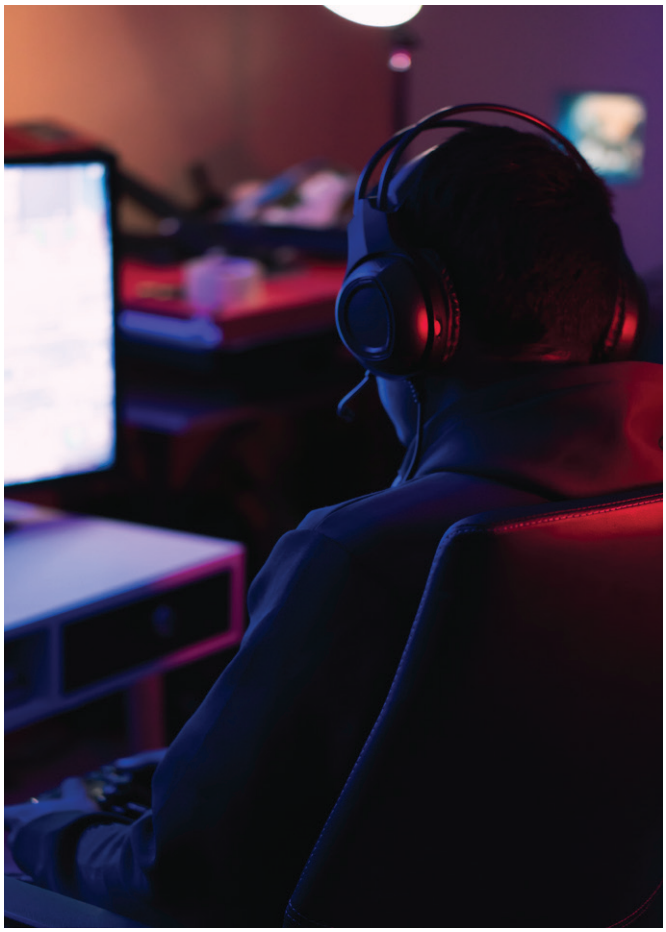
10. Online safety

Neurotechnology will increasingly be integrated into the gaming, social media and other online industries. For example, the UK ICO has predicted that within the next four-to-five years there will be an increased adoption of neurotechnology in the gaming sector.[312]

In the medium term, it is possible that limited forms of neural data-led games will emerge providing basic gameplay for users. These games may be limited to simple puzzle-based mechanics with limited interoperability.[313]

It seems more likely that EEG-based gaming, which focuses on controlling devices (such as drones), may be more broadly adopted by consumers. Neurotechnologies are already being used for games that allow players to operate drones remotely via neurotechnology.[314]

This chapter considers consumer-oriented devices, with a particular focus on online gaming.



10.1 Immersive technologies

Neurotechnology may be increasingly used to connect brain waves to gaming and virtual experiences.[315] It has been predicted that this will be most visible in gaming settings linked to virtual reality (VR) or augmented reality (AR).[316] It is possible that VR/AR headsets could be advanced to take commands via neural information.

In May 2025, eSafety released an updated position statement on immersive technologies, which considers neurotechnology.

New and emerging immersive technologies (such as those capable of facilitating the emergence of renewed virtual worlds like VR, AR, haptic devices etc) provide organisations with increased opportunities to accumulate and utilise neural data.[317] According to the IEEE, the risk of invasions of privacy, safety and security for people in such immersive technologies may be wide-sweeping,[318] 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[319]
- cyberbullying
- assaults, sexual exploitation and abuse
- dissemination of harmful or illegal content, such as child sexual abuse material or violent extremism, in a more visceral and interactive form than ever before.[320]

The personal data involved in immersive worlds will likely be 'more granular and unprecedentedly ubiquitous to build a digital copy of the real world'.[321] This is especially the case as immersive technologies collect and process data such as brain wave patterns.[322]

It is possible that there will be an increase in the use of neurotechnology to connect brain waves to gaming and immersive experiences to allow for more fulsome experiences for the user.[323]

10.2 Cognitive enhancement

Neurotechnology may be adopted into game play, without becoming a part of the game itself. The UK ICO has predicted a significant uptake of neuromodulating technologies aimed at boosting responses, player concentration and multi-tasking capacity.[324] Given the immense size and market value of the e-sports industry, players looking to gain a competitive edge may take advantage of these technologies.

eSports

eSports is a form of competition which takes place entirely within a particular video game in a highly organised environment. These games range in popularity and format.

With a market size valued at $1.72 billion USD in 2023,[325] the industry continues to grow in popularity.

For example, in 2019 the Fortnite World Champion won $3 million USD (over $4.5 million AUD) prize.[326] This was part of a larger pool of $30 million USD in total prize money available for the event.[327] In comparison, Jannik Sinner won a $3.15 million AUD for winning the Men's Singles at the 2024 Australia Open tennis tournament.

In respect of gaming and online safety, EEG-based neurotechnology may provide benefits to competitors, enabling them to remain calm during high stake gameplay.[328]

10.3 Online harms

As neurotechnology is integrated into the gaming industry, it is important to consider how the technology could potentially be used to facilitate online harm.

of Australian children aged 8 to 17 have played an online game in the last year.[329]

Many people already use video games similarly to social media platforms – as a means to spend time with friends and family while playing a game they enjoy.[330] For example, multiplayer games such as Genshin Impact are shaped and influenced by the ability to communicate with friends, socialise and build relationships with other players in the game.[331] Socialising is now a key aspect of many games.

of parents play video games with their children to connect as a family.[332]

As a consequence of neurotechnology being integrated into gaming spaces and potentially into other online spaces like social media, it will also become a part of how people socialise. It is necessary to consider online safety in the development of this technology.

10.4 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.[333]

Under the *Online Safety Act 2021* (Cth) (Online Safety Act), eSafety approaches its work 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 child cyber-bullying, adult cyber-abuse, or image-based abuse (the non-consensual sharing, or threatened 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.[334]
- **Proactive and systematic change:** encouraging systemic change – through mandatory industry codes and standards,[335] as well as the Basic Online Safety Expectations,[336] accompanied by reporting powers to drive greater transparency and accountability. eSafety also conducts horizon scanning and consults with subject matter experts, other regulators, government and civil society to identify emerging online safety risks and opportunities to inform its approach to these challenges.[337]

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.[338] In an emerging field such as neurotechnology, there is genuine opportunity to implement safety into all products and services by anticipating and minimising threats before they occur.

Recommendation 10:

Neurotechnology companies implement a Safety by Design approach when designing, developing and deploying products and services.

(a) Online Safety Act

The Online Safety Act is technology-neutral and focuses on specific online harms.[339] Yet, new and emerging technologies, such as neurotechnology, can provide new functionalities, experiences and harms online.[340]

As neurotechnologies are increasingly integrated into online services, games, social media, search engines, and internet-enabled devices, certain aspects may be covered by the Online Safety Act where online material or activity meets the relevant legislative threshold. This is particularly pertinent 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.

eSafety has functions in respect of 'relevant electronic services' as defined in s 13A Online Safety Act. This definition incorporates electronic services that enable end-users to play online games with other end-users.

