Horizon Report for The Law Society

Neurotechnology, law and the legal profession

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The Law Society

Contents

Foreword

What are the implications of neurotechnology for the law and the legal profession?

This is the complex question we attempt to answer in this horizon scanning report.

Neurotechnology is a scientific field that consolidates and connects electronic devices with the nervous system. Neurotechnology can pose interesting and complex ethical and legal issues since it can be used to create a so-called "interface" between the brain and computers. Neuralink is an example of this technology which is initiated by inserting a microchip into the brain. The brain-computer interfacing technology is arguably a positive step towards merging humans and artificial intelligence. The proponents argue that this technology could allow humans to overcome disorders such as Alzheimer's, Parkinson's disease, blindness, anxiety, depression, and insomnia. The opponents argue that this technology will be overly invasive and could create unanticipated complications.

Neurotechnology presents novel ethical and legal issues which should be carefully considered beforehand. For example, what if a person commits a criminal act by using the implanted microchip. Who would be responsible for the criminal violation? So, if another person somehow manages to control the electronic device to commit a violation, how would the courts address the legal issues? In essence, how do we regulate human mental capacity? There are other questions that can come up when implementing this technology. For example, could solicitors one day be instructed to use a microchip to enhance their mental capabilities? Could the courts force known offenders to use special microchips, so their brain activities are monitored and controlled by a government agency?

Brain implants are not an entirely new technology since they have been used in medical interventions. However, merging microchips and artificial intelligence is relatively new and untested currently. There are multiple ethical and legal issues that will arise. First, there are privacy concerns. Second, the individual's identity can be stolen without permission. Third, the individual's autonomy can be taken away. Fourth, the culprits (e.g. hackers) can exploit the technology and manipulate individuals for self-serving purposes.

The debate on whether and how we should make our brains ready to be "plugged" to technical devices must begin today. We must discuss which are the risks we are willing to take—and whether there are paths in this uncharted territory that we may not wish to enter. Law firms can develop their client base in new directions and perhaps some firms will try to become known for specialising in ethical issues related to neurotechnology. Other new opportunities might involve guiding neurotech clients through the regulatory process or advising them on other legal issues. If neurotechnology were to take off in the workplace, or the context of consumer devices, there might be scope for providing advice on related employment law and consumer law issues. It is hard to know how widespread the uptake of neurotechnology might ultimately be, but to neglect it would be unwise particularly given the backing of neurotech projects from investors like Elon Musk, Peter Thiel and Facebook (Meta).

Dr Kion Ahadi
Director of Strategy, Futures and Insight

Executive summary

This report contends that in the coming years neurotechnology will make an impact on the law thereby creating challenges and opportunities. Looking further into the future, it may also impact on the way lawyers work and their cognitive performance. The precise magnitude and nature of the impact is uncertain.

It is further contended that decisions about how to respond to the neurotechnological trend that is now emerging will need to be made at the level of society. Decisions may well also be required of bodies that provide legal education, law firms, and individual legal professionals.

The report unpacks what neurotechnology is, its emerging ripples of impact in society, and the potential challenges, opportunities and questions facing the legal profession and the practice of law.

What is neurotechnology and what can it be used for?

Neurotechnologies are technologies that interact directly with the brain, or more broadly the nervous system, by monitoring and recording neural activity, and/or acting to influence it. Sometimes neurotechnology is implanted in the brain but it may also be external to the body in the form of a headset, wristband or helmet.

Neurotechnology can be used to treat neurological conditions such as Parkinson's disease and perhaps one day many others, including dementias. In relation to psychiatric conditions the hope is that depression, anxiety and a variety of other mental issues will one day also be treated by way of neurotechnology. Non-therapeutic neurotechnologies, such as those employed in computer gaming and the monitoring of workers' attention in the context of employment, are currently available and used by some companies and individuals. Neurotechnology has attracted significant military interest and some military institutions are considering the prospect of cognitively enhanced supersoldiers. Whilst it is not clear precisely how the neurotechnological trend will develop, the prospect of widespread use of neurotechnologies is fuelling commercial excitement.

Why consider neurotechnology?

In a world where some people can connect their brains directly to the internet and thereby post to social media *without bodily action*, others control drones by way of brain-computer interface, and still others manage their epilepsy by way of brain-implants that algorithmically monitor and from time to time electrically stimulate their brains, it is time to ask what the implications of neurotechnology are for the law and the legal profession.

This question is becoming pressing as investors such as Elon Musk are backing neurotechnology, as are companies such as Meta (Facebook). Organisations such as the New York based Neurorights Foundation are worrying about the technology's human rights implications, and some countries are starting to take legislative action to address the coming challenges. Of particular note in this respect is the 2021 change to the Chilean constitution that took place in response to concerns about emerging neurotechnologies.

Ethical, social, political, and economic issues

A very important ethical upside to neurotechnological development is their potential to significantly alleviate suffering caused by neurological and psychiatric conditions. Conversely, **the large amounts of brain data that these technologies are likely accumulate give rise to concerns about mental privacy**. This brain data might give the companies or governments that have access to it the capacity to make inferences about the mental world of users of the technology, about their predisposition to neurological and psychiatric issues, and their likely future behaviour. This capacity may also **give rise to a power to manipulate people** - a power that would only be increased if the technologies also write to the brain, perhaps by way of electrical stimulation, adding to the threat to individual autonomy and the democratic system.

At some point, a division might arise between those who are neurotechnologically (and perhaps otherwise) enhanced and have greater cognitive skills, and those who are not. Some individuals may see **neurotechnological enhancement as a way of outdoing competitors in the market** for jobs, and also as a way of keeping up with AI systems as those systems increase in their capacity to disrupt the employment market.

Regulation, legal doctrine and human rights

Some neurotechnology has a clear therapeutic aim and yet other neurotechnology requires no surgical intervention and has no therapeutic aim. It will be necessary to consider **whether current regulatory systems are adequate** given that some devices may monitor and stimulate the brain for non-therapeutic purposes.

Neurotechnologies are likely to bring challenges in many areas of law including employment, consumer protection and a host of others. To take criminal law as an example, one might ask what conduct constitutes the actus reus (criminal act) where a person injures another by controlling a drone or other system by thought alone. Moving to sentencing, would it be acceptable for criminal justice systems to monitor and perhaps even intervene on offenders' brains by way of neurotechnological device whilst they are serving sentences in the community?

This latter question raises human rights concerns and there is now an important debate as to **whether existing human rights protections are fit for purpose given the possibility of brain-monitoring and manipulation**.

The human rights issues extend well beyond criminal law into other areas of law.

Legal education and the legal profession

In time legal educators might start to face new questions relating to equity and academic integrity; for example: what kinds of neurotechnological assistance are permissible in relation to assessment tasks? What if some students have access to performance-enhancing neurotechnologies and others do not?

Some lawyers might try **to gain an advantage over competitors and try to stay ahead of increasingly capable AI systems by using neurotechnology to improve their workplace performance**. Perhaps clients might provide pressure to do this, and one can imagine changes to billing that may be brought about by the attention-monitoring capacities of neurotechnologies. This might even prompt **a move from billable hours to billable attention**.

Looking to the future

To meet some of the challenges addressed in the report, law will need to have a role in rising to address various very serious **human rights issues**, in particular those relating to **privacy, surveillance and manipulation of people's behaviour** by those who develop and sell neurotechnology, or perhaps others. The stakes are very high in relation to these matters. The law may also need to consider issues of **equity of access to the technologies, device safety and concerns about algorithmic bias**. Law has the opportunity to attempt to maximise the upside and to minimise the downside of the technological developments described in this report. In terms of practical steps, law reform bodies need to start to consider the emerging trends with input from civil society and the companies who develop the technologies. Whilst such consideration is important, it is necessary not to overestimate law's impact in relation to other approaches to influencing technological development which will also need to be employed.

Legal educators can expect to encounter interesting new problems that might challenge existing modes of legal thinking.

Reflection on neurotechnology (and other technologies) provides the opportunity to respond by encouraging an anticipatory style of thinking in students, and to foster the development of critical thinking skills, whether students are learning the law for the first time or are engaging in continuing

professional development. However, educational institutions might be challenged by novel questions relating to neurotechnological forms of academic misconduct.

Law firms have the opportunity to **develop their client base in new directions** and perhaps some firms will try to become known for **specialising in issues relating to neurotechnology**. It is hard to know how widespread the uptake of neurotechnology might ultimately be but to neglect it might be regretted particularly if, as has been speculated, brain-implants or wearable devices might become the **iPhone of the future**. Importantly given the technology's close connection with the brain and mind, and perhaps even the creation of cyborgs, **this should not just be thought of as straightforwardly a variation on existing approaches to technology in the context of legal practice.**

Moving further into the future, it might be worth considering the possibility of lawyer and technology becoming less distinct than they now are, and legal technologists may need to think about how this could impact upon their work. From the perspective of more traditional individual legal practitioners, the possibility of developing a neurotech client base and reputation, or engaging with interesting new legal issues, might be attractive but the more distant possibility that neurotechnological enhancement and brain-monitoring might one day become expected of them may be less so. There are opportunities for bodies such as the Law Society to consider these issues in discussion with its members and other stakeholders in order to decide how to respond and help shape the neurotechnological sphere.

Introduction

We are now in a world in which some people can control a cursor, type text and interact with **social media** by thought alone rather than by a traditional bodily action. Individuals can **control drones** in a similar manner, and others manage their **epilepsy** with a device that monitors their brain and periodically intervenes to stimulate it. As these uses expand and accelerate we need to consider how such technological development might affect the law and the legal profession.

When considering the possible impact of neurotechnology on law and the legal profession it is worth noting that this is certainly not the first time that law and the profession have been challenged by technological developments. Some readers will remember when the internet started to raise legal questions. We might also note that there was a time when the idea of artificial intelligence (a technology that is integral to much emerging neurotechnology) having an influence on law and the legal profession seemed to be a remote possibility, almost one best left to science fiction writers. However, the internet is now a mainstream factor for the legal profession, both raising substantive legal issues and affecting the way lawyers work. The idea that AI might shake things up no longer seems radical – in fact estimations of the likely impact of artificial intelligence now seem to be an important consideration in the strategic planning of some law firms and these technologies are starting to generate interesting challenges for the courts. This report contends that the law will have to deal with ripples from a related field - that of neurotechnology. Whilst it is clear there will be impact, the extent and nature of that impact remains to be seen.

Whilst neurotechnologies (technologies that interact with the brain) such as have just been mentioned are a staple of science fiction[1], for example featuring in the movie the **Terminal Man** (1974), **The Ghost in the Shell** (2017), and in **Black Mirror** (Channel 4 2011-14; Netflix 2016-19), there is now a great deal of commercial interest in real-world neurotechnological advances. Silicon Valley billionaires such as **Elon Musk** and **Peter Thiel** are investing, as are Facebook (Meta) (who is working on a **neural interface bracelet**), and there are now a host of other companies, including UK companies (**KTN Innovation Network: 26**), racing to commercialise the advances. This gives reason to think that in the coming years there will be wider uptake of neurotechnologies. Furthermore, neurotechnologies may be created that monitor and perhaps even **enhance the performance of workers** by improving their attention. It is not out of the question that lawyers may one day employ neurotechnologies to assist with their legal work. In this way it might impact upon not just the law but on the way that lawyers work.

