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Demarcation problems in law and neurotechnology: persons, cyborgs and neurohackers

Talya Deibel

University College Cork, Cork, Ireland

ABSTRACT

Technology creates demarcation problems for law, with legal agents existing in a constant state of in-betweenness. Digital and biotechnologies challenge legal definitions by changing our understanding of what constitutes a 'person' and what constitutes a 'thing'. This similarly affects the boundaries between inner–outer, personhood–property, and subject–object distinctions. The result is a plethora of legal problems, as modern European private law theories are built upon these dualisms. For instance, the integration of technology with human minds disturbs the liberal foundations of personhood. Human–machine interactions challenge our concept of self, as technology becomes integral to both personal identity and how individuals experience the world. Traditional understandings of personality, property, privacy, and freedom prove inadequate when confronted with liminal categories such as human–machine symbioses and the figure of the 'hacker'. However, this challenge is not unprecedented; European legal history offers numerous examples demonstrating that these boundaries were never truly stable. A key illustration is found in Roman law, where jurists developed a hybrid conception of subjectivity to address the practical legal problems of their era. This paper therefore examines neurotechnology, with particular attention to the figure of the hacker, to analyse the ontology of modern boundaries in private law.

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Introduction

Technology changes what it means to be a person and what are things. This is what 'the cyborg' metaphor, invoked in the title, takes a step further: illustrating a symbiosis of humans and machines at a symbolic level (Haraway 1985). It refers to the material integration of the digital and the biological, as technology is becoming part of organic bodies. Not only does the cyborg exist in sci-fi and speculative fiction, but it is also living among us. It is the person with the organ transplant, the hearing device, the prosthetic leg, and soon with sophisticated neural transplants. In other words, post- or

CONTACT Talya Deibel tdeibel@ucc.ie Senior Postdoctoral Researcher in the Law and the Inner Self Project, funded by a Research Ireland Laureate (Consolidator) grant (2022/2628) at University College Cork, Ireland

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transhumanism in emerging technoscience is not the future of law; they have been its present, even if law often did not notice (Braidotti 2019).

Today AI and machine learning technology are integrated into our bodies by wearable devices (e.g. insulin pumps), implanted devices (e.g. pacemakers) or complex prostheses that are coupled with the central nervous system (e.g. BCIs used in neural prosthetics) (Quigley and Downey 2022). Many of these examples are in-between, hybrid and complex. They lack a neat boundary between 'life' and 'information'. This is expected given how difficult it has been for decades to isolate biology from informatics, software from wetware. Yet, it creates a culture clash between law and technology as law routinely invokes boundaries to provide conceptual clarity. This includes the exchanges between humans and things, personhood and property, nature and innovation, subjects and objects, and the inner and outer sphere.

This paper is motivated by the integration of the 'artificial' with the 'organic', a topic that characterizes much of the field of science and technology studies (STS). Yet, its focus is legal, crystallizing how digital and biotechnology create wild zones that are seemingly beyond traditional legal concepts' reach (Latour 2004). These fields are exemplary for how high-tech developments change our understanding of well-established legal concepts like personhood or property. Specifically, they challenge the boundaries between them. These are no arbitrary boundaries; these 'lines in the sand' are what modern European laws are founded on (Foucault 2008). Not only is there a practical problem of demarcation, caused by how machines and humans blend, but modern law also clings to its binary apparatus in a modern world where those categories are fluid. The boundaries are constantly crossed and intensely negotiated, if not all together emptied out of meaning (Braidotti 2016; Hirvonen 2006; Latour 1993).

Within this context, it is also important to note 'how' law narrates boundary metaphors to describe those things we experience as basic to ourselves. Yet, there is indefiniteness and instability that sit in the heart of modern law. What are now seen as historically rigid boundaries between categories have always been challenged. To foreground exactly this last point, we should take a long perspective on law. The open question regarding boundaries in law requires starting from antiquities, through the transition from the Greek *polis* to the Roman empire (Hegel 1977; Loick 2015).

Today's hybrid state between humans and things might be experienced as a challenge to modern law, it is not, thereby, novel. Our conception of personhood and subjectivity dates back to antiquity in a relatively consistent manner and this includes how boundaries have been unclear and context dependent. This paper comments exactly on this point as manifested in the relation between law and the field of neurotechnology. The existing demarcation problem in law is exacerbated in this field, and describing law from this perspective is a necessity when seeking to engage with the speculative subjectivity that permeates the technologies, such as those that are coming out of the neurosciences.