As with other services, material in such online games may be classified as class 1 or class 2 material. Material will be class 1 material where it has, or would likely be, classified as 'refused classification' under Australia's National Classification Scheme.[341] As such, eSafety's removal powers under the Online Content Scheme can be used to require the removal of such material.

Material will be class 2 material where it has been, or would likely be, classified as R18+.[342]

Industry codes and standards are also in force in relation to class 1 material, and apply to a wide range of online services, including relevant electronic services as noted above, and – importantly – equipment providers. Equipment includes virtual reality devices and may include some forms of neurotechnology, depending on the features provided. A second phase of codes are currently under development and focus on preventing children's access to age-inappropriate material such as online pornography.

The wide array of existing legislation and regulatory frameworks that might apply in some way to neurotechnology 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 that may be facilitated through neurotechnology, and to ensure that regulatory gaps do not emerge. This will require ongoing collaboration and dialogue at both the domestic and international levels.[343]

As the integration of neurotechnology in gaming and online social spaces continues, it will be important to ensure a focus on online safety. eSafety should continue to consider this emerging technology.

11. Military applications

The Australian Army has previously trialled BCI technologies in 2022 and is testing the use of neurotechnology in its operations. Military applications of neurotechnology can broadly fall into three categories:

- BCIs
- neurotechnical enhancement
- neurotechnological systems for deception, detection and interrogation.[344]

These military applications may have both medical and non-medical applications.

Vision 60 Ghost Robotics

PRACTICAL USES

The Australian Army has been testing neurotechnology that allows for the use of neural information to remotely control the Vision 60 Ghost Robot.[345] The use of such technology would eliminate the need for verbal and device commands.[346]

Using HoloLens 2 headsets and Raspberry Pi-based AI decoders, the device 'translates' neural signals into instructions that directly control an autonomous robotic 'dog'.[347]

Similar technologies have been utilised to control aerial drones,[348] which could have applications for scouting and reconnaissance operations.

The application of neurotechnology could be used for a range of purposes in military applications, including:

- treating personnel for physical and psychiatric injury
- enhancing a combatant's effectiveness by improving cognitive and emotional capacities
- neural remote control of weapons.[349]

The UK Ministry of Defence has claimed that brain interfaces could allow the manipulation of the physical world by thoughts alone – such as opening a door handle to an aircraft from anywhere in the world.[350]

Neurotechnology may better support military decision making by providing soldiers and commanders with the ability to process a greater amount of data at a faster pace, and enhance situational awareness.[351]

The use of neurotechnology extends beyond just the use of BCIs to nanotechnologies (that can manipulate chemical and biological functions) as means of biological and chemical warfare. Leading voices are already turning their minds to these issues, which should be further researched and investigated.[352] However, it is beyond the scope of this report to consider the human rights dimensions of broader nanotechnologies and neurosciences.

11.1 Consent

The application of neurotechnology raises specific concerns surrounding consent and vulnerability due to the hierarchical nature of military service.[353] Military personnel are part of a disciplined organisation in which orders must be obeyed. Accordingly, free and genuine consent can be difficult to obtain.[354]

Defence forces need to use the best equipment to achieve success and preserve the life of military members, neurotechnology can reveal very sensitive information and may interfere with the way people think.

There is risk that in extremely hierarchical settings, soldiers may be coerced into using neurotechnology. This may have implications for the right to personal integrity under art 1 UDHR and art 9 ICCPR. The right ensures protection from endangering a person's autonomous control over their body and mind. Where military personnel are coerced into using neurotechnology, it could 'produce effects on the body and the psychological sphere and their application can result in actions causing mental harm'.[355] The risk is exacerbated when misuse is associated with implanted devices. Soldiers should maintain a right to refuse neurotechnology (especially if they are invasive in nature) due to the ability to analyse and interfere with the brain.[356]

The Australian Defence Force should ensure that free and informed consent is obtained for the use of both invasive and non-invasive neurotechnology by defence force personnel. This would require the Australian Defence Force to develop and deploy guidance on how to obtain consent specifically in respect of neurotechnology.

11.2 Geneva Conventions

International humanitarian law is a fundamental international legal framework that sets out what can, and cannot, be done during conflict.[357] The Genevea Conventions and their Additional Protocols set out the international rules that limit the barbarity of war and protect non-combatants.[358] Australia is a signatory to the Geneva Conventions and has ratified the Additional Protocols – this means Australia must comply with these rules. One such rule is contained in art 36 and requires countries to review new weapons and means of war.

Article 36 review

LEGAL

Article 36 of the Additional Protocol I of the Geneva Conventions requires states:

> ... in the study, development, acquisition or adoption of a new weapon, means or method of warfare ... to determine whether its employment would, in some or all circumstances, be prohibited by [Additional Protocol I or other applicable international law].

Article 36 obliges party countries to analyse the legality of new weaponry, methods and means of conflict. This provides a benchmark seeking to prevent or mitigate the suffering inflicted on populations by new means of combat.

The Australian Chief of the Defence Force has stated that all new (or modified) weaponry intended for study, development or acquisition undergoes an art 36 review to ensure the weaponry is compliant with Australia's legal obligations under international humanitarian law.[359]

While art 36 reviews perform a critical role, the process has been criticised as lacking accountability and transparency.[360] There are no mechanisms for compliance if a state fails to conduct a review and there is no requirement to disclose outcomes.[361]

Neurotechnology will, and already does, utilise AI in its functioning. Where AI is integrated into products or services, it is possible that the AI component will 'learn' and improve its functioning based off collected data. This raises additional concerns about art 36 reviews which generally take place at a particular point in time. There is a serious risk that a review conducted at one point in time, may quickly become inaccurate as the product or service changes due to machine learning.[362]

Article 36 reviews are a necessary, but not sufficient, safeguard in this context.

Recommendation 11:

Article 36 reviews be regularly conducted throughout the lifecycle of neurotechnology devices utilising AI. This includes where neurotechnology is used as part of a new weapon or means of warfare.

There is significant public interest in ensuring that Australia's defence forces are utilising neurotechnology in a manner that is consistent with international humanitarian law.

Recommendation 12:

Without revealing information that negatively impacts national security, the article 36 reviews conducted by the Directorate of Operations and International Law on neurotechnology should be publicly disclosed.

The Department of Defence may be placed under pressure to utilise experimental or novel neurotechnologies to gain technological superiority against adversaries and enemy forces. However, Australia is still required to comply with international law and the Geneva Conventions, even if our adversaries may not do so. Ethical principles and lawful decision making must be embedded in any pursuit of technological superiority.

12. Children and young people

The rights of children receive specific protection under the Convention on the Rights of the Child (CRC). Although many of the rights discussed in this final report are re-affirmed in the CRC (e.g. freedom of expression is protected under both art 13 CRC and art 19 ICCPR) the majority of the discussion in this final report is framed around the broader human rights framework.