1 Sadly, my own contributions to the consideration of neurotechnology in science fiction have not yet been picked up by any television or movie producers. See Our Debt to Vulcan (2009) and Vulcan (2022).

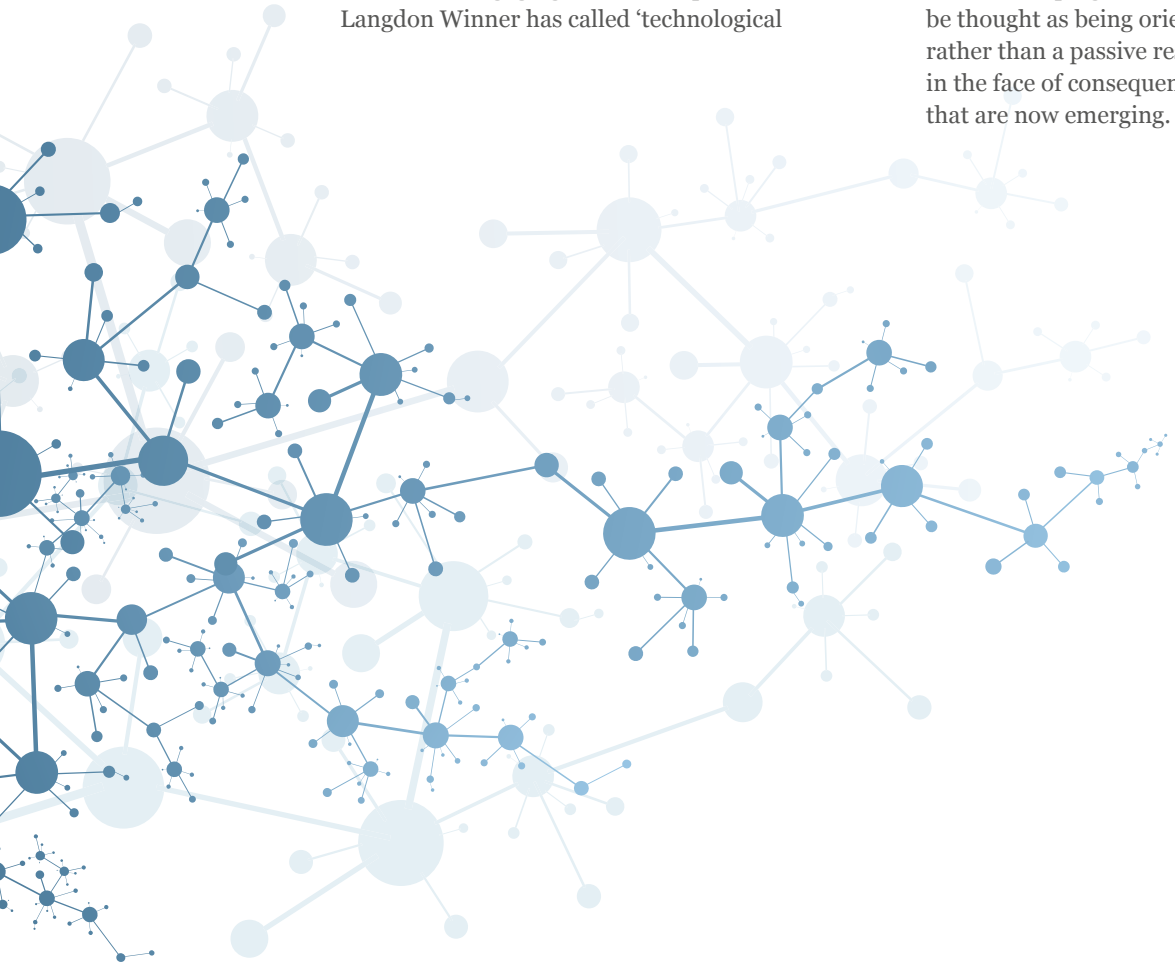
The legal implications to all of this are starting to be acknowledged. **Chile** has become the first country in the world to alter its constitution, in part to respond to these and future possible developments and, at the time of writing, a further piece of legislation that aims to address issues relating to neurotechnologies is making its way through the country's legislative process. Other countries may also start to take legislative action.

This report considers some possible implications of neurotechnologies for the law and the legal profession, with the intention to stimulate a discussion of some technological developments that are likely to become more significant in society. An important aim of the report is to provoke thought and discussion. This seems to be a worthy goal since neurotechnology could, as well as greatly improving the lives of many, and in the context of the legal profession provide interesting new opportunities for legal work, also facilitate ethical failures and even human rights abuses. Thinking about the challenges and opportunities brought by neurotechnology has a number of possible benefits and these can be considered at the **levels of society, firm and individual lawyer**.

At the level of **society** it lets us think about what the law might do to channel neurotechnology in a way that is consistent with society's values, rather than engaging in what the political theorist Langdon Winner has called 'technological somnambulism' (**Winner 2020**) - perhaps even sleepwalking into a dystopia. It is important not to overlook the way economic incentives, cultural factors, and the provision of education in ethics and the fostering of ethical culture in those who might develop the technologies might also help channel technological development. This is especially important to remember as law is often a lagging influencer that has a difficult time in keep up with the increasingly rapid pace of change.

At the level of **the firm**, the analysis in this report allows for consideration of opportunities and threats that might be generated by neurotechnology, perhaps in relation to the development of client base or even ways of working, and at the level of an **individual** lawyer similar considerations may be useful in relation to thinking about career development and positioning oneself within the market for legal skills.

This report contends that given the commercial excitement about neurotechnologies, in the future they are likely to have a greater uptake in society than at present, and that this will impact upon the law and may well impact the profession. It adopts an intentionally provocative stance, not in order to make definitive predictions about the future, but to raise important possibilities in order to stimulate a conversation in the legal profession that may have a role in shaping the future. Thus, the report might be thought as being orientated towards action rather than a passive resignation, or worse, denial in the face of consequential technological trends that are now emerging.



What is neurotechnology?

Neurotechnologies are technologies that interact directly with the brain or more broadly the nervous system by **reading from and/or writing to the brain**. An example of currently available technology which *reads* from the brain would be a brain-computer interface which is used to control a cursor.

Let us assume that a person is unable to type or use voice recognition software to compose text and control a cursor. This might be due to a medical condition such as **locked-in syndrome**. Such a person might have a device implanted into their brain or even a non-invasive headset which they wear, which can 'read' the neural activity associated with mental acts (**Reza Abiri et al 2019**) such as imagining waving one's hand. This device would associate certain mental acts with different commands. For example, an imagined handwave, when interfaced with a computer monitor, might be recognised as a command to move a cursor right. Perhaps imagining kicking a football could be the command that is equivalent to clicking 'return' on a keyboard and so forth. In this way a person might compose and send an email, or in a similar manner a brain-computer interface might allow for the control of a wheelchair, drone or other device.

Another form of brain-reading involves decoding images seen by a person and displaying them on a computer screen. A striking example of this comes from scientists who have managed to record neural activity of people who are watching movies and using the recorded neural activity to play back hazy images of the movies that the people saw using only the recording of activity in their brains (**Anwar 2011**). Yet another form of brain-reading involves scanning the brains of those who engage in suicidal ideation. One of the hopes emerging from this kind of research is that if neural markers could be found that are predictive of a suicide attempt, then these markers might have a role in finding a successful intervention that might avert the attempt (**Just et al. 2017**).

Other forms of neurotechnology write to the brain so for example a **brain implant to treat Parkinson's disease** operates by providing stimulation to the brain aimed at preventing the symptoms of the disease and this could be thought of as 'writing' to the brain. This is different from the situation in the previous paragraphs where the devices do not stimulate the brain but only monitor it (reading from it), in order to identify neural activity associated with images or the commands that are necessary to control a cursor and compose text. More controversially some have considered the possibility of writing to the brain using deep brain stimulation to lower sex drives of those who are at risk of sexual offending (**Fuss et al. 2015**).

Human brains are not the only brains that are currently being read and intervened upon. An example of writing to animal brains involves triggering hallucinations. It seems that scientists can trigger *specific* hallucinations in laboratory mice by writing to their brains in ways that make them think they have seen a food stimulus and behave as if they had (**New York Times 2019**). If one causes a person to take LSD that might in turn cause a hallucination but the person who administers the drug has little control over the precise nature of the hallucination. The neurotechnology seems to make more fine-grained

control over internal worlds possible. Perhaps these techniques will one day lead to a similar capacity with respect to humans.

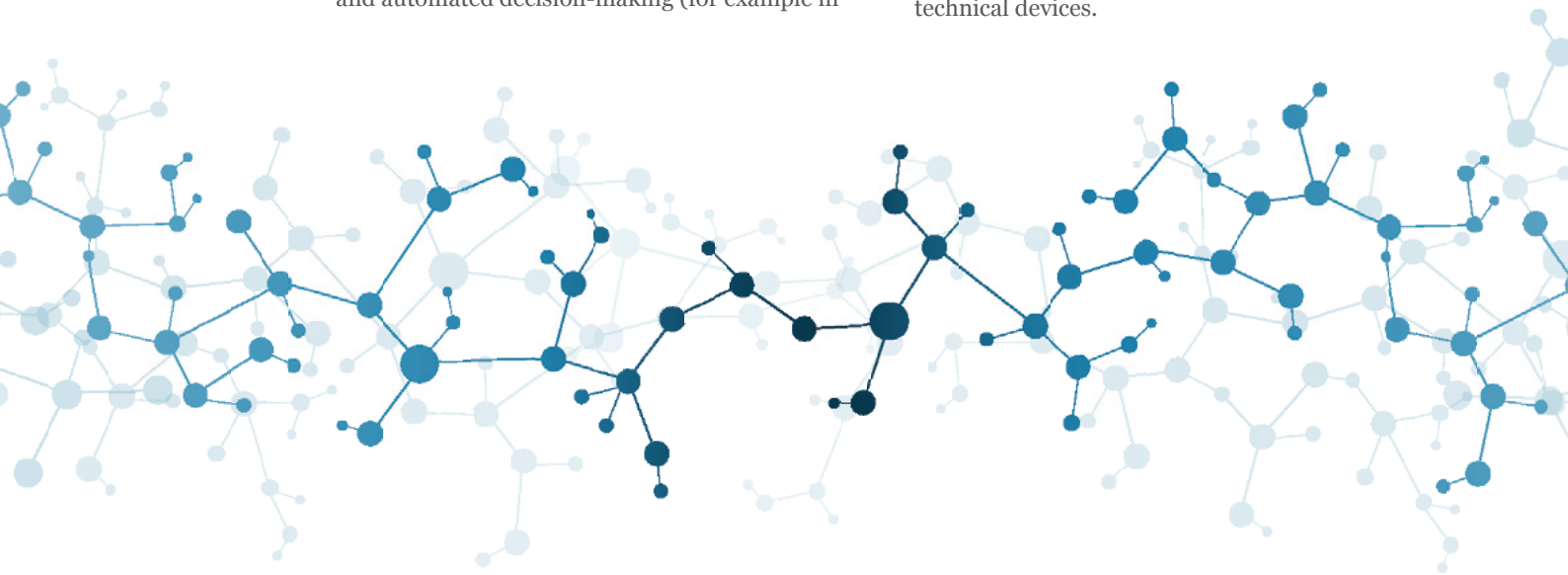
Other forms of technology both read and write to the brain. An example of this might be the **Neuropace device** that monitors the brain ('reading' from it) in order to identify the neural precursors to an epileptic fit and then acts to stimulate (writing to the brain) in order to avert it. One might contrast this with epilepsy medication which does not operate only when a fit is imminent but is more consistent in its impact for the duration of the efficacy of the medication. More generally therapeutics that operate in this way might be hoped to reduce the side effects of therapy because they operate only on an as needed basis. To facilitate technologies like this requires a machine learning approach in which sophisticated algorithms 'decide' when intervention by way of stimulation is needed based on their monitoring of patterns of neural activity.