Neurotechnologies are designed to be embodied; bodies, in turn, are where in law the authentic experiences of selfhood are located, including the physical and psychological risks that this implies. The basic problems that are the everyday concern of positive law include the material damages to the body, unauthorized access to the system, violation of privacy, unfair usage of automated data and more. These are questions that are typically addressed in tort law. However, they are *prima facie* questions of 'personhood'. They depend on how we qualify the complex, multiple and highly ambiguous relations

between technologies and individuals. What are, perhaps, practical questions when the boundary is seen as given, requires sophisticated legal analyses in close contact with a constant re-evaluation of the boundaries between persons and things.

This task is challenging when assuming the point of view of neurotechnology. The concept of personhood appears as if it is on the verge of a transformation, both phenomenologically and physiologically. The manner wherein future neurotechnology seeks to refashion our lives and, by extension, our legal system is neither linear nor decisive. It is doubtful that even today such a simplified view on science, technology and society is still practical, especially when it comes to how law can function by favouring non-messy objectivity. By contrast, this paper argues that this 'flat' view of law and technology must be abandoned; law must (re-)consider its critical history to be able to answer the challenges of current and future technologies.

As such, the paper proposes to take the cyborg and the hacker as philosophical illustrations of fluctuating legal categories. The cyborg is simultaneously the machine and the human, whereas the hacker is the pirate and the goodwill rebel. This dichotomy invokes another metaphor of boundary for the legal system. However, neurotechnology demonstrates that the gap is closing between these fringes. In their relationship to neuroscience, these figures present us with marginal examples of the contemporary equivalence of dialectics between slavery and emancipation. Through their lens, we can look at the questions of personhood.

To this end, the paper revisits the duality of the subject–object nexus and its intricacies in private law. It refers extensively to private law theory but in the background concepts from STS inform the theoretical framework of the paper. This setup makes it possible to retain proximity to the core questions that law focuses on and at the same time to present a critique of the legal subject as a historical and political construct. The objective of the paper is, therefore, not to present practical 'solutions' to possible problems that might arise from neurotechnology. Rather, it seeks to demonstrate how the critique is integral to contemporary private law to be able to engage with the messiness and hybridity. To this end, the first part of the paper deals with the change and continuum of personhood as the basis for contemporary questions that come out of the intricacies of persons and things. The second part of the paper engages with neurotechnology, highlighting the concept of 'neurohacking' and its implications for an authentic self and a protected inner sphere.

Part 1 personhood

Boundaries of personhood

Conventionally, personhood is seen as a bundle of fundamental capacities which includes being capable of having rights and duties, as well as being able to act with legal affect (Kurki 2019). The orthodox legal scholarship takes the person both as a physical and a moral being. In private law, personality interests are often conceptualized either in tort law or in personality rights. The theory of 'personality rights' has been developed within the continental legal tradition. The civilian systems recognize personality rights as absolute, private, non-transferable, and non-hereditable by nature (Resta 2014). Personality rights begin at the birth of the living child and end at death. However doubts

arise regarding these boundaries, since birth and death are complex biological and social phenomena.

Many such interactions of law, technology, and society are expected to be resolved with private law policies. For instance, a foetus is not accepted as a fully autonomous legal person. Legally, it is an attribute of a pregnant woman. However, if injured *in utero*, s/he can be entitled to compensation if born alive. This is an illustration of how the idea of a legal person inside another legal person is alien to law. In other words, law wants to assume a separate existence (Davies and Naffine 2002). At the same time, the case demonstrates how law can conditionally stretch legal personality to the foetus. This stretched notion of personhood applies to the foetus, regardless of the controversies that surround this topic: the foetus is already a 'subject' of law.

One might point out that 'personality rights' do not refer to a universal concept, as it has civilian roots and there is not a consensus about what this concept entails and its scope of protection. While some jurisdictions (e.g. Germany, Switzerland, The Netherlands) recognize a general personality right, some jurisdictions (e.g. France, Belgium, Italy) provide protection for different types of personality rights and interests. Personality rights are conceptually alien to the common law tradition. However, American and English law provide tort law protection for some personality interests that that go hand in hand with personhood, such as privacy and reputation. No matter what we call them, these legal mechanisms aim to guarantee the person's enjoyment of his/her existence (Resta 2014). This not only includes physical integrity but also one's inner sphere, freedom, identity and authenticity. In one perspective, personality rights are hybrids themselves.