Neurotechnology offers means to diagnose, respond to and rehabilitate impairments impacting the brain or nervous system.[363] However, the brains of children and young people are unique as they continue to develop. Childhood is a crucial stage in the development of brain functions, and neurotechnological intervention may have long lasting impacts (although this is largely untested in longitudinal studies).[364]

The risk to children extends far beyond the purely medical application of neurotechnology (which is largely beyond the scope of this chapter) to everyday life and communications. Accordingly, it is important to specifically consider the rights of the child when developing, deploying or utilising neurotechnology.

12.1 Best interests of the child

The best interests of the child must be central to all development, deployment and utilisation of neurotechnology, in accordance with art 3 CRC.

Best interests of the child

Article 3 of the CRC states:

> In all actions concerning children, whether undertaken by public or private social welfare institutions, courts of law, administrative authorities or legislative bodies, the best interests of the child shall be a primary consideration.
>
> States Parties undertake to ensure the child such protection and care as is necessary for his or her well-being, taking into account the rights and duties of his or her parents, legal guardians, or other individuals legally responsible for him or her, and, to this end, shall take all appropriate legislative and administrative measures.
>
> States Parties shall ensure that the institutions, services and facilities responsible for the care or protection of children shall conform with the standards established by competent authorities, particularly in the areas of safety, health, in the number and suitability of their staff, as well as competent supervision.

This means that organisations developing, deploying or utilising neurotechnologies, that are likely to be used by children, must act in accordance with their best interests.

What is considered to be in the best interests of the child in the particular circumstances may not be straightforward and organisations and policy makers will need to take a nuanced approach that considers a broad range of factors.

Children and young people grow up regularly engaging with online environments and technologies as part of their day-to-day existence.

These engagements can offer both opportunities and risks to realise their rights and participate in society.[365]

As children engage in these spaces, it is essential that their 'best interests' are at the forefront of neurotechnology. Placing best interests at the forefront demands:

> ... strong default privacy settings and human rights by design requirements. There should be a requirement to comply with children's rights principles, such as demonstrated under the National Principles for Child Safe Organisations in the physical world. This would include a requirement to assess and report the impact on the rights of children at every stage of design, implementation and operation.[366]

The bests interests of the child must be the primary consideration in all matters concerning them.[367]

Recommendation 13:

Organisations using neurotechnology demonstrate how they have addressed the requirement to ensure the best interests of the child when designing or offering products and services likely to be used by children.

This would include considerations of:

- privacy
- safety
- security of neural data
- prevention of harm
- protection from harm
- freedom of thought
- children's right to express their views and to seek, receive and convey information.

A best-interest approach may require the 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).[368]

It is important that organisations do not make assumptions about what is in the best interests of children. Their views and opinions should be sought and actively considered.[369] This requires consideration for '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',[370] in addition to ensuring transparency over the criteria applied to determine best interests.[371] Where rights are limited to protect children from harms, limitations must be lawful, necessary and proportionate.

This would require consultations and input from a diverse cross section of children, young people, parents, guardians/carers and (possibly) schools. It is important that the views of individual children

be sought in relation to decisions that affect them in addition to speaking to children as a group.

The Commission has developed a Child Rights Impact Assessment tool to assist policy makers assess how children's rights and wellbeing will be affected by new laws and policies. Consultation with children is a fundamental aspect of the tool and may be useful in designing laws and policy on neurotechnology in Australia.

Recommendation 14:

The Australian Government conduct Child Rights Impact Assessments when developing laws which impact children and neurotechnology.

It will also be necessary to directly consider how consent is treated when parents or caregivers believe they are acting in the best interests of their children. This consideration is especially important given that some neurotechnologies require early adoption at a time when children may lack an ability to understand what is happening.

Early intervention of Cochlear Implants

During the Neurotechnology and *Human Rights: Opportunities, Challenges and the Pathway Forward Symposium* issues around parental consent were raised in respect of cochlear implants.

At the symposium it was presented that:

> Congenitally deaf infants who are implanted prior to 12 months of age have the potential to develop near-normal expressive and receptive language skills.[372]

However, this raises important questions in respect of best interests and consent.

There have been concerns expressed about the perceived negative implication of cochlear implants – that deafness is a medical disability which should be cured. This raises important tensions as many parents and carers may view early intervention via cochlear implant to be necessary for their child. Other parents and carers may believe it is in the best interests of the child to grow up celebrating their deafness.

Given implantation outcomes (hearing and speaking levels) are more significant when implantation occurs within the first 12 months (when an infant cannot consent or be consulted), it requires a parent or carer to make an important decision. They should be supported in doing so with a full awareness of all available options, including information from the Deaf community. Regarding all such decisions in respect of early implantation, the best interests of the child should be given primacy.

12.2 Age restrictions on access to neurotechnology

In recent years, there has been an increased focus on the capacity and rights of children in respect of digital technologies.

In December 2024, the Australian Government passed laws which will effectively ban people under 16 years of age from accessing social media accounts by the end of 2025.[373] In the future, it is likely that similar issues will be raised about consumer neurotechnology and what age children and young people can utilise it (if at all).

When determining what is 'age appropriate', the evolving capacities of the child must be taken into account. As noted by the former Special Rapporteur on the Right to Privacy, Professor Joe Cannataci:

> Children vary enormously in their physical, intellectual, social and emotional capacity. The differences are particularly pronounced in adolescence, a period characterized by rapid physical, cognitive and social changes, including sexual and reproductive maturation.[374]

Professor Cannataci further cautioned that the 'notion of age-appropriateness sits uneasily with the principle of evolving capacity' and recommended that state parties 'adopt age-appropriate standards as a regulatory instrument only with the greatest of caution when no better means exist'.[375] He made the following points in this regard:

> Material may be age appropriate and still harmful to children and their rights. The mechanism which may protect and empower a child when individualised, may not meet the needs of a cohort of children given the considerable variation in intellectual and emotional development among children of the same age.[376]
>
> As a generic threshold, age appropriateness poses inequities for children of differing capacity and is a crude measure of their evolving capacities, potentially constraining the development of their personalities and the autonomous exercise of their rights, and is possibly discriminatory.[377]

What risks children and young people face when interacting with neurotechnology will change based on their level of development, circumstances and environment – in most instances age appropriateness should not be solely determined by chronological age alone. However, if neurotechnology has been shown to be unsafe or inappropriate for children, age-related restrictions may be an appropriate policy response.

12.3 Education

Education is 'both a human right in itself and an indispensable means of realising other human rights'.[378] In realising a person's potential, it is essential their enjoyment of human rights and engagement as active citizens are upheld.

The right to education is recognised in several international instruments,[379] and 'considerable evidence supports the right to education as a norm of international customary law based on the universality of treaty provisions'.[380]

It is also reflected in UN Sustainable Development Goal 4, which aims to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. The right to education is recognised as including the 'interrelated and essential features' of availability, accessibility, acceptability and adaptability.[381]

Neurotechnology may be increasingly used in the education sector with the aim of improving concentration in class and academic performance. The UK ICO highlights 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) higher education sectors may use BCIs to monitor student concentration and stress levels, and to improve student performance.[382]

The use of neurotechnology may also provide benefits to teachers, providing real-time insights into student learning and attention – allowing for the identification of the need for additional support for students.