Beyond reading and writing, a further distinction between neurotechnologies relates to degrees of invasiveness. Some neurotechnologies are invasive and require surgery. Such surgery might require the device that interacts with the brain to be placed just under the scalp or to be more deeply implanted into the brain. Alternatively, it may not be invasive at all and just be worn on the head as a headset or helmet. More invasive forms of neurotechnology offer some advantages in terms of the capacity to read and write, whereas the less invasive procedure would avoid surgery and perhaps, when considering the legal environment, also regulation under a therapeutic regime.

Some neurotechnologies employ machine learning approaches in their operation and so consideration of the technology brings up artificial intelligence-related issues and questions of algorithmic bias and automated decision-making (for example in the case of the 'decision' to stimulate the brain of an epileptic person when certain patterns of neural activity have been detected). It is for this reason that some of the debates about ethical issues relating to artificial intelligence are also relevant to the present context. As noted, neurotechnologies can facilitate a connection with the online world (for example by enabling a person to engage with social media) and thus there is a connection with another area of technology that law has already grappled with- internet law.

Whilst some have speculated about futuristic possibilities relating to interfacing the brain with the cloud (**Martins et al. 2019**) the kind of research that is perhaps most striking when thinking of networks is the idea of **an 'internet of brains'**. Scientists have now managed to enable direct brain to brain connection whereby a rudimentary form of communication between humans was achieved enabling collaboration on a task (**Martone 2019**). Importantly this communication did not involve gesture or language. Humans have also had their brains directly connected to cockroach brains enabling the humans to control some of the behaviour of cockroaches by steering their paths by thought alone. In this way the neural activity connected with the intentions of a human was decoded by a brain-reading device that the human was wearing, and then wirelessly transmitted to a brain-stimulation device that was attached to the brain of a cockroach, thereby enabling the human to direct it left or right by engaging in mental action (**Li and Zhang 2016**). It seems that any future 'internet of brains' might not necessarily be restricted to human brains.

While a more extensive network of brains does not appear to be a short-term possibility, such an internet of intelligence could one day include human brains, animal brains, as well as a variety of technical devices.



Applications of neurotechnology

Medical

Neurotechnology has multiple applications in the medical context. It is not possible to survey the extensive range of medical possibilities and existing technologies but other applications are at varying degrees of development and include auditory prosthetics for restoration of hearing, visual prosthetics for sight, forms of neurotechnology for neurological and psychiatric disorders and hippocampal prosthetics aimed at improving memory (**Glannon 2021**). If hearing impairment, depression, dementia, locked-in syndrome, stroke, Parkinson's disease and other serious health issues can, or might one day, be treated by way of neurotechnology one might see enormous social benefit. Given such possibilities it is not hard to understand some of the commercial excitement that is fuelling neurotechnological development.

Military

Beyond medical applications there are military projects, some of which go beyond therapeutic aims. A significant example of military interest in neurotechnologies comes from the USA where the Defence Advanced Research Projects Agency (DARPA), an American body that aims to make sure that the USA does not lose its military advantage over others, has a longstanding interest in neurotechnological development (**Jacobsen 2015**). UNESCO's International Bioethics Committee describes both therapeutic and non-therapeutic applications of neurotechnology in the military context (**2021:18**) noting that warfare can lead to psychiatric disorders and such disorders might be treated by way of neurotechnology. They also note that enhanced cognitive or emotional capacities could be desirable in the battlefield and the enhancement of military personnel is one potential military application, as is the ability to remotely control a weapon by way of neural activity another.

In the UK, a report from the Ministry of Defence outlines some of the feature of neurotechnologies that are of interest in the context of enhancing warfighters. The report says that:

> "[I]n terms of augmentation, brain interfaces could: enhance concentration and memory function; lead to new forms of collaborative intelligence; or even allow new skills or knowledge to simply be 'downloaded'. Manipulating the physical world by thoughts alone would also be possible; anything from a door handle to an aircraft could in theory and more recently in practice, be controlled from anywhere in the world."
>
> **Ministry of Defence 2021:33**

In terms of potential military scenarios, of course there is a variety of possibilities but a recent paper (**Kosal and Putney 2022**) has envisaged the widespread use of brain-computer interface in both civilian and military contexts. The authors further envisage a hypothetical situation of

conflict in which drones are routinely controlled by brain-computer interfaces provided by the military, that are very difficult to hack. However, enemy combatants hack the pilot's civilian neurotechological devices (which are in place as well as the highly secure military devices) causing drowsiness in the drone pilots and military error. Whilst this is just one hypothetical scenario it does give an idea of how this emerging technology might be used by the military and gestures at some problematic features of technological progress. In relation to law, it seems to also raise a new dimension to hacking. Laws relating to hacking have thus far mainly focussed on unauthorised access to and manipulation of computer systems rather than the brains of human beings, and this point will be returned to later in the report.

Learning, skills and leisure

Military interest in neurotechnology is significantly if not entirely fuelled by competition for advantage over adversaries, but military affairs are hardly the only area of human endeavour where competition is a factor. The Ministry of Defence report referred to enhanced memory, concentration and the possibility of 'downloading' new skills and knowledge. Such capacities would very likely confer an advantage on a school pupil, university student or workplace learner. Also in an educational context, it has been reported that neurotechnology has been employed in China to monitor the attention of primary schoolchildren by way of a device that records their neural activity (**Guardian 2019**).

People need to acquire new knowledge and skills in the workplace and some of the technology described with respect to military and educational affairs could be used in other workplaces to assist with job training. However, there might be other reasons to use neurotechnology in the workplace. Perhaps workplace performance might in some situations be improved by the monitoring of cognitive states such as alertness for example in the case of air traffic controllers (**Hramov, Maksimenko and Pisarchik 2021:83**) and some companies are offering neurotechnological solutions for improving productivity by giving employers the opportunity to monitor the attention and stress levels of employees (**Farahany 2021**). Whereas the possibility of downloading new skills is not a current option, workplace brain-monitoring is, and it is not hard to imagine that some of this technology might generate disquiet and questions of employment law.

Some **currently available** forms of neurotechnology are used in video gaming. The video game developer Valve's co-founder and president, billionaire Gabe Newell envisages games which use neurotechnology to monitor players' brain states to work out whether or not they are bored and adjusts the degree of difficulty of the game in response to neural activity. Mindful of the possibility of being hacked as a disincentive to use consumer neurotechnology for gaming, rather memorably he is reported to have said:

> "[N]obody wants to say, 'Oh, remember Bob? Remember when Bob got hacked by the Russian malware? That sucked – is he still running naked through the forests?"
>
> Porter 2021

What next?

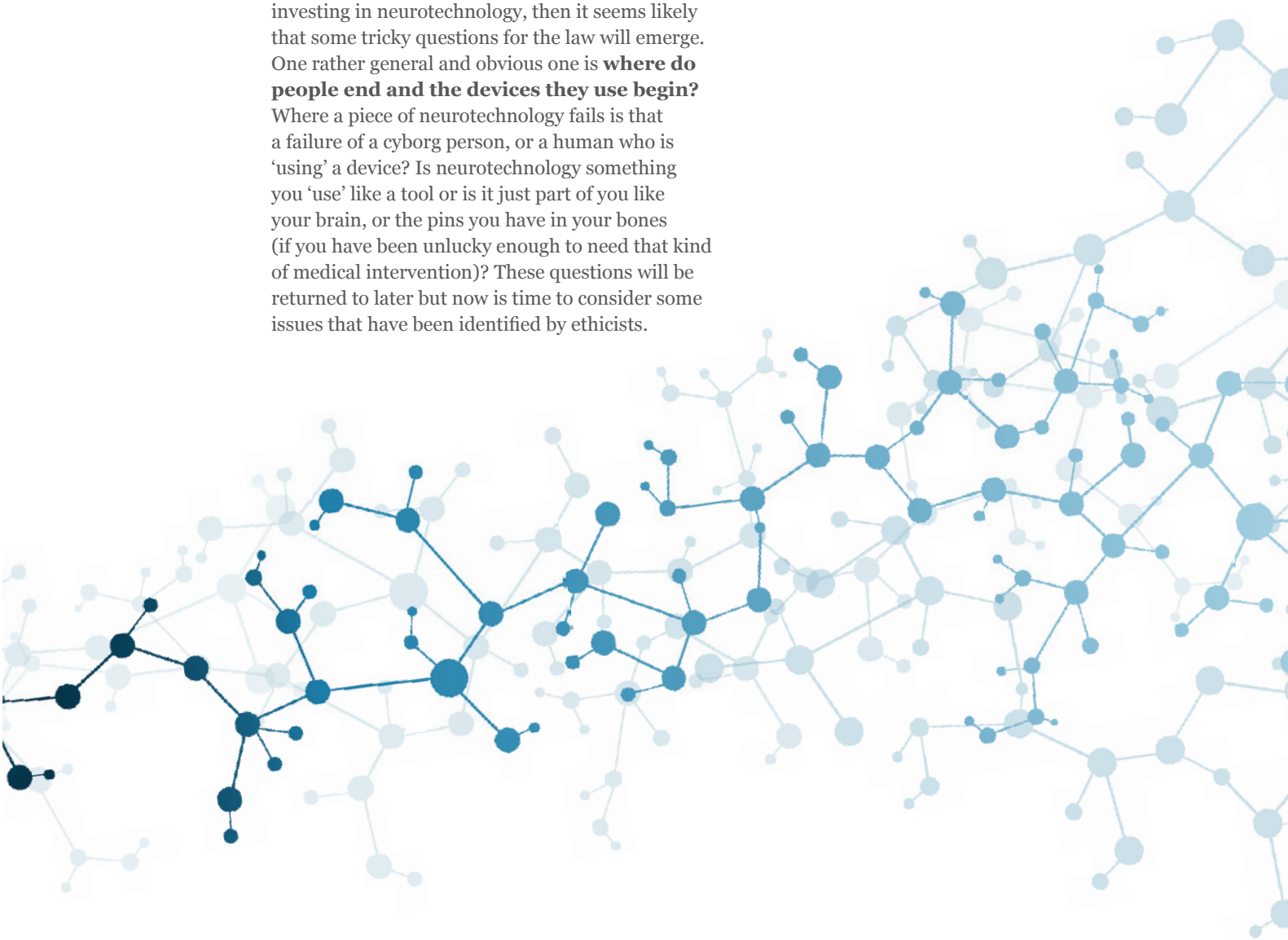
Taking into account what has been said in this section, we have an overall picture of an emerging technology that currently has some important medical uses, but considerable promise for further development. The technology has started to take some tentative steps towards a consumer market (for example in relation to video gaming) and has some limited application in the workplace in relation to workplace safety and productivity. It seems to be a technological trend that is in its early stages, but given the rate of technological progress and interest both from the private sector and the military, one can expect the trend towards the uptake of neurotechnology to continue and gain pace leading to new medical, educational, workplace, consumer, military and perhaps criminal justice applications.