These similarities between different legal systems are the reflections of the liberal models of personhood. On the one hand, a person has personality rights, property interests, and rights to the product of their labour. S/he is the possessive and self-possessing individual who is free from any arbitrary will of another (Davies and Naffine 2002). On the other hand, the moral theory of personhood finds its roots in a Kantian logic based on non-instrumentalism of the persons. In his lecture on ethics, Kant explains this as follows: '*Man cannot dispose over himself because he is not a thing. He is not his own property: to say that he would be self-contradictory*' (Kant 1996). Kantian non-instrumentalism dictates that humans are persons and not things. They are not means to the end of others' gratifications but ends in themselves. However, the modern interpretation of the Kantian personhood is based on Roman law and is mutually constitutive with the concept of property (Hegel 2008). Being a person refers to being the '*subject in whom the ownership of things can be vested*' (Kant 1996). After all, property does not only refer to the thing *(res)* itself. The right to property as *ius in rem* refers to the relationship between individuals with respect to a particular thing. Without addressing the intricacies in political theory, one should refrain from reducing the complexities to a binary model and assuming a clear dichotomy between personality and property.

People and/as things in Rome

It is at this point that we should turn to the longue durée of European private law to address the questions of 'duality' within the context of 'hybridities' that are generally perceived as post-modern (Haraway 1997; Hayles 1999). Tracing the Roman roots of modern

laws demonstrates that this is not the first-time private law scholarship has dealt with symbioses of persons and things.

While today the premise might be that each person is a separate human entity, this notion has been challenged repeatedly in history. For instance, a stretched idea of personality and a hybrid conception of subjectivity existed in Roman law. Roman personhood did not primarily refer to being human. Rather, it referred to an abstraction which permitted some human beings to become subjects of law. This was through the atomistic character of Roman law, which formed the modern conception of subjectivity and intersubjectivity (Loick 2015). In Rome, being a person *de facto* meant having the capacity to have rights. Most important was the right to property (du Plessis 2020). Indeed, personality and property have always been the two sides of the same coin, as property relations are constitutive of subjectivity. Personality is externalized and re-grasped in the form of an external object as a presupposition of self-actualization (Davies and Naffine 2002; Hegel 2008). Accordingly, property becomes a phenomenon that bridges the gap between subject and object.

Modern concepts of personality, property, and responsibility for their infringement are based on Roman law. Roman private law flourished during the golden age of the empire, from the first century BCE to the third century. Following the imperial despotism, law was developed as an abstract, privatizing, formal, and colonizing social dynamic (Loick 2015). Even after the collapse of the Western Roman Empire, Roman law spread throughout Europe through the Justinianic compilation, medieval *ius commune* and the codification movements in early modernity. In Rome, personhood revolved around 'status'. The liberty status (*status libertatis*), the civic status (*status civitatis*), and the family status (*status familiae*) defined the legal subjectivity of people living in the stratified society of Rome. As a result, free male citizens of Rome were typically considered 'persons' while slaves, foreigners and women, who mostly fell under the sovereignty of the head of the family, were not seen as capable of having rights.

The status of the slaves as 'objects' in Roman law is generally perceived as clear. For example, Roman slaves were seen as the mere instruments of the masters, just like the tools of the craftsmen. This idea dates to ancient Greek philosophy. According to Aristotle (1944), the slave was nothing other than the owner. Aristotle used the word '*organon*' to refer to the slave, as another body part of the owner (*Politica* 1255b; Stiegler, Colette, and Ross 2016). Slaves were animate things. They were not ends in themselves but rather used by their owners to achieve an end. This was based on *dominica potestas*, which referred to the power exercised by the master over his subjects. It referred to the wide exercise of sovereignty over the body, mind, labour, and presence of the subjects.

Dominica potestas is a key concept for the civilian understanding of the right to property. Property in Roman law referred to the sovereignty over a 'thing' (Agamben 1998). This sovereignty included certain powers such as to use (*usus*), to enjoy (*fructus*), to dispose or to alienate (*abusus*). It provided a type of freedom which was different than our modern conception. It existed in the private realm and was exercised through personality as an abstract legal tool which created a thin concept of human being who becomes hegemonic through ownership (Loick 2015). As a legal concept, the core of property was to exclude others from interference with one's freedom (Hegel 2008). In Rome, property was coined by two terms: *dominium* or *proprietas.* While the former echoes *dominica*

potestas, the latter comes from the word *proprium* (one's own). In parallel, *dominica potestas* was based on the mastery and control relationship. However, unlike other 'things', slaves were placed in a liminal space, within the traditional subject–object dichotomy.