Wearable neurotechnology could help personalise education, identify the best learning environments for children and develop detailed learning programs for individual students.[383] However, it is important that informed consent is provided by parents and that privacy protections are firmly in place. Otherwise, it could lead to the misuse of neural data by teachers, administrators or parents. In countries lacking robust human rights protections, the possible violations of the right to privacy and risks of discrimination are more severe.[384]

Primary schools

PRACTICAL USES

In a trial conducted in China, primary school children were required to wear non-invasive BCI headbands that recorded concentration levels during class.[385] The headbands were intended to improve the learning experience for students and assist teachers. The headbands produced an 'attention score' based on the collected neural data, which was stored on a teacher's computer and later shared with parents.[386] Ultimately, the trial was abandoned due to public backlash and concern.

In the US, non-invasive neurotechnology continues to be experimentally trialled in classrooms (under the supervision of neuroscientists and teachers).[387] The Aerie Enrichment Program and Wheeler Science Department is not intended to produce the equivalent of an attention score. Instead, the devices are being made available to kindergarten to Year 12 students to use in their own hands-on investigation into the functions of the brain.[388] Students have also used neurotechnology to play video games to observe the effect of music on the brain.[389]

12.4 Neuromarketing and children

The rise of targeted advertising can have negative impacts on children, from increasing problems such as obesity, early alcohol consumption, smoking cigarettes/e-cigarettes[390] to gambling.[391]

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.[392]

However, the use of neurotechnology to collect neural data (which can be sold and used by companies to advertise to children) could one day allow microtargeted advertising on an unprecedented scale and impact.

As discussed above 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.[393]

While this may seem hyperbolic, digital platforms already provide services to marketers to test consumer responses to advertisements and products by measuring captivation, stimulation or memory of that product or brand. Often this is measured via biometric signals (heart rate, eye tracking etc). Neural data is yet another form of biometric information which can be used for marketing purposes.

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.[394]

Neural data will likely give organisations the ability to make inferences about users of neurotechnology. This could extend to their predisposition to neurological and psychiatric conditions or future behaviour.[395] Such insights would, in the future, put those with access to the neural data in a powerful position to manipulate children and young people.

It is well known that algorithms can make inferences about people and suggest content they are most likely to engage with.[396] While problematic, this issue will be exacerbated if such tailored content or 'nudges' are made on the basis of neural data.[397] This has the potential for the technology to manipulate beliefs, motivations and desires.[398] 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*).[399]

Neurotechnology can facilitate the collection and sale of neural data to companies that target children. This level of advertising is likely to have detrimental effects on children and young people as their minds and sense of self develops.[400] For these reasons the Commission has called on the Australian Government to prohibit the use of neuromarketing in recommendation 5. This prohibition would apply in respect of neuromarketing on children and young people.

12.5 Safety and trials

Children have the right to be kept safe from harm.[401] Australia has rigorous ethical frameworks that apply to children and clinical trials.[402] A recent report from UNICEF details the emerging risks and benefits of neurotechnology for children. A significant portion of that work relates to considerations of experimental trials of invasive BCI devices involving children.

It is always important to ensure existing frameworks remain fit for purpose in context of neurotechnology. The Commission welcomes this work and further research in the Australian context.

13. People with disability

Many people will experience some form of impairment in their lifespan. For some this can start from birth, but for others it may happen later in life. Societal barriers for people with impairments can be disabling.

Disability is a social construct where people are not disabled by their impairments, but rather by the world around them. Neurotechnology promises to both address the negative impacts of impairment, while also allowing people to overcome barriers. For example, Cochlear implants assist people to hear, while the Stentrode allows people with paralysis to communicate.

It is important to consider the impact of both medical and consumer neurotechnology on people with disability. Although the majority of this paper concerns consumer-oriented devices, this chapter focuses more heavily on medical devices.

Neuroprosthetics

PRACTICAL USES

One research participant and recipient of a neurotechnological product highlights the potential of the technology. The participant has paraplegia after a car accident in 2004. Over a decade later in 2015 he underwent surgery to implant a BCI and became the first person to control a robotic arm and recover his sensations of touch through implantation in the cortex of the brain.[403] The participant described the neuroprosthetic 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.[404]**

This has allowed the participant to play video games, fight in a 'lightsabre' duel and even shake hands with former US President, Barack Obama.[405]

This has allowed the participant to both address an impairment, while providing him with the means to improve accessibility via the use of the prosthetic arm.

In ensuring that people with disability are supported, it is essential that they be treated equally and in a non-discriminatory way. Discrimination against people with disability on the basis of their disability is against the law, as set out in the *Disability Discrimination Act 1992* (Cth). Generally, the Act seeks to eliminate discrimination against persons on the ground of disability in the areas of:

- work, accommodation, education, access to premises, clubs and sport
- the provision of goods, facilities, services and land
- existing laws
- the administration of Commonwealth laws and programs.[406]

The Act also strives to:

- ensure that people with disability have the same rights to equality before the law as the rest of the community
- promote recognition and acceptance within the community of the principle that people with disability have the same fundamental rights as the rest of the community.[407]

As neurotechnology becomes more commonplace, it will be important that all people consider their obligations under anti-discrimination legislation.

13.1 Models of disability

Society conceptualises disability in different ways which are often referred to as 'models'.

The medical model defines disability as something that is 'wrong' with their body or mind and that needs 'fixing'.[408] The medical model is the dominant way of thinking about disability. It plays a role in contributing to ableism in society by viewing disability as something negative. The medical model underpins ableism, as the basis of how society understands what it means to be 'normal', where disability is viewed as something lacking within a person who does not meet the standard of 'normal'. The results of ableism are inequality and discrimination against people with disability.

In the 1970s, people with disability fought against this societal view to strive for rights in everyday society.[409] This led to the development of the social model of disability that distinguishes between an impairment and disability:

- Impairment is part of being human and an individual characteristic that is just one attribute that makes up who a person is.
- Disability results from the way society responds to impairment. It is barriers within society that disables people with impairments.

As such, the social model recognises that barriers in society prevent people with disability participating in everyday life.[410]

The United Nations CRPD is the international human rights law relating to the rights of people with disability. The CRPD builds on the social model of disability by adding a human rights element. This model acknowledges disability as a social construct and recognises impairment as a natural aspect of human diversity. The human rights model reinforces that human rights cannot be denied or limited on the basis of impairment. People with disability enjoy human dignity and worth on an equal basis with others.

The human rights model goes further than the social model.[411] Even when barriers to access are removed, many people with a disability will still require supports to enjoy their human rights on an equal basis to others.[412] The human rights model places a strong focus on active participation of people with a disability by recognising that they are experts in all matters that affect them.[413]

Neurotechnology can be invaluable in reducing the barriers faced by people with disability. To ensure that neurotechnology contributes to the enjoyment of human rights, developers must abide by principles of user-centred design, focussing on effectiveness, efficiency and user satisfaction.[414] In doing so, people with disability should be consulted and involved in the research and testing to ensure the outcomes achieved are accessible and reflective of the community.[415]

Neurotechnology companies should ensure people with disability are included in research, development, implementation and post-trial evaluation of the technology, in line with art 4(3) CRPD. It is crucial that people with disability are consulted in the development of neurotechnology, ensuring that applications of upcoming neurotechnology are actually desired by their target groups.[416] At the same time, people with disability should not be exploited or subjected to experimental medical technology without free and informed consent.