How might the technological trend develop? It seems possible that it could initially be driven by therapeutic applications. If one considers all the people who are anxious, depressed, suffering from dementia or have some other psychiatric or neurological condition this amounts to quite a lot of people. If therapeutic neurotechnology reached a substantial proportion of these people, then it might start to normalise neurotechnology in the minds of the public. Perhaps technologies that initially had therapeutic aims might have a role in providing the basis for consumer applications. Alternatively, it seems possible that consumer technologies might reach a wide group of people first. Perhaps the vanguard might be some sort of neurotechnology that forms part of the cultural phenomenon known as 'the quantified self', or one that facilitates interaction with one's appliances at home, or makes for an easier, enhanced or more fun connection with social media or the metaverse, or helps achieve some workplace goal. It is hard to

know precisely which application or applications will lead the way.

A further general reflection based on this brief review of neurotechnology is that it reveals that a convergence of neuroscience and artificial intelligence seems to be taking place – **a drawing together of the biological and the algorithmic. This seems to raise a question about neurotechnology's place in legal thinking:** is it best thought as a subdivision of law and technology or is better thought of as relating to the way the law deals with developments in the cognitive sciences such as neuroscience? It seems to be both, and a narrow focus on technology which omits the human brain and mind seems very misguided.

Relatedly, for the law the connection between human and machine might become closer than it has been in the past. If the process of merging with technology (that for some has already begun), gathers pace, as is presumably the hope of those investing in neurotechnology, then it seems likely that some tricky questions for the law will emerge. One rather general and obvious one is **where do people end and the devices they use begin?** Where a piece of neurotechnology fails is that a failure of a cyborg person, or a human who is 'using' a device? Is neurotechnology something you 'use' like a tool or is it just part of you like your brain, or the pins you have in your bones (if you have been unlucky enough to need that kind of medical intervention)? These questions will be returned to later but now is time to consider some issues that have been identified by ethicists.



Ethical issues

As will be argued later, neurotechnologies are likely to present new challenges for the law but perhaps before considering legal issues and responses that might emerge, it is useful to think of the ethical issues that flow from technologies that read from and/or write to the brain.

Ethical issues are important in their own right, but in the context of a paper which tries to consider possible challenges for the law and possible legal responses, **the following ethical considerations can have a role in helping us to think about how the law *should* respond**.

To the extent that law is actually influenced by ethical considerations, these considerations might help to think about how the law is likely to respond. Of course, there is a variety of other considerations including those that are historical, cultural, economic, political, and pragmatic which are likely to affect the law's response to neurotechnology, but still it seems that the below-mentioned ethical considerations might have an influencing role alongside other factors.

In scholarly literature it is worth noting that ethicists started to engage in a serious consideration of neurotechnologies before lawyers. For some time there has been an area of legal scholarship known as '**neurolaw**' which focusses on the challenges to law that come from developments in neuroscience (**Catley and Claydon 2015**). An example of the way those involved in neurolaw work involves the examination of the way that sentencing courts do and/or should make use of expert evidence derived from hospital brain scanners (which are forms of brain reading neurotechnology) (**McCay and Ryan 2019**). However, ethicists were quicker to consider the implications of *emerging* technologies such as brain-computer interfaces.

Now is not the time to survey the extensive neuroethical literature on the topic, but the views of The Morningside Group provide a good place to start. The Morningside Group is a group of neuroscientists, technologists, clinicians and ethicists, 23 members of whom published a much-cited paper in the prestigious science journal *Nature* which called for attention to be paid to ethical issues relating to neurotechnologies (**Yuste et al. 2017**).

They started by addressing **privacy and consent**. Given the likely accumulation of brain-data by neurotechnological devices and the ability to make health inferences from such data (for example whether a person is a risk of Alzheimers disease) one might consider **whether existing privacy protections, whether technological or legal are fit for purpose**. If we also start to imagine the possibility of using the data to predict behaviour and then perhaps using this knowledge to manipulate people, this suggests that the data raises privacy considerations that are especially important. It also raises questions about how consent might work in relation to neurotechnological devices given the intimate nature of data that might allow inferences to be made about people's mental experience. It seems that these issues are something the law will have to grapple with.

They also considered agency and identity noting that some people who are receiving therapeutic treatment by way of a neurotechological device feel unsure about their identity. So, for example,

a person who has performed an action whilst receiving brain-stimulation might feel unsure of whether the action is attributable to her or the device, and this seems to be an ethical consideration that needs to be considered.

A further issue they consider is that of **augmentation**. Let's say someone is using a brain-stimulation device to treat their depression, then such a device has a therapeutic aim. But as already noted, neurotechnologies do not have to be limited by therapeutic aims and may be orientated towards human enhancement. The group use the example of research from DARPA which focusses on providing soldiers and military analysts with mental capacities that are beyond the normal range and are advantageous in situations of warfare.

One can imagine a society where some people are augmented in this way and others are not. This seems to raise issues of equity and **the possibility of forms of neurotechnological discrimination**. It may also lead to a social pressure to augment in order to compete with others, and the issue of augmentation will be returned to in the next section and in the discussion about possible implications of neurotechnologies for the legal profession.

Before moving on it is certainly worth noting that it is perhaps too easy to dwell on the possibilities for inequity as neurotechnologies also have potential to promote equity by addressing neurological and mental disorders (**International Bioethics Committee 2021: 17**). This potential must be a very significant consideration in any legal response. Ethics is of course not solely concerned with what should be refrained from but also about what ought to be done, and consideration might be given to supporting the development of some therapeutically beneficial technologies perhaps through government funding or public/private partnerships.

Another important ethical issue is that of ensuring that neurotechnological devices are safe (**Parliamentary Office of Science and Technology 2020:2**). This is most salient in respect of invasive neurotechnology but could also relate to non-invasive brain stimulation devices and must of course be a factor in any regulatory response to the developments, which will be discussed later in this report. We are now at a stage where there are a number of users of neurotechnology around the world including some people with disabilities, and when considering the ethical issues pertaining to neurotechnology it will be vital to obtain the perspectives of these groups. Some neuroethicists are including such perspectives in their work (**Gilbert and Viana 2018**). This is an area where further work might be needed.

Given that neurotechnologies may herald the possibility of alleviating much suffering by way of therapeutic means, governments will need to confront ethical choices, relating to the allocation of such technology, in a way that is similar but perhaps not identical to the choices they face with respect to allocation of existing medicines and medical technologies. They will need to think about paying for, or at least subsidising, therapeutic applications of neurotechnology that may significantly improve the lives of their citizens with neurological and psychiatric issues.

In addition to ethical questions relating to concerns for humans, a further ethical issue relates to the use of animals in the development of neurotechnologies. Elon Musk's company Neuralink has attracted criticism over its treatment of animals used in the development of its product (**Guardian 2022**). To the extent that neurotechnology companies use animals in their research they need to address questions about the way those animals are used.

One would hope that that the companies who are engaged in the production of these emerging technologies are willing to consider and take account of the issues described in this section, and there is some evidence that at least some in technology companies are considering them (**Gil 2020**). However, one concern is that for some companies the 'entrepreneurial mindset to move fast, break things, scale up, and worry about consequences later' (**Pfotenhauer et al. 2021**) may not be conducive to a tendency to incorporate ethics-by-design principles in neurotechnology. As will be discussed later, there are calls for the law to have a role in channelling neurotechnological development in a way that is ethically acceptable.

Lawyers have an important role in the provision of normative guidance to their clients but as is apparent from this section, law does not have a monopoly on norms, and one might ask whether guidance on how to meet *ethical* norms is adequately provided by existing service providers in the market for normative guidance. However, it is not clear how many neurotech companies are seeking such guidance and, in any case, it seems unwise to place too much reliance on the good intentions of companies that are primarily motivated by considerations of a more commercial nature and may be in such a hurry get to the market that little time is made for ethical deliberation.

Other technologies and the social, political, and economic context

One critical contemporary social issue is the role of **surveillance** in our lives (Lyon 2018 , Zuboff 2019), which is closely related to the issue of privacy mentioned in the last section.

In a world in which we are under both (i) corporate surveillance, particularly in respect of our online behaviour, and also (ii) governmental surveillance through monitoring of online behaviour, security cameras and other means, it seems that the addition of brain data gathered through neurotechnology to existing forms of surveillance, might ramp up the capacities of various organisations. This would make it increasingly possible for corporations and governments to not just surveil our behaviour but to surveil our mental states. We might consider whether the law should, or is likely to, create a permissive environment for surveillance or try to reign the emerging capacity in.

If neurotechnological devices (implanted or non-invasive) start to become more widely used in society then those who produce the devices will likely gain knowledge about our mental states. It might be that existing technology companies could acquire or otherwise develop neurotechnology businesses, and then their new neurotechnological capacity might add to their existing capacity to know about people and manipulate them, thereby increasing their influence.

Naturally there are already serious and well-founded concerns about equity and discrimination in society. Debates about AI have increasingly considered the way that artificially intelligent systems might contain gender, racial and other biases in their application (**Coeckelbergh 2020: chapter 9**). The algorithms involved in neurotechnology might also contain these biases and the social, economic and political implications may be affected by the extent to which considerations about diversity are addressed in their development.

The previous section considered enhancement of mental capacities in a military context. However, if it were possible for some people to have mental capacities that are well beyond the normal range such that they can no longer be regarded as human but are better thought of as transhuman, this might open up a class divide that could exceed any from history. This would be a division between the enhanced and unenhanced or even between humans and transhumans, raising concerns about equity and discrimination. Perhaps some libertarian transhumanists might oppose any attempts by law to regulate neurotechnological augmentation thereby making law a battleground for this ideology.