Their inclusion into social and business life demonstrated their identity as 'persons'. They were human according to natural law. They could think, they could talk, they could learn, they could act, they could decide, they could desire, and they could feel. Many legal sources emphasized this and put them in an in-between status between objects and subjects of law. First, the legal issues regarding the slaves were addressed within the law related to persons (*ius ad personas pertinent)*. Second, slaves were given the legal capacity to act. Even though they were not capable of having rights and obligations of their own, they could complete legal transactions on behalf of their masters. They concluded contracts, ran businesses, took risks. This duality created many practical legal problems, especially in matters related to personhood and responsibility.

From a modern perspective, while Roman jurists were deeply involved in the immoral and reprehensible institution of human slavery, they also demonstrated a remarkable degree of non-binary legal thinking to address these legal problems. For instance, they extended the legal personality of the master to the slave, thereby granting the slave a derivative legal subjectivity (Ucaryilmaz Deibel 2021). This later constituted the basis of the medieval theory of *persona ficta* which further established and formalized the practice of assigning legal personality to collective entities. In that sense, mastery and slavery were integral to the creation of individual subjects in law (Hegel 1977; Loick 2015).

Things and persons in today's law

Going back to Roman law is shows that today's categorical understanding of subjectivity is not the norm in legal history, and, therefore, the same ought to apply to the future. Llegal personhood was introduced as a fiction; its primary axis was the distribution of agency and person–object interactions. Notably, this is later embraced by legal positivism in the twentieth and twenty-first centuries.

Positivism sees personality as a personified unity of the legal norms which obligate or authorize the person. The legal person does not reside outside of the law and has no additional existence (Davies and Naffine 2002; Kelsen 1967). This strips the personhood away from its social and political context. Roman law already presented us with a more nuanced understanding of personhood, one that was context dependent. Roman personhood did not form a single category. It had moral foundations in natural law. Slaves were the object of the legal system, but at the same time, their natural status as humans could never be denied. They existed in the liminal space, in the boundary-sphere between subjects and objects.

Unlike ancient Rome, humans are now paradigmatic subjects of law, but this is not a perspective with a great deal of support in some fields. The key figures in STS, in particular, affirm that hybridity is characteristic of the relation between science and society, both practically and in terms of an approach to modernity (Haraway 1997; Latour 1993). Accordingly, the legal split between humans and things can be characterized as a process of purification, which is also the context in which Donna Haraway introduces the figure of the cyborg as part of her posthuman feminist critique of subject–object models. The cyborg is a creature in a technoscientific world that is neither exceptionally

human nor machine. It is disassembled and reassembled, both collective and personal. It represents the disintegration of boundaries between life and artificial, mind and world, and beyond.

What this implies for this paper is a perspective in which the isolation of humans and things from one another imposes a boundary that challenges established legal practices within multiple domains, each with overlapping or conflicting meanings across different communities (Tamminen and Deibel 2019). This type of complexity amplifies how advancements in digital and biotechnology create human machine interactions which are not modelled on what law uses as its boundaries. This includes seeing the brain as a functionally biological cognitive system and integrating AI and machine learning technologies into our bodies. The result is hybrid relationships between persons and property, where the boundary between technology and the body becomes increasingly difficult to delineate at different levels (Bublitz 2022). This is why the field of neurotechnology stands out. It is one of the areas that show any type of commitment to keep the natural separate from the artificial, the mind from the body and the self-developing from externally designed, fails to address the reality.

Personhood and inner self

Some claim that humans are nothing but the changing polarities of their neurons. However this perspective once again reduces the complex relations between science and society, including law (Foster 2011). The human being is more complex than the corporeal person, and this complexity crystallizes in an inner life with thoughts, emotions, feelings, hopes, and desires. Dichotomizing the inner and the outer into two autonomous, separately analysable realms reflects Cartesian philosophy and Kantianism (Patterson and Pardo 2016). For instance, it is generally accepted that the 'mental' and the 'physical' are captured by the 'inner' and the 'outer'. The outer reflects the tangible matters including the body, whereas the inner reflects the mind. As such, modern law assumes the body and mind dichotomy, where the mind is in possession and in control (Davies and Naffine 2002).

One of the key roots of this split between the inner and outer is Locke's theory of property. According to Locke, '*every man has a property in his own person. The labour of his body and the work of his hands we may say are properly his*' (Locke 1980). One interpretation of this labour theory is the 'possessive individual', a successor to the Roman concept of personhood, as the proprietor (Macpherson 1962). In turn, the same applies to 'us' as cyborgs, which is still premised on certain identities that are privileged over others. Then, like now, 'possessiveness' revolved around criteria based on gender, race, and class relations (Davies and Naffine 2002; Marx and Engels 2013).