The views and experiences of people who utilise neurotechnology are invaluable. Their voices should always be paramount as they offer important insights about utilising neurotechnology:

> **[Utilising the implant] was a great distraction from his body failing, because Motor Neuron Disease is one of the few diseases where you're physically deteriorating – but you're mentally astute.**

The ability to continue to read, write, send emails or even turn off the lights by thought alone reportedly provided users with a sense of autonomy and control, leading to a sense of achievement from users:

> **[Anonymised patient] was, you know, really punching the air for … all those years that came.**

13.2 Equal access

Under international human rights law, everyone has a human right to the highest attainable standard of health, which includes both physical and mental health.[417] Neurotechnology promises to help realise this right as devices can improve outcomes for people with disability by enhancing their independence and inclusion and mitigating the societal barriers which create disability.

Right to health

Article 12 of the ICESCR that States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.

Article 25 of the CRPD stipulates:

> States Parties recognize that persons with disabilities have the right to the enjoyment of the highest attainable standard of health... In particular, States Parties shall: Provide persons with disabilities with the same range, quality and standard of free or affordable health care and programmes as provided to other persons... Provide those health services needed by persons with disabilities specifically because of their disabilities, including early identification and intervention as appropriate.

Interviews revealed that people believed that implants provided people with greater health and wellbeing while being impacted by other diseases:

> **[The devices] gave him something to focus on after he was diagnosed. He would have passed away sooner [if not for the device] because he was not one to sit and watch daytime TV – which was all that was available to him [without an implant].**

The realisation of the right to health requires the following essential elements:

- **Availability:** functioning public health and healthcare facilities, goods, services and programs must be available.
- **Accessibility:** health facilities, goods and services have to be accessible to everyone without discrimination.
- **Acceptability:** all health facilities, goods and services must be respectful of medical ethics and culturally appropriate.
- **Quality:** health facilities, goods and services must be scientifically and medically appropriate and of good quality.[418]

To promote this right, it is necessary that neurotechnology be accessible. International human rights law provides that health goods and services must be accessible – meaning they must be:

- **Non-discriminatory:** accessible to all, especially people in vulnerable situations and marginalised people.
- **Physically accessible:** within safe physical reach, especially for culturally and linguistically diverse communities and indigenous populations.
- **Affordable:** health facilities, goods and services must be affordable for all.
- **Informationally accessible:** all people have a right to seek and receive information about health issues.[419]

13.3 First users

People with disability are often the first to trial experimental neurotechnology, which means they can be the beneficiaries of positive innovations.

Interviewees explained that for those first adopters of new technologies, there can be a sense of pride about furthering research which can assist others:

> **[Anonymised name] was always putting his hand up, wanting to be part of any trials. … He was absolutely honoured to be asked [to participate].**

> **It was a whirlwind journey and at the end of it, as hard as it was, it gave him pleasure.**

> **[Anonymised name] and I were talking about how this could change the future for people who have a disability … so we were both excited by what was going on. [But] obviously there was a risk.**

> **[Anonymised name] felt like he was pioneering something that's going to be great for people in the future. That was a wonderful thing that he could focus his mind on.**

However as first users, they can also be the first to suffer when technologies fail. For example, users of implanted BCIs require significant and continued support for the life of these device, irrespective of the economic viability of the product itself. This may leave people with limited support if they are left with redundant technology, with little means of seeking support and assistance.

There is always an amount of risk associated with any medical procedure, particular during the implantation stage. Interviewees explained the anxiety this can induce noting:

> **You're going into the land of unknown really.**

> **It's like the first of anything though. You know, it's the great unknown. … Being a pioneer is hard. You always have to worry.**

Others reported concern over how their device would continue to function as related technologies updated and changed:

> **My biggest fear is not the actual equipment that's in his body, but Windows will move beyond the software level that he's connected to because of his equipment. And that's probably my biggest fear is trying to stop automatic updates on machines and still allow him to work within the house and have control over his environment.**

Policy makers, researchers, developers, insurance companies, and neurotechnology companies must consider how individuals with implants will be supported for the lifetime of their implant. This requires consideration of:

- What legislative safeguards are currently or should be in place to support individuals for the lifecycle of an implant?
- How will the patient/end-user/trial participant and their device be supported at the end of a trial or for the lifecycle of the implant?
- How genuine, informed and ongoing consent can be obtained?
- What happens if an organisation is made insolvent?
- What happens when an experimental trial of a new technology ceases? Explanation or continuation of usage and support?
- What intellectual property protections are in place? Will these protections impede user safety/quality of life if an organisation is unable to support the continued use of the device?

Unexpected faults or malfunctions can occur. For example, just weeks after first human implantation of its Telepathy device, Neuralink reported that a number of threads – thinner than a human hair – 'retracted from the brain, resulting in a net decrease in the number of effective electrodes'.[420] Developers were able to respond to the issue through software adjustments,[421] but this does raise questions about how to ensure that businesses respond appropriately to faults and malfunctions.

Second Sight

PRACTICAL USES

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 retinal implant to help them see again.[422] With over 350 patients globally, this neurotechnology product initially assisted many people. However, in 2019–2020 Second Sight discontinued its product and came close to insolvency. This resulted in some users having their implants 'turned off' as their artificial vision 'went dark'. One user reported:

> **I remember exactly where I was: I was switching from the 6 train to the F train … I was about to go down the stairs, and all of a sudden I heard a little 'beep, beep, beep' sound [before the implant stopped working].[423]**

While some report that the implants still worked, at this stage there is little indication that users can have their device fixed if it malfunctions.[424]

A further challenge may arise where neurotechnology is developed by start-up companies that end up being unsuccessful. This can leave individuals without technical support, limited avenues to facilitate repair or reprogramming, or facing barriers to accountability for the fault.[425] Safeguards need to be in place to ensure that early adopters of neurotechnology are supported for the life of their device.

NeuroVista

PRACTICAL USES

Difficulties may also arise when an implantable device is removed. NeuroVista was a company that 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.[426] 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 no choice but to remove the device (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.[427] 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.[428]**

Recommendation 15:

Companies developing or deploying implantable neurotechnology should have a plan describing how implantable devices will be managed throughout a product's life cycle. Such a plan should include:

- **Commitments to upgrade and repair devices**
- **Instructions on how a third party can maintain or remove a device; and**
- **Long-term planning for monitoring of devices and implantees.**

The removal, decommissioning or end of life of an invasive BCI raises complex human rights issues – especially where removal results in disability or physical or mental injury returning or being experienced in a heightened manner.[429]

Although there may be business, financial, intellectual property or even safety reasons for the removal or decommissioning of implantable devices – any non-consensual removal raises grave human rights concerns.

Recommendation 16:

Companies implanting and monitoring neurotechnology implants should ensure that, where possible, informed genuine consent in respect of the removal, decommissioning or end of life of an implanted device is obtained before the process occurs.