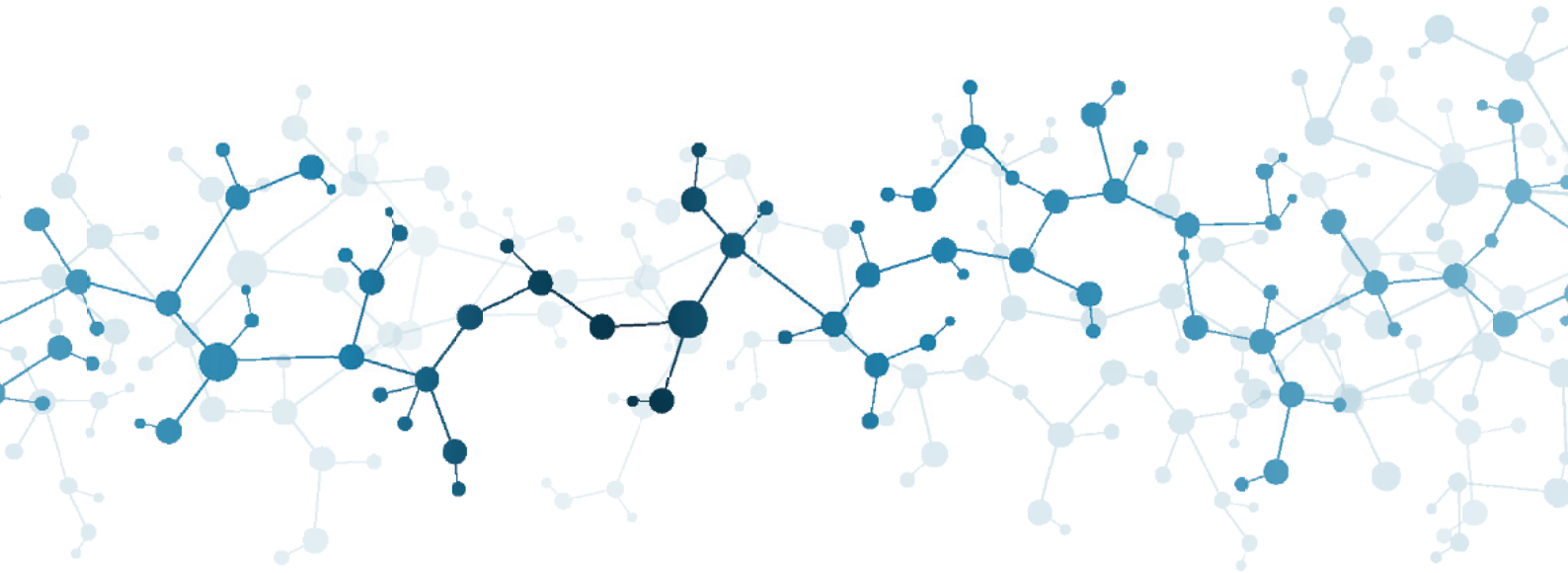
The possibility of competition between the enhanced and unenhanced arises in the economic context, but maybe that should extend beyond humans: Elon Musk has suggested that it might be good for humans to augment themselves in order to compete with artificial intelligence in the workplace (**2017**). Some may find the idea of neurotechnological augmentation appealing, or even necessary in the face of diminishing economic prospects, and this kind of competition could influence the economic landscape in which law evolves. In this view human augmentation, perhaps

by way of neurotechnology, might be a way for some to handle the economic disruption brought on by AI. This topic will be returned to when considering the possible impact of neurotechnology on the legal profession.

One might also consider the question of which political jurisdictions regulate and fund the development of whatever technologies become widely used. Some have considered neurotechnology with regard to competition between USA and China (**Kosal and Putney 2022**). It may be that the social, economic and political implications of technologies developed in either of these countries (or some other country) might be different and it is not clear where the successful neurotechnologies will emerge. Coeckelbergh (**2020: chapter 2**) has considered the differences in the way that technological narratives vary across cultures. In Western culture there are some distressing narratives, such as exemplified by Mary Shelley's Frankenstein monster, which according to the story was brought to life by electricity (a force that had recently been harnessed by technology at the time the book was written). By contrast, Coeckelbergh suggests that the relationship with technology in Japanese culture is less anxious and it may be that various forms of differing cultural narratives about technology ultimately have a role in influencing the regulatory environment in which neurotechnological development takes place, by creating an anxious or perhaps more accepting social context.

Before moving on, and perhaps in response to some of the concerning possibilities already mentioned, one further issue to bear in mind is the possibility of a 'techlash' (**Flew 2022: 21**) or maybe even for the present purposes, a neurotechlash. The idea of a 'techlash refers to negative sentiment towards technology companies and calls to regulate them such as has been seen in relation to some of the large social media companies. Whereas debates about the regulation of technologies such as those facilitating social media are fairly mainstream, at the moment calls to regulate neurotech are generally coming from a small number of scientists and ethicists. However, one can speculate that in time, public opinion might start to become concerned about any emerging power of neurotechnology companies, whether operating independently, or subsumed into larger technology companies, or companies in the medical sector. Such a development in attitudes to neurotechnology might create a political pressure to eschew a light touch with respect to regulation. Alternatively, if the capacity to manipulate populations were to be significantly developed by the companies involved prior to the emergence of widespread concerns, they might try to use their capacity to impact upon negative sentiment in order to reduce the neurotechlash risk to their businesses. Given the possible upside of neurotechnology for many vulnerable people, the therapeutic applications of neurotechnology might also be emphasised in the public relations efforts of companies with a view to moderating any neurotechlash. It seems less likely that they would emphasise any possible military or criminal justice applications.

Although it is very hard to know how all of this will play out, it is useful to consider the future of law in more specific terms with these possible social, political and economic trends in mind.



Regulating neurotechnology

Whilst the implications for the law have been considered in general terms in earlier sections, it is now time to look at possible legal challenges and change employing a slightly more fine-grained analysis which starts with a brief examination of the regulation of the technology. But perhaps a preliminary question might relate to timing. Why is consideration merited now?

In response to this it is useful to look to Chile, a country that has recently been moved to action, where Senator Girardi, one of the key figures in the country's legal response to neurotechnology has said '[w]e didn't regulate the big social media and internet platforms in time, and it cost us' (**Reuters 2021**). Social media platforms are fairly well entrenched in society, and it now seems difficult to address the social and political problems that they cause. Perhaps there is value in trying get on to the regulatory front foot, in order to influence the direction of neurotechnologies before they have wide uptake in society. However, this is tricky because it is not yet clear precisely how any problematic issues might play out, and in any case regulation may be resisted by those who are attracted by a libertarian political philosophy and/or are concerned about a potential threat to commercial interests. Nonetheless bodies such as the OECD are considering how to rise to the regulatory challenge (**2022**).

One regulatory consideration is the risk of inhibiting valuable innovation. When considering regulation, it is important to remember the miraculous upside of some forms of neurotechnology that currently can, or in the future might, allow people who are unable to communicate or interact with their environment to communicate with a friend, perform meaningful work and other projects, or to hug a loved one. Consideration of the possible downsides of neurotechnology that also appear in this report must be tempered by the technology's enormously valuable possible upside. It would be disastrous if progress in treating conditions that cause so much suffering and quite properly could be viewed as requiring urgent action, were unnecessarily slowed by too cautious a regulatory environment. There may also be economic considerations that favour a regulatory environment that is not too onerous for potential investors.

The UK's Parliamentary Office of Science and Technology has considered the regulation of neurotechnology in a **report** noting that the Medical and Healthcare products Regulatory Agency is responsible for regulating (amongst many other things) therapeutic neurotechnology, and some other neurostimulation devices that have risks that are in some way similar to those of medical devices. However, the report also points out that other forms of neurotechnology such as non-invasive brain-reading devices for gaming are outside the scope of this form of regulation. Consequently, one might wonder whether laws aimed at protecting consumers such as are contained in the UK's Consumer Rights Act 2015, are up to the job of regulating neurotechnology and **whether brain data gathered from devices that are not regarded as medical devices are adequately protected under the existing privacy regime**. Early in this report the concerns of the Morningside Group about the protection of

brain data were noted and the Parliamentary Office of Science and Technology explicitly referred to the concerns of this group.

As well as thinking about the proper scope of medical regulation, a question arises as to the nature of the regulatory body or bodies that should regulate neurotechnology. In their discussion of the Food and Drug Administration (FDA) regulation of neurotechnological devices in the US context, Binkley, Politz and Green have raised the question of whether the FDA have the expertise to properly regulate neurotechnology (**2021**). One reason why this might not be so is that as well as having a therapeutic role, neurotechnologies might augment human capacities – and this could conceivably lead to a very significant social divide between those who are and who are not augmented. The question of whether this is acceptable might become an important political and ethical question. Binkley, Politz and Green suggest that a new governing body might be needed to consider such questions because they involve important value judgments (**2021**).

There are a number of dimensions to neurotechnology that might intersect with the scope of a variety of regulatory bodies such as medical regulators, privacy commissions, human rights bodies, consumer bodies and perhaps even AI regulators (in jurisdictions where consideration is being given to the setting up of AI regulators). Given that neurotechnology may give rise to a variety of ethical issues including those relating to safety and efficacy, privacy, autonomous agency, identity and equality, some of which could also have political and legal upshots, it would seem important to consider how any new or upgraded regulatory regime and regulator might fit in with other forms of regulation. It will also be necessary to consider how whoever is charged with regulating neurotechnology might manage to interact with and take account of the views of those who are impacted by it, as well as those who are developing the technologies (**UNESCO(IBC)(2021):33-34**).

Legal doctrine

Beyond the regulatory environment, it is useful for lawyers to turn their mind to the implications for legal doctrine. A report such as this cannot possibly consider the implications for all areas of practice and so one area will be used as a case study.

Criminal law is one of the core units in any law degree and crime has consistently kept many lawyers employed over a long period of time, but it is also useful to use it as a case study because it provides some striking examples of emerging legal challenges, and connects well to a consideration of the ways in which human rights law might adapt to some of the more troubling capacities for brain-monitoring and brain-manipulation. Although readers from various areas of law may well already have some ideas about how their own areas of law are likely to be challenged in the future, hopefully the consideration of the neurotechnological challenges to criminal law will provide further stimulation that extends beyond the specific focus of the case study.

Much of the law we now have has been created with presumptions that may soon be challenged by brain-computer interfaces that allow people to control drones or even cockroaches by mental acts rather than more conventional bodily acts, and may one day be challenged by direct brain to brain collaboration that allows for communication that circumvents the senses. Considering what might be thought of as the prospect of something of a paradigm shift in relation to legally significant action and perception, we might expect neurotechnology to shake up legal doctrine. However, before considering some coming challenges, we might consider a way in which developments in neuroscience and some related technology does *not* seem to have had major implications for criminal law. In discussion of neurolaw, some have made the claim that neuroscience is going to revolutionise criminal law by demonstrating that no-one has free will or deserves to be punished for their crimes.[2] They claim that law will reject its retributive aim and move to orientation that focusses more on community protection (**Greene and Cohen 2004**). However it has been argued that available evidence does not support such claims and that the implications identified by Green and Cohen have not eventuated (**McCay and Kennett 2021**).

It is important to note that the extent that neuroscience and neurotechnology has thus far had a role in criminal law, it is generally in the form of hospital brain scanners that have sometimes had a role in forming the basis of an expert witness opinion, for example in a sentencing matter (as mentioned earlier in this report). Things might change if neurotechnology becomes more integrated into people's lives as is presumably hoped will be the case by the various companies that are investing in the technology. If that situation were to come to pass, we can probably expect to start to hear of neurotechnologically-mediated crime.

England and Wales, like a variety of other jurisdictions around the world, has criminalised intimate image abuse (often informally referred

2 For a discussion of the significance of free will for the law see McCay and Sevel 2019.

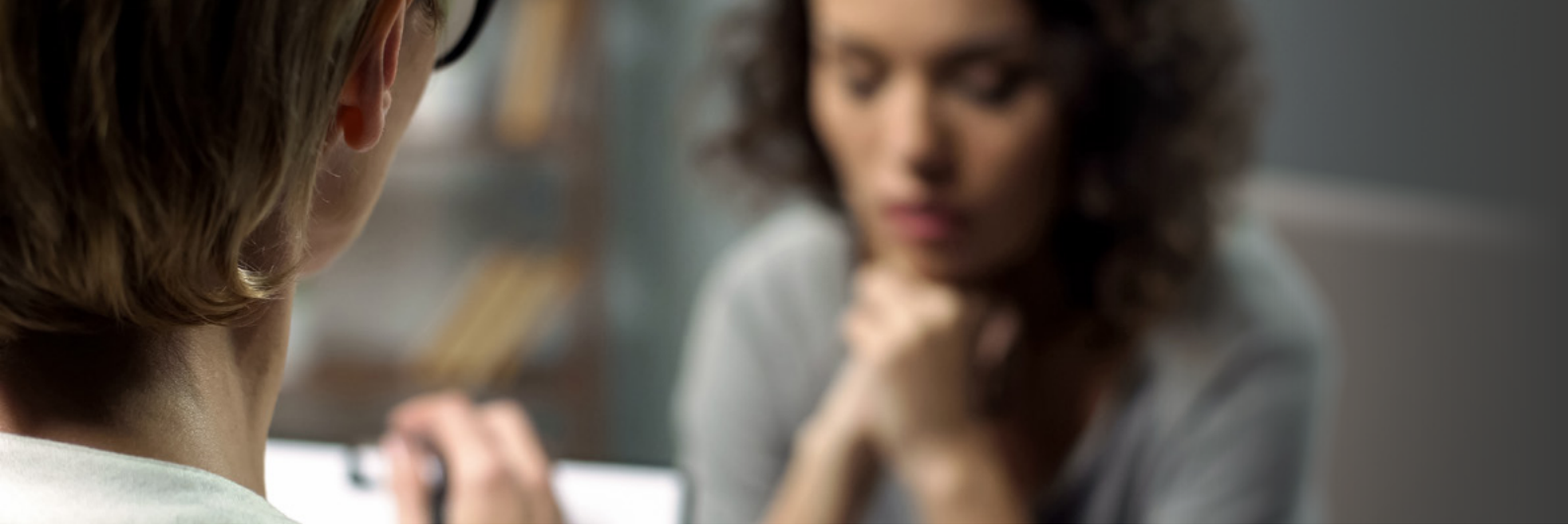
to as 'revenge porn') (**Haynes 2018**). One way that a person might commit an intimate image abuse offence might be by uploading intimate images onto social media knowing that the person depicted in the images does not consent to the upload. The upload might be instigated by way of a hand controlling a mouse or trackpad, or issuing a voice command to a system such as Siri – it is noteworthy that all of these conventional ways of interacting with the virtual world involve the defendant using their system of musculature. It is central to criminal law that the prosecution in a serious criminal matter must prove both the actus reus (criminal conduct) and the mens rea (guilty mind), beyond reasonable doubt. McCay (**2020**) has considered the possibility of a defendant committing the intimate image abuse offence by way of brain-computer interface and asked what constituted the criminal act. To expand this a little, what conduct constitutes the actus reus where an offender controls a cursor by way of mental acts (such as imagining handwaves) rather than using their system of musculature, for example by using their hands to type text and move a mouse on a mousepad, as is the case in more conventional forms offending? Perhaps the law might say that the mental act of imagining the handwave is the conduct constituting the actus reus, but that could be regarded as a major step in the history of criminal law as it seems to blur an important distinction that law has thus far attempted to maintain - the distinction between the guilty mind and criminal conduct.[3] Further, neurotechnological malfunction seems to raise the question of boundaries of legal subjects (**Soekedar et al. 2021:37**). One might then ask whether the defendant is to be thought of as a cyborg entity that malfunctioned (a cyborg defendant) or human that was using a malfunctioning tool (the neurotechnological device).

As well as criminal responsibility it is also worth considering criminalisation. Where a person has connected their brain to the internet in order to use social media then it is possible that the device might be hacked (**Ienca and Haselager 2016**). Some devices only read from the brain in which case the hacker might get unauthorised access to data that could allow them to make unauthorised inferences about the mental states of the victim. However other devices write to the brain and one can imagine a hacker, for example, causing a device to stimulate a brain in order to injure the person, make the person act impulsively or perhaps one day even to experience a particular hallucination. Whilst the criminalisation of hacking is not novel, the idea of hacking brains seems to have a different quality and may well require the creation of new offences (**Bublitz and Merkel:73-75**). The law might one day have to decide how to respond to defendants who claim their criminal behaviour has resulted from having had their neurotechnological device or even brains hacked. In that eventuality the law would have to consider how this form of hacking did or did not fit into the scope of defences such as insanity or automatism or alternatively how it fitted into existing forms of mitigation at sentencing.

Thus far the report has considered the significance of neurotechnologically-mediated action on the part of the defendants. But could the state itself start to mandate neurotechnological solutions to the problem of crime? And perhaps whether there might be a role for neurotechnology in a sentencing disposition. For some time, criminal law has employed electronic monitoring in community-based sentences (**Daems 2020**). As far as the state is concerned an attractive feature of electronic monitoring in the community as compared with prison relates to substantial costs involved in maintaining prisons. However, a disadvantage of the community-based sentences, even those involving electronic monitoring, is the risk of recidivism. Could the risk of recidivism be reduced by a system of electronic monitoring that does not just involve geographical monitoring but also incorporates brain-monitoring?

Gilbert and Dodds (**2020**) have envisaged neurotechnology that monitors the brain for neural patterns associated with an impending aggressive outburst and the intervenes on the brain by way of stimulation to avert it. Perhaps if neurotechnologies were to be widely used in the community for managing conditions like epilepsy, depression and obsessive-compulsive disorder this might set the scene for public support for this kind of approach to the management of crime. In the first instance one can even imagine the defence in a criminal matter raising the neurotechnological solution in a situation where prison is a possibility. So an offender, with expert witness support, might argue in their plea in mitigation that they have satisfactorily dealt with a mental condition that had a role in their offending by way of neurotechnological intervention. According to this argument it might be contended that instead of sending them to jail the judge should order a community-based sentence with a condition that they keep the neurotechnological device active, under the supervision of their psychiatrist, as the risk of recidivism and consequently the need for community protection is very low. Perhaps even conditions like psychopathy might one day be treated by way of neurotechnology (**Jotterand 2022**) and the political conditions might emerge for seeing neurotechnology as a broader solution to crime might come into place.

3 For other possible legal options see McCay 2020 and for a view on the how the law should proceed with respect to actus reus see Thompson 2021.



Human rights

This kind of response to crime raises some important human rights concerns which go beyond criminal law.

One can imagine forms of commercial manipulation that exceed the capacities that advertising agencies or technology companies have thus far had at their disposal. These and other concerns have led to the call for recognition of 'neurorights' by various individuals and groups.

Technologies such as those described in this paper were not on the horizon at the time when the Universal Declaration of Human Rights and subsequent covenants were being discussed and some have taken the view that, as a result of the kind of developments described in this paper, the current human rights framework - one that has its origins in the aftermath of World War 2 - is no longer fit for purpose. Columbia University's Professor of Neuroscience, Rafael Yuste has been a significant figure in advocating for the recognition of neurorights through the New York based **Neurorights Foundation** and also through involvement in Chile's recent constitutional change.

The Neurorights Foundation advocates for the recognition of the following rights:

- **The right to personal identity**
- **The right to free will**
- **The right to mental privacy**
- **The right to equal access to mental augmentation**
- **The right to protection from algorithmic bias**

However, others are critical of the proposed set of rights and are of the view that more scholarly work is required before settling on any new rights in response to neurotechnology (**Bublitz 2022**). There is an ongoing debate about whether the existing framework is adequate and what new rights might be considered to be neurorights (**Lighthart 2020 and Ienca and Adorno 2017**). Some scholars are significantly less pessimistic about the capacities of the existing human rights framework to address the issues presented by neurotechnology than those who are advocating for neurorights (**Borbon and Borbon 2021**).

In the meantime, Chile has altered its constitution to address concerns about the protection of data relating to neural activity and the mental integrity of people who are making use of neurotechnology (**McCay 2022**). At the time of writing, a draft law named **The Neuroprotection Bill** is making its way through the Chilean legislative process (**Strickland 2021**). Advocates are also urging for reform at the international level (**Yuste, Genser and Hermann 2021**) and there are signs that other countries, such as Spain, are starting to respond to the issues (**Strickland 2021**).

Legal education

As well as the issues in the areas of regulation, criminal law and human rights, neurotechnology is likely to have an impact in many other areas of law. Whether it be **contract lawyers** dealing with neurotechnological forms of unconscionable conduct, the possibility of objections to workplace brain-monitoring in relation to **employment law**, or a host of other novel legal issues, interesting new questions may be on the way for law academics.

Given the pace of neurotechnological change, it may be that a more prominent role for an anticipatory stance in legal education is worth considering. Legal traditions connect the future to the past and law students are required to be aware of the body of law composed of cases, legislation, and other sources of law, as this provides the legal context for the legal analysis of any issue they consider. A fairly common way of studying law is one in which a hypothetical scenario is created, and students are asked to bring their analytical skills to bear on the issues whilst making use of relevant legal resources. Often, where these hypothetical scenarios involve technologies, they use forms of technology that are currently available and have significant prevalence in society. Perhaps more use could be made of scenarios involving technologies that are starting to emerge, or are predicted to emerge, in order to encourage an anticipatory style of thinking in law students that may be of use to them if they become practitioners. This might be useful if students have to think not just about existing law but possible future legal developments when advising clients interested in the future direction of regulation in relation to their neurotechnological investment decisions. An anticipatory stance may also be useful if students start to shape the law through activism or legal office. Some legal scholarship currently employs such a forward looking approach in relation to neurotechnology (**Billauer 2021, Hopkins and Fiser 2020, McCay 2020**) and this might be thought of as a form of anticipatory legal scholarship that could have a greater role in legal education.