13.4 Informed consent

People with disability must not be presumed to lack decision-making ability. Supported decision-making is encouraged to allow people with disability to make, communicate and participate in decisions that affect their lives.[430]

Article 12 CRPD recognises that people with disability enjoy equal recognition before the law. In particular, art 12 directs State Parties to ensure that people with disability enjoy legal capacity on an equal basis with others, including by being provided with access to the supports required in exercising their legal capacity. Art 12 also directs State Parties to ensure all measures relating to the exercise of decision-making capacity provide for safeguards. It is critical that this be applied in the context of neurotechnological treatments to ensure rights protection for people with disability.

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.

In the exercise of informed consent, power asymmetries in the context of medical decision-making need to be addressed.[431] Power imbalances can affect users as active right-holders.

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

Users of neurotechnology 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.[432]

The 'duty to warn' a patient about the potential risks of a procedure or treatment prior to administration is recognised in Australia under state legislation, such as the *Wrongs Act 1958* (Vic), the *Mental Health and Wellbeing Act 2022* (Vic) and common law principles.[433] This includes providing a person with adequate information to make an informed decision such as an explanation of the proposed treatment, the advantages and disadvantages of undergoing or not undergoing the procedure, how the device and their care will be managed and paid for after a trial or in the long-term and any other alternative procedures.[434]

The Disability Royal Commission highlights the need to move away from substitute decision-making towards supported decision making as a significant human rights development by recognising equal recognition of rights before the law.[435] The Australian Law Reform Commission recommended National Decision-Making Principles that include:

- **The equal right to make decisions:** All adults have an equal right to make decisions that affect their lives and to have those decisions respected.
- **Support:** Persons who require support in decision-making must be provided with access to the support necessary for them to make, communicate and participate in decisions that affect their lives.
- **Will, preferences and rights:** The will, preferences and rights of persons who may require decision-making support must direct decisions that affect their lives.
- **Safeguards:** Laws and legal frameworks must contain appropriate and effective safeguards in relation to interventions for persons who may require decision-making support, including to prevent abuse and undue influence. [436]

Recommendation 17:

Neurotechnological interventions align with the National Decision-Making Principles.

A person should be supported to make informed decisions, consistent with art 12 CRPD. In addition to being provided with the necessary supports in decision-making, any treatment provided should align with a recovery-based model which revolves around patient-centred care and sees 'recovery' in a multifaceted, holistic way.[437] This often sees the person's potential for recovery as a key focus and ensuring they achieve a fulfilling life, rather than simply addressing symptoms alone.

Given the risks associated, assessment of decision-making capacity must be conducted before implantation or usage of neurotechnological devices.

Surgery should not be performed to implant a device unless the person 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 approaches should be used where the same goals can be achieved.

Neurotechnology is evolving quickly, and it may offer new ways to support people with disability. But just because a technology exists doesn't mean it should be automatically offered or encouraged. The choice to use neurotechnology must always belong to the person with disability.

People have the right to understand what a technology does, how it might affect them, and to say 'yes' or 'no' without pressure. If someone is helping to make decisions, like a carer or appointed decision-maker, they must listen to the views and respect the preferences of people with disability. If wishes aren't clear, they should still act in ways that protect human rights.

Ultimately, neurotechnology should be a tool that supports the goals of people with disability - not something that overrides them.

13.5 Ageing and disability

There is a clear intersection between ageing and disability, given that as people age they are more likely to experience impairment. Much of the limited literature on older people and neurotechnology focuses exclusively on this intersection. As noted in the following chapter, the rights of older people are not limited to older people with disability.

While consideration of age and disability is important, neuro-ethicists, developers and policy makers should consider the rights of older people more broadly – rather than limiting themselves to issues surrounding disability and disease. This is a notable gap in the literature that needs to be addressed.

Neurotechnology can lead to greater understanding of how memories are stored and retained.[438] The medical uses of neurotechnology have demonstrated clinical efficacy in repairing, augmenting or assisting cognitive or sensory-motor functions in people experiencing spinal-cord injury, stroke and motor neuron disease.[439] Neurotechnology may also assist with many other impairments (as explored throughout the final report) which may impact older people.

Neurotechnology promises to improve quality of life and increase autonomy in older people. There are already growing global calls for countries to support programs that integrate neurotechnology into routine care for older people.[440]

However, such calls must better consider whether older people want to utilise such technologies. While non-invasive technologies may be less intimidating than their implantable counterparts, they still pose human rights risks.

Societies must avoid ageist policy-making whereby decisions made to adopt neurotechnology in care settings are done to 'help' older people based on stereotypes. One way to avoid ageist policy making is to ensure that older people are consulted before adopting measures to implement neurotechnology in certain settings, such as in care facilities.

As noted earlier, considerations of informed consent, capacity and impaired decision-making will all be highly relevant for older people with disability.

14. Older people

The process of ageing can lead to increased rates of disability and dependence. The previous chapter addresses disability which may be experienced by older people. The issues at the intersection of disability and ageing are not the only challenges surrounding the use of neurotechnology and older people. A holistic approach to human rights protection of older people is necessary. This requires consideration of both consumer and medical devices throughout this chapter.

Like most developed countries, Australia's population is ageing due to sustained low birth rate and increased life expectancy.[441] Australia's median age has climbed from 33 years in 1993 to 38.3 in 2023. Over the same period, the percentage of people aged 65 and over has increased from 12% to 17% of the population.[442]

Despite an ageing population there is no convention on the rights of older people. Australia's Age Discrimination Commissioner, Robert Fitzgerald AM, has publicly called on the Australian Government to formally endorse the creation of a UN Convention on the Rights of Older Persons.[443]

International conventions provide a foundational protection for human rights and act as a formal safeguard against relevant risks such as those associated with the use of neurotechnology. Without a convention on the rights of older people, the risks to older people are less likely to be specifically addressed.

14.1 Age discrimination

Ageism impacts people across their lifespan and remains the most pervasive and socially acceptable form of prejudice.[444] While ageism affects people at all stages of their life, this section of the report is specifically concerned about how it may impact older people.

What is ageism?

'Ageism' refers to stereotypes (how we think), prejudice (how we feel) and discrimination (how we act) towards people based on their age.[445] Ageism can impact people's physical, mental and cognitive health and wellbeing.[446]

Ageism can infiltrate institutions and sectors of society such as:

- health and social supports
- workplaces
- media
- legal systems.[447]

90% of Australians believe that ageism exists, while a further 83% believe it is a problem in this country.[448]

Ageist views can reinforce marginalisation, exclusion and discrimination.[449] For older people it is associated with 'poorer health outcomes, increased risk of social isolation and decreased quality of life'.[450]

Often ageism may result in older people being 'helped' without being asked.[451] This is combined with stereotypes that older people have declining agency, vitality and skills. Older people may also be viewed as being more frail and generally unwell.[452]

These ageist views can have implications for autonomy and decision-making, especially if decisions are made to 'help' older people for example in respect of neurotechnology.

Neurotechnology may address cognitive decline or diseases in older people. It is important that neurotechnology is not 'pushed' onto older people in attempt to 'help' them. Decisions regarding the use of neurotechnology by older people must respect their autonomy and agency, to ensure that consent is informed, ongoing and free. This issue is particularly relevant when a carer or family member is an appointed decision-maker for an older person.