Having said that, some historical resources that do not generally feature prominently in a law degree might be worth revisiting. It is interesting to note that a number of prominent technologists such as Bill Gates and Mark Zuckerberg see value in learning about history as is evident from the Silicon Valley reaction to historian and futurist Professor Yuval Noah Harari's work on the history of humanity (**Bastone 2019**), and perhaps the consideration of technological developments such as are under consideration here should prompt legal education to upgrade the role of legal history.

If one considers English legal history, there was a pre-modern time when a different worldview prevailed that involved witchcraft and demonic possession (**Levack1995**). The study of this period, as well as alerting students to the awful consequences that might flow from forms of conspiratorial thinking, gendered ideas, and the persecution of particular groups in society (in this case relating to the alleged conduct of witches), might be enlightening because it shows how legal paradigms relating to manipulation and threats to human agency can change over time. One might even see some analogy between hacking a person's neurotechnological device in order to manipulate their behaviour and the forms

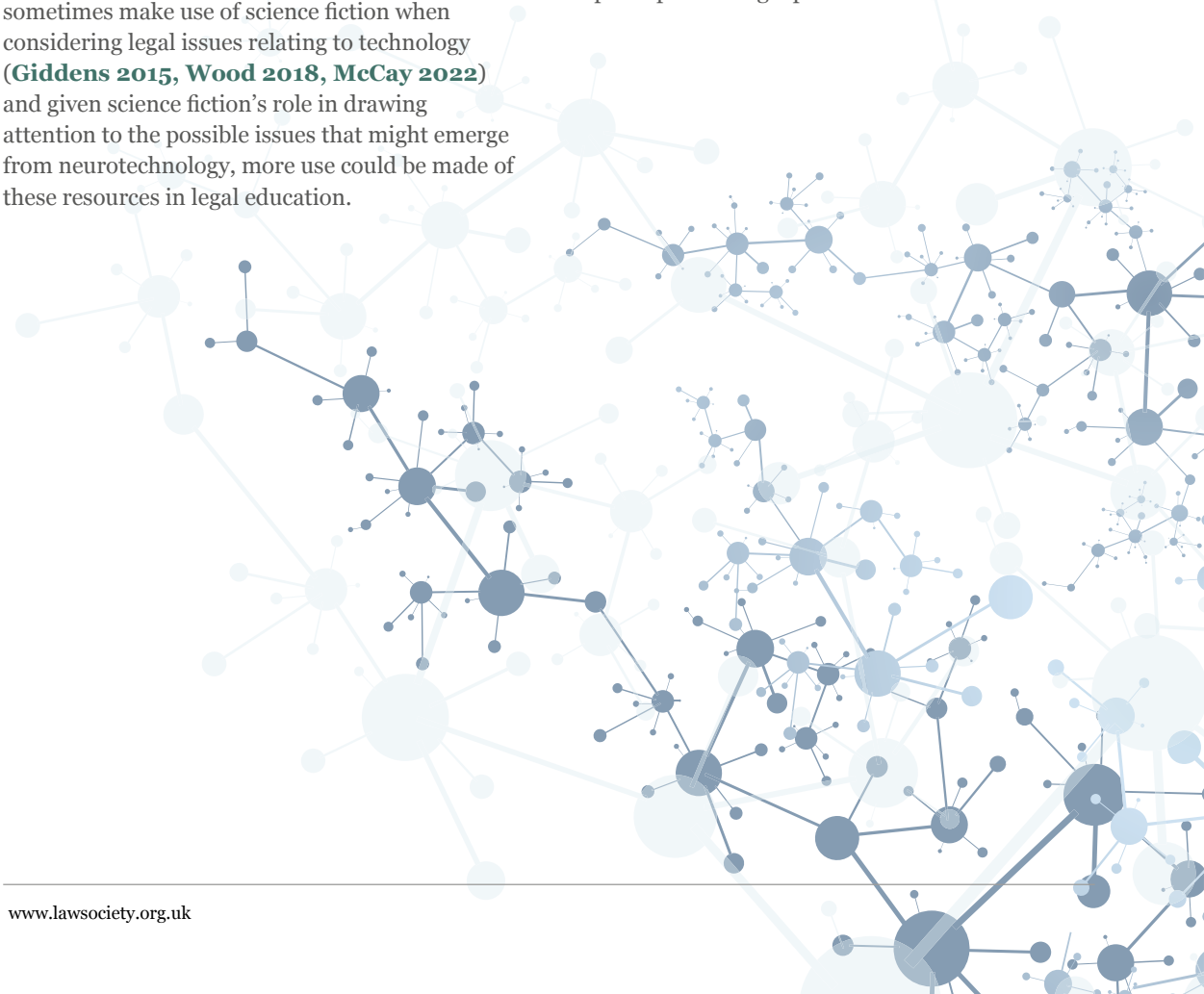
of demonic possession that were purportedly instigated by witches. Even though the purported forms of control of humans in the middle-ages were ineffective (or at least did not work through the supernatural means they were supposed to), learning of times when English law embraced a paradigm incorporating other kinds of threats to agency might be a useful 'corrective' to complacent habits of legal thinking when considering neurotechnologically-mediated influences on behaviour. As the science fiction writer Arthur C Clarke famously said '**any sufficiently advanced technology is indistinguishable from magic**'.

It seems that an open mind is needed to consider the challenges of neurotechnology and this might be increasingly needed in relation to law. It might also be useful to consider a variety of legal cultures in legal education including those radically different from the dominant culture in order to leave behind the assumption that the common law tradition must necessarily contain pointers to the best way forward. This would allow for the consideration of possibilities for adapting to neurotechnological advances that may be present in these other bodies of law.

Given that the consideration of neurotechnology also brings questions that are of a philosophical nature (**Friedrich et al. 2021**) such as those relating to the free will problem or philosophy of mind and philosophy of technology, it seems that philosophical resources may be of use to lawyers, and might be incorporated into legal education beyond current applications. Scholars also already sometimes make use of science fiction when considering legal issues relating to technology (**Giddens 2015, Wood 2018, McCay 2022**) and given science fiction's role in drawing attention to the possible issues that might emerge from neurotechnology, more use could be made of these resources in legal education.

Another factor for consideration is the possibility that law students themselves may make use of neurotechnologies to assist with their studies. As discussed earlier, if neurotechnology facilitates cognitive enhancement then law schools might have to decide whether some forms of neurotechnological assistance constitute academic misconduct. Questions of equity would then be relevant if some students had access to the technologies of augmentation and others did not. One might also bear in mind that legal scholarship is a competitive field and the students' lecturers might be minded to incorporate neurotechnology in order to augment themselves and expand their research output in prestigious journals.

To use an expression which is often attributed to ice hockey player **Wayne Gretsky** more aspects of legal education could be orientated to 'where the puck is going rather than where it has been'. Whilst this expression is useful for illustrating a point about the virtues of an anticipatory stance, the expression is not entirely apt when thought about in the context of law as it seems to imply a sort of fatalism about where the law will go without acknowledging the role of human choices is determining where the law does in fact go. It may be better to ask students to consider where the puck (the law) might be going as well as where it should be going. Similarly, continuing legal education might also benefit from more of an anticipatory stance made more prominent in the continuing professional development of legal practitioners. But how else might neurotechnology impact upon the legal profession?



The legal profession

The implications for the legal profession, whether that be solicitors, barristers, legal technologists or other legal professionals, have a connection with the implications for legal education.

Given the increasingly fast uptake of emerging technologies, lawyers may benefit from focusing a bit more on where the puck is going (which is not to suggest that they currently do not already do this – albeit to varying degrees of intensity). The technological developments described here, and related legal challenges give rise to new kinds of clients with interesting and novel problems. Given that these potential clients will be aiming to commercialise their expertise in neuroscience and technology, some firms may wish to develop the capacity to specialise in meeting the needs of such clients, perhaps by engaging in relevant continuing professional development, or putting in place hiring and marketing policies that will enable them to interact with potential neurotech clients. Some individual lawyers might also wish to develop this speciality. Importantly, this would not just be an orientation towards technology but an orientation towards *neuro*technology with a neuroscience dimension that connects to the brains and minds of human beings.

As indicated at the outset, lawyers are already interested in the possible impact of technology on the future of the profession and one scholar who has paid particular attention to this is Richard Susskind. In his book *Tomorrow's Lawyers: An Introduction to your Future* (**2017:188**) he envisages competition between human lawyers and machines in relation to the performance of some legal tasks that have traditionally been performed by humans.[4] However if lawyers were to start to make use of neurotechnology this way of seeing the competition might be subject to what Michael Bess has called 'The Jetsons Fallacy' (**2016:7**). The Jetsons was an animated television series that featured a futuristic family that had access to all sorts of advanced and sophisticated technologies. However, Bess regards the fallacy in the series (and much other science fiction) as stemming from its failure to envisage that humans with such sophisticated technology would themselves be transformed by technology - the humans in the series do not themselves appear to be augmented or otherwise transformed in any way. If we are to avoid the Jetsons Fallacy, we should consider the possibility that future lawyers who find themselves competing with technology might themselves be augmented. To be fair to Susskind it seems he may be right in his characterisation of the competition in so far as it relates to '*Tomorrow's* Lawyers' (italics added) but if we look beyond tomorrow and the short term, and into the medium term then perhaps...

4 In their chapter on the legal profession in The Future of the Professions (2022) Richard and Daniel Susskind also seem to envisage competition as between human lawyer and machines and do not envisage cyborg lawyers.

> "one can imagine a three-way competition between lawyers who have not been augmented, neurotechnologically-augmented lawyers (perhaps in conjunction with other[5] forms of augmentation that do not make use of neurotechnology), and artificially intelligent systems."

Lawyers who are neurotechnologically augmented may have some of the benefits of artificially intelligent systems whilst retaining some desirable human capacities (**Legg and Bell 2020:262**, **McCay 2018** and **2019**), and perhaps in the competitive environment of the market for the provision of legal services (whether from other humans or artificially intelligent systems) there might be a pressure to augment. If neurotechnology has a role in enabling human lawyers to retain their place in the profession in the face of technological disruption, it is interesting to consider whether neurotechnology is best thought of as disruptor or a technology that mitigates disruption.