Older people or their appointed decision-maker must provide free, informed and ongoing consent when adopting neurotechnology. Additionally, appointed decision-makers for older people should reflect the will and preference of the older person, and if not able to be ascertained, then respect their autonomy and agency as appropriate.

It is also important that medical practitioners respect the will and preference of the older person or their appointed decision maker, about their decision to utilise, or not utilise, neurotechnology.

Views around age can also impact how society views older people through what may be described as differing cultures or discourses of ageing, which include positive models such as 'active' ageing, 'productive' ageing or 'successful' ageing. These discourses emphasise choice and agency, as well as maintenance of personal health and vitality in order to participate fully and age 'successfully'. Other models rely on more traditional assumptions about old age, which focus on decline and decay, particularly in the later part of old age.[453]

The broadly positive models are generally multidimensional and can encompass the avoidance of disease and experiencing of disability, maintenance of high physical and cognitive functions and continued engagement with social and productive activities.[454] However these narrow views of successful ageing may promote unhealthy and discriminatory views about older people. This may in turn push older people into seeking out neurotechnology to meet narrow societal expectations about how they should age.

Consumer devices including those promising cognitive enhancement may be an attractive option for some. However, this should not become another way of promoting rigid ideas of the 'right' way to age, where some become 'successful' and others 'fail'.[455]

This may also fuel an emerging trend which suggests that as people age their need to engage with neurotechnology increases due to an assumed reduction in both physical independence and mental function.[456] Declines in physical and mental health will differ from person-to-person as many retain high functioning well into the late life.[457] What matters is living a life with fulfilment, dignity and respect into older age.

Discrimination against people of all ages on the basis of their age is against the law, as set out in the *Age Discrimination Act 2004* (Cth). Generally, the Act seeks to promote equality before the law for all people, regardless of age; eliminate unlawful age discrimination in the community; act as a catalyst for attitudinal change; and provide individuals with an avenue to make complaints of discrimination.[458]

The Act makes it unlawful to treat people less favourably because of their age in areas such as access to:

- education
- employment
- accommodation
- services (amongst others).[459]

As neurotechnology become more commonplace, it will be important that all people consider their obligations under anti-discrimination legislation.

14.2 Employment

Australians are increasingly working to older ages and remaining in the workforce longer.

Older workers

Despite perceptions that older people over the age of 65 retire from the workforce, this demographic had a workforce participation rate of 15% in 2021, compared to just 6% in 2001.[460]

This reflects a broader trend of people working into older ages. In 2019:

- 75% of people aged 55-59 worked, compared to 70% in 2009 and 60% in 1999.
- 59% of people aged 60-64 participated in the workforce, compared to 50% in 2009 and 33% in 1999.
- 20% of people aged over 70 also continued to do paid work.[461]

Despite increasing participation in the workforce, older workers continue to face ageism and discrimination. Past work by the Commission has demonstrated that too many older people are 'shut out' of the workforce due to underlying stereotypes associated with age.[462] A 2021 survey revealed that almost half of Australian businesses were reluctant, or may be reluctant, to recruit older workers.[463] This is likely influenced by strong ageist perceptions that older workers are not suitable employees – with more than a third of workers over 50 experiencing age discrimination in the workplace.[464]

Age discrimination against older people often manifests in assumptions about poor health and wellbeing.[465] These perceptions that older people are frail or incompetent (along with stereotypes suggesting they are less tech savvy, resistant to change and find it difficult to learn) fuels discrimination against them in the workplace.[466] In turn, this may place pressure on older workers to adopt neurotechnology, which promise to enhance cognitive performance or mitigate cognitive decline or disease.

Should neurotechnology be capable of delivering significant benefits in cognitive function (or mitigate the impacts of cognitive decline), older workers may feel pressured to adopt these technologies to address prevalent negative stereotypes. It is important to also note that the use of neurotechnology may have significant benefits for older people in the workplace and could allow them to work to much later in their life.

Traditionally older workers may have been involved in workplace conversations about retirement as they age; as neurotechnology become more effective and adopted, workers may one day face conversations about when/if they plan to utilise neurotechnology. It is possible that employment decisions made about an older person and their decision to adopt, or not adopt, neurotechnology could risk breaching the Age *Discrimination Act 2004* (Cth) or *Fair Work Act 2009* (Cth).

Older people should only be adopting neurotechnology where consent is both free and informed. Workplace pressure to address inaccurate or stereotypical assumptions about fragility and mental competence via neurotechnology is inappropriate. Workplaces should not inquire into whether older workers will utilise neurotechnology as a condition of employment.

14.3 Elder abuse

In Australia, almost one in six older people experience elder abuse.[467]

Elder abuse

The World Health Organisation defines 'elder abuse' as:

> a single, or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust which causes harm or distress to an older person. Elder abuse can take various forms such as financial, physical, psychological and sexual. It can also be the result of intentional or unintentional neglect.[468]

Ageism has been considered as a societal risk factor which may impact the rates of elder abuse.[469] This has led researchers to determine that:

> ... ageism brings a negative view of the older people and a negative perception of the aging process and can be a risk factor, not only of avoidance, denial or subordination of behaviours but also of mistreatment, neglect or elder abuse situations.[470]

The Commission has conducted research on attitudes surrounding older people needing protection versus having autonomy.[471] Discussion from participants linked advanced age with a decline in physical health and cognitive ability – underpinning a perception that age is associated with vulnerability and dependence.[472]

Some researchers link this pattern of stereotyping older people as likeable but vulnerable and needing assistance to a paternalistic view of them, which can result in benevolent ageism. Benevolent ageism occurs when older people are perceived as vulnerable and therefore needing protection. When the desire to express care for an older person crosses over to limiting their autonomy due to an assumed lack of ability or frailty, this can have negative impacts.[473]

Existing stereotypes can seriously impede older people's actual or perceived capacity to adopt neurotechnology. Their children or others close to the older person may use actual or perceived reductions in capacity to 'push' neurotechnology onto older people or to gain access to collected data (such as vital health markers).

Within this context, neurotechnology may be forced upon older people as a form of elder abuse. For example, pharmaceuticals are already misused in care settings by carers to deal with 'difficult' people. It is not unfathomable to think that as neurotechnology develops it may be similarly misused in aged care. The risk of misuse of the technology as a form of elder abuse is exacerbated where surrogate decision-makers can use it to harm older people. Conversely, surrogate decision-makers could equally withhold desired neurotechnical intervention as a form of abuse.

Recommendation 18:

Surrogate decision-making must reflect the will and preference of the older person in respect of neurotechnology, and if not able to be ascertained, then must act in the best interests of that older person.

15. Moving forward

Human rights apply both offline and online, however in this digital era the border between these realms is becoming increasingly harder to identify. This complicates how we can best ensure that our rights are protected in both spaces. But now, more than ever, it is critical that the development of neurotechnology respects human dignity, reason and conscience in line with art 1 of the UDHR.

No technology better exemplifies this complexity than the rise of neurotechnology. For many people, particularly those with disability, it will reduce barriers and substantially improve their lives – providing opportunities for rights fulfilment. Yet it can also pose a serious threat to human rights by enabling unprecedented access to individuals' thoughts, emotions and mental privacy. Allowing access to people's neural data undermines privacy and freedom of thought, as well as the neural data potentially being used to discriminate against people in their daily lives.

Innovative and emerging technologies require proactive and flexible responses to protect and promote human rights. This report does not provide the perfect solution to the difficult issues posed by neurotechnology. Instead it sets out a pathway to reform which will allow Australia to innovate while ensuring rights can be protected and promoted.

Neurotechnologies are already being adopted in Australian workplaces and healthcare settings. Before long it is possible it will become integrated into these and other parts of our lives, such as our education system and homes. Technology develops rapidly and can be adopted rapidly if there is consumer trust in the product. Australian policy makers, businesses and society must ensure that as neurotechnology develops and is increasingly adopted, our laws and practices are prepared.

An innovative environment requires certainty, and consumers need to trust products if they are to adopt them. A human rights centred approach to neurotechnology provides both – as the recommendations made throughout this report balance the need to support a growing industry that offers to deliver real improvement to people's lives while also protecting users against misuse and rights abuses.

16. Recommendations

The Commission makes the following recommendations:

Recommendation 1:

The Australian Government set out a clear timeline for when each 'agreed' and 'agreed in principle' amendment to the Privacy Act will be introduced in future tranches and prioritise the passage of these reforms.

Recommendation 2:

Neurotechnology companies create plain-English privacy policies and collection notices.

Recommendation 3:

The Australian Government resource the Australian Human Rights Commission and Office of the Australian Information Commissioner to produce guidance on the treatment of neural data and neurotechnology under the Privacy Act.

Recommendation 4:

The United Nations Human Rights Committee provide guidance on freedom of thought and neurotechnologies through the adoption of a general comment on article 18 of the International Covenant on Civil and Political Rights.

Recommendation 5:

The Australian Government legislate to prohibit the use of neuromarketing for political advertising, polling research and other consumer purposes.

Recommendation 6:

The Attorney-General refer to the Australian Law Reform Commission an inquiry to consider the potential application of neurotechnology in the criminal justice system, and examine in what circumstances (if any) it can be appropriately used. Until this work is completed there should be a moratorium on the use of neurotechnology in the criminal justice system.

Recommendation 7:

The Australian Government ensure there is specialist regulatory capacity to oversee consumer-oriented neurotechnologies by establishing a Neurotechnology Safety Agency. This agency should:

- Establish effective safety standards.
- Provide guidance to businesses on required information for consumers on device operation, potential indicators of faults, and avenues to report faults. Where businesses have sole access or control over operational or device data, they should report identified faults to the regulator and consumer in a timely manner.
- Have regulatory powers to protect against misleading and deceptive conduct.

Recommendation 8:

The Australian Government ban the use of workplace neurotechnology, other than for addressing the most serious work health and safety risks in high-risk industries.

Employers should consult with employees and their unions when they are considering the use of neurotechnology in the workplace.

Recommendation 9:

Recommendations 14-2 and 14-6 of the ALRC's Report 123 'Serious Invasions of Privacy in the Digital Era' should be implemented as a priority:

Recommendation 14-2: Surveillance legislation should be technology neutral. It should regulate surveillance through the use of listening devices, optical devices, tracking devices, data surveillance devices, and other devices and systems.

Recommendation 14-6: Workplace surveillance laws should be made uniform throughout Australia.

Recommendation 10:

Neurotechnology companies implement a Safety by Design approach when designing, developing and deploying products and services.

Recommendation 11:

Article 36 reviews be regularly conducted throughout the lifecycle of neurotechnology devices utilising AI. This includes where neurotechnology is used as part of a new weapon or means of warfare.

Recommendation 12:

Without revealing information that negatively impacts national security, the article 36 reviews conducted by the Directorate of Operations and International Law on neurotechnology should be publicly disclosed.

Recommendation 13:

Organisations using neurotechnology demonstrate how they have addressed the requirement to ensure the best interests of the child when designing or offering products and services likely to be used by children.

Recommendation 14:

The Australian Government conduct Child Rights Impact Assessments when developing laws which impact children and neurotechnology.

Recommendation 15:

Companies developing or deploying implantable neurotechnology should have a plan describing how implantable devices will be managed throughout a product's life cycle. Such a plan should include:

- Commitments to upgrade and repair devices;
- Instructions on how a third party can maintain or remove a device; and
- Long-term planning for monitoring of devices and implantees.

Recommendation 16:

Companies implanting and monitoring neurotechnology implants should ensure that, where possible, informed genuine consent in respect of the removal, decommissioning or end of life of an implanted device is obtained before the process occurs.

Recommendation 17:

Neurotechnological interventions align with the National Decision-Making Principles.

Recommendation 18:

Surrogate decision-making must reflect the will and preference of the older person in respect of neurotechnology, and if not able to be ascertained, then must act in the best interests of that older person.

17. Glossary

Amyotrophic Lateral Sclerosis	ALS
Artificial intelligence	AI
Augmented reality	AR
Australian Capital Territory	ACT
Australian Competition and Consumer Commission	ACCC
Australian Consumer Law	ACL
Australian Human Rights Commission	Commission
Australian Law Reform Commission	ALRC
Brain computer interfaces	BCI
Convention on the Rights of the Child	CRC
Convention on the Rights of People with Disability	CRPD
Deep brain stimulation	DBS
Direct-to-consumer	DTC
Electroconvulsive therapy	ECT
Electroencephalography	EEG
European Union	EU
Functional Magnetic Resonance Imaging	fMRI
Human Rights Impact Assessment	HRIA
International Covenant on Civil and Political Rights	ICCPR
International Covenant on Economic, Social and Cultural Rights	ICESCR
International Labour Organisation	ILO
Large language models	LLM
Motor Neurone Disease	MND
National Human Rights Institution	NHRI
New South Wales	NSW

Office of the Australian Information Commissioner	OAIC
Online Safety Act 2021 (Cth)	Online Safety Act
Organisation for Economic Co-operation and Development	OECD
Positron emission tomography	PET
Post Traumatic Stress Disorder	PTSD
Privacy Act 1988 (Cth)	Privacy Act
Privacy and Other Legislation Amendment Bill 2024 (Cth)	Privacy Amendment Bill
Privacy impact assessments	PIA
Protecting Cognition: Background Paper on Neurotechnology and Human Rights	Background Paper
Single-photon emission computed tomography	SPECT
European Charter of Human Rights	ECHR
Therapeutic Goods Act 1989 (Cth)	TG Act
Therapeutic Goods Administration	TGA
Transcranial direct current stimulation	tDCS
Transcranial direct stimulation	TDS
Transcranial magnetic stimulation	TMS
United Kingdom's Information Commissioners Office	UK ICO
United Nations	UN
United Nations Educational, Scientific and Cultural Organization	UNESCO
United Nations International Children's Emergency Fund	UNICEF
United States	US
Universal Declaration on Human Rights	UDHR
Violent Extremism Risk Assessment Version 2 Revised	VERA-2R
Virtual reality	VR

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