If it were possible to **augment one's cognitive capacity in order proceed more quickly and effectively through legal work**, and make partner more quickly, some might be minded to opt for an upgrade. This might be particularly so if one's colleagues were augmenting their capacities, or one was on the receiving end of pressure from clients to work more efficiently. Without any special focus on the legal profession some ethicists have considered the question of whether a coercive pressure to augment might emerge (**Erler 2020**) and this kind of ethical debate is one that the legal profession and the Law Society of England and Wales might have to grapple with.

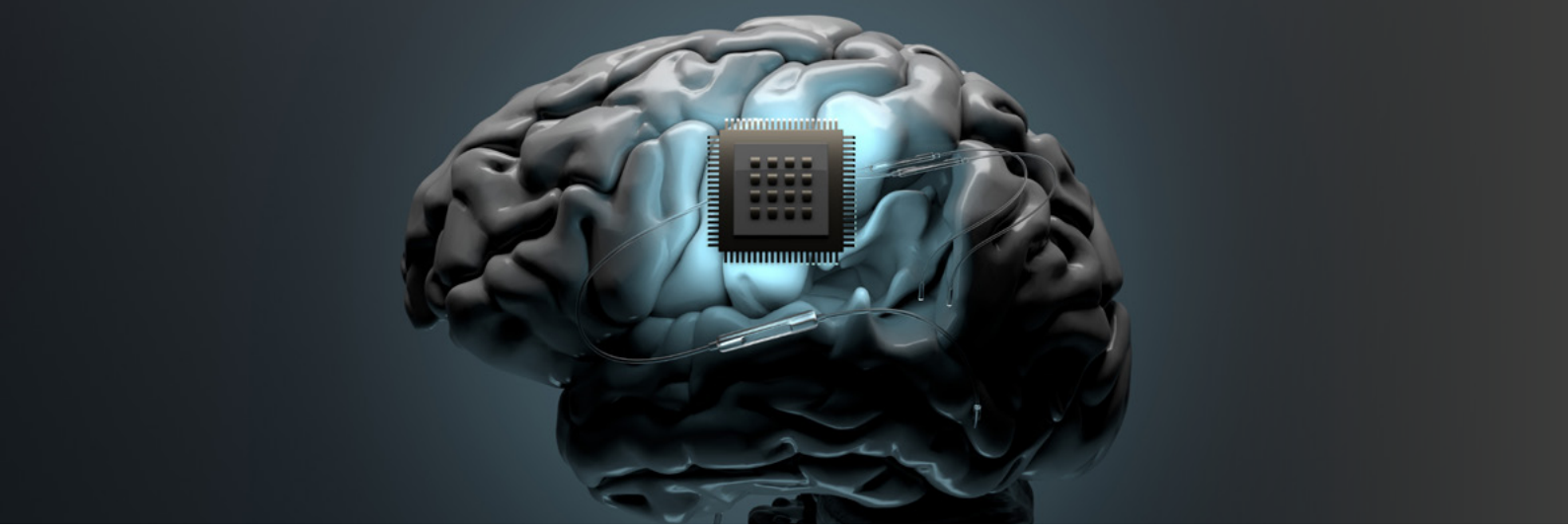
One might even ask whether there could be some circumstances where lawyers generally engage in cognitive enhancement and a lawyer who has not taken up the opportunity to enhance makes an error. Could such a failure support a professional negligence argument? **Some devices** purport to give indications of when workers are attentive, and perhaps to continue with important legal work that requires attention to detail when a piece of neurotechnology has warned you that you are not at your best, would be negligent. This might also be so if you had failed to use a device that could have averted the costly lapse in attention.

Perhaps the day might come when some clients prefer cognitively enhanced lawyers who only work on their matters when they are fully attentive. Whilst the legal profession currently has a variety of approaches to billing including forms that are responsive to the employment of technology in legal work, (**Legg, Vines and Chan 2020:16**), one metric that many lawyers will be familiar with (perhaps too familiar) is that of 'billable hours'. In light of the development of attention-monitoring neurotechnologies, **the billable hours metric might become too crude for some clients who might prefer to pay for 'billable units of attention**'. In this connection it is interesting to note that the practice of billing by the hour, which arose in the 1950s, was initially client driven, coming from inhouse legal departments (**Legg and Rogers 2020;270**). Maybe the inhouse legal departments of neurotech companies might one day drive the development of the billing innovation considered here. The shift to billable attention would involve the gathering of lawyers' brain data, which could perhaps be reused for other purposes such as making inferences about things other than their states of attention. The mental privacy dimension of a firm's brain-monitoring system seems unsettling to say the least and one may well see such billing practices as concerning for other reasons.

The idea of an 'attention economy' has attracted much discussion most recently focussing on the way that some technology companies have a business model that involves attracting people's attention (**Giraldo-Luque and Fernández-Rovira 2021**). The form of billing described here might even be thought of as a labour side dimension to the concept that could perhaps be employed beyond law and by other service providers that currently bill by the hour.

For some firms it might be of interest to note the approaches of other organisations that have a strategic interest in future technological development. Some military organisations, such as the US Marine Corps, the Australian Defence College and the French Defence Innovation Agency now make use of science fiction in order to assist them envisage future forms of competition (**Ryan 2022: Chapter 4**), and companies such as Pepsi, Samsung and Visa are reportedly taking a related approach (**Romeo 2017**). Perhaps neurotechnology (together with non-neurotechnological forms of AI) might prompt law firms to consider novel forms of anticipating how they will work, organise themselves, engage in competition with other firms, and interact with clients.

5 For a discussion of the legal significance of various forms of neurointerventions that include but go beyond those of a neurotechnological kind see Vincent, Nadelhoffer and McCay (2020).



Conclusion: challenges and opportunities

To conclude the report, I will endeavour to summarise and draw together some of what has been said earlier in order to focus on the challenges and opportunities that neurotechnology presents for the law and legal profession.

As has been suggested earlier in this report, there is a race on to develop commercially successful neurotechnologies, particularly in the therapeutic, educational, workplace, and consumer domains. There is also significant military interest in these technologies and in time other applications may emerge, for example in the criminal justice context. Given the backing of neurotech projects from investors like Elon Musk, Peter Thiel and Facebook (Meta) one would expect that the uptake of the technologies in society is likely to increase, but it is not yet clear what direction of technological change will prove to be most prominent. At the moment, much of the commercial activity seems to be taking place in relation to medical devices, with some consumer and workplace and educational applications starting to emerge. **Once neurotechnology becomes integrated into more people's lives we might well see ethical, social and other challenges that will require legal thinking, and in some cases legal responses.** This integration may be pursued for a variety of aims including the treating of neurological and mental health conditions, controlling devices, playing video games, and facilitating more efficient ways of working.

For lawyers, there are a variety of different levels worth considering in response to these developments, but because of the importance of law's role in shaping society, the level of society will be the starting point. A compelling reason to make sure the law does not unduly hinder neurotechnological progress relates to the very significant therapeutic applications that are already emerging and are likely to continue to emerge. These are applications that have the potential to be enormously beneficial in terms of alleviating suffering and other health burdens, thereby creating related individual and social benefits. Whilst perhaps commercially significant, other applications provide a less persuasive case for a permissive legal environment for the development of neurotechnology.

To meet some of the challenges addressed earlier in the report, law will need to have a role in rising to address various very serious human rights issues, in particular those relating to privacy, surveillance and manipulation of people's behaviour by those who develop and sell neurotechnology, or perhaps others. The stakes are very high in relation to these matters. The law may also need to consider issues of equity of access to the technologies, device safety and concerns about algorithmic bias. Law has the opportunity to attempt to maximise the upside and to minimise the downside of the technological developments described in this report. In terms of practical steps, law reform bodies need to start to consider the emerging trends with input from civil society and the companies who develop the technologies. Whilst such consideration is important, it is necessary not to overestimate

law's impact in relation to other approaches to influencing technological development which will also need to be employed.

Legal educators can expect to encounter interesting new problems that might challenge existing modes of legal thinking.

Reflection on neurotechnology (and other technologies) provides the opportunity to respond by encouraging an anticipatory style of thinking in students, and to foster the development of critical thinking skills, whether students are learning the law for the first time or are engaging in continuing professional development. However, educational institutions might be challenged by novel questions relating to neurotechnological forms of academic misconduct.

Law firms have the opportunity to develop their client base in new directions and perhaps some firms will try to become known for specialising in issues relating to neurotechnology. It is hard to know how widespread the uptake of neurotechnology might ultimately be but to neglect it might be regretted particularly if, as has been speculated, brain-implants or wearable devices might become the **iPhone of the future**. Importantly given the technology's close connection with the brain and mind, and perhaps even the creation of cyborgs, this should not just be thought of as straightforwardly a variation on existing approaches to technology in the context of legal practice.

New opportunities might involve **guiding neurotech clients through the regulatory process**, or advising them on other legal issues. If neurotechnology were to take off in the workplace, or the context of consumer devices, there might be scope for providing **advice on related employment law and consumer law issues**. Given that in time, existing legal doctrine may struggle with neurotechnology in a variety of areas of law, some clients might need advice on these matters, or where legislatures respond to perceived deficiencies in the law (for example by creating new brain-hacking offences), in relation to those responses. In the meantime, some firms might want to consider their approach to monitoring the trends to ensure they are ready to make the most of any opportunities that might otherwise be taken up by competitors. This kind of monitoring is needed to ensure that there is an empirical basis for action as the precise nature of the neurotechnological trend or trends start to become clearer.

Firms might also consider how they approach strategy, including foresight, hiring, marketing and continuing professional development, in order to develop the firm's expertise and position in the market for legal services.

There may be substantial benefits for firms that are well placed to capture the new work as the market for neurotech devices matures and the technology increasingly becomes a driver of change.

The question of how to make the most of the coming opportunities may well be one that merits further discussion and strategic thinking.

Moving further into the future, it might be worth considering the possibility of lawyer and technology becoming less distinct than they now are, and legal technologists may need to think about how this could impact upon their work. From the perspective of more traditional individual legal practitioners, the possibility of developing a neurotech client base and reputation, or engaging with interesting new legal issues, might be attractive but the more distant possibility that neurotechnological enhancement and brain-monitoring might one day become expected of them may be less so. Bodies such as the Law Society of England and Wales might also at some point need to consider what to do about such matters.

Overall, neurotechnology is likely to have an increasing impact on society and thus on the law and the profession. In order to best respond to the challenges and opportunities, the first step is to find out about neurotechnology, and hopefully this report is a useful starting point. The next step is to think about what to do and again it is to be hoped that this report will provide stimulus leading to action.

Author

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Allan trained as a solicitor in Scotland, practised as a commercial litigator in Hong Kong with Baker McKenzie, and has been admitted to practice in two Australian jurisdictions. He is also experienced in providing continuing professional development to the legal profession in areas as diverse as behavioural legal ethics, and legal aspects of neurotechnology.

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For more information about the Law Society's foresight and futures work, please contact Dr. Tara Chittenden, Foresight Manager, **tara.chittenden@lawsociety.org.uk**

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