The more immediate point, however, is that Lockean theory requires a conceptual division between the self as subject and the self as physical object. It refers to the body as what is owned and the inner self as the owner. The body, which is inferior, natural and mundane, becomes an external vessel for the immaterial mind (Davies and Naffine 2002). This view is compatible with identifying the mind as a computer, and identifying the self with the mind. There are many examples of this, both in the history of cybernetics and more recently, in various types of thought experiments that explore detaching the brain from the body and argue that personhood and selfhood will remain with the

detached brain (Putnam 1999). Such a view of the brain clashes with the view of the cyborg as a postmodern subject that is never fully realized, but always becoming and always multiple.

On the one hand, we can now move from the notion of a deep, rich and separate inner sphere to the legal conception of a *forum internum*, the suggestion of an inner sphere is an entirely metaphysical realm, independent of the outer world (Taylor 1989). It is sometimes identified with the concept of the 'self', in the sense that the inner self refers to the reflectivity of the self, a process of creating selfhood. Although legal norms mostly deal with the *forum externum*, such as speech or behaviour, thet often do so because they are seen as expressions of the authentic inner self. On the other hand, one can critique on similar grounds the conventional 'mind–brain identity theory'. This theory refers to the mind and the brain as conceptually identical and linguistically interchangeable (Place 1956). Yet different people can be in the same mental state without having identical brain physiochemistry (Putnam 1999). Other critiques focus on the immateriality of the mind. The brain can be experienced with the senses whereas the mind is not a unitary thing and does not have a spatial location. For example, the extended mind thesis which is inspired by systems theory claims that human cognition is not confined to an individual but might be distributed across a cognitive system created by several interacting agents (Clark and Chalmers 1998, Bublitz 2022). Humans do not exist in a vacuum, they are interconnected. Individual subjects do not come into the world fully formed, rather they are constituted through a set of social relations. This external power has a formative force over the agents and is a condition for the possibility of individual subjectivity (Foucault 2003, 2008).

While brain activity and emotional experiences are closely related, the precise nature of their relationship and whether they can be reduced to another remains a scientific and a philosophical question. Take the example of neuroprostheses, which are developed to improve or restore motor or perceptual functions of patients. They are directly coupled to the central nervous system and operate at the neural level, without being mediated by the muscular system. Users receive sensory feedback, which affects their minds and experiences. A constant feedback loop is created, with the human and the thing acting in concert. Deep brain stimulation (DBS) exemplifies this technology, having been performed for more than twenty years to modulate brain activity in Parkinson's disease and other neurological conditions (Bublitz 2022).

The basic point is that the separation between the inner and outer ends up dissipating when taking a closer look, following the prescriptions of STS and much of the modern literature on science–society relationships. More concretely, even if we acknowledge that neuroscience can properly capture brain activity, this does not mean that it can ever unveil the inner self that is often assumed in legal philosophy. Turning to modern molecular biology is similar in this regard, especially when considering how sophisticated and capable it has become in modelling and simulating the activity of genes, genomes, cells – even in synthetic forms (Davies and Naffine 2002). Such processing of information at every level might reveal vital insights in a wide variety of areas but it has not thereby led to a more determinate and stable sense of the inner realm. This inner realm in law is still assumed to be epistemically private and ontologically hidden, with only the self-having a privileged type of access (Patterson and Pardo 2016).

Nonetheless we can similarly observe that this inner realm is never closed; it is a realm that is dependent on the outer world from which it borrows its language. Wittgenstein famously argued that portraying psychological phenomena such as thoughts and feelings as literally inner entities fails to capture what we take to be their essence (Patterson and Pardo 2016). Accordingly, first-person access is not privileged, it is just categorically different. The inner is not necessarily a closed-off Platonic realm of collected mental materials. It is intertwined with the outer, and the inner self is unintelligible in the absence of the outer. As such, this is, for now, a space that we own and that we are, both, at once.

From inner self to property

The Latin word *persona* derives from ancient Greek and originally means 'disguise'. This original meaning is often referred as the outward appearance of the man, symbolized by the theatrical mask (Ucaryilmaz Deibel 2021). Personhood exists in between the autonomous self-conscious psychological being and the outer realm. The mask mediates between the inner self and the outer world. The public presentation of the outer and the authenticity of the inner disconnect through the Roman *persona* (Loick 2015).

This implies that legal personhood is not just a boundary, but also refers to a 'boundary work', which establish, maintain, or challenge boundaries between humans and things (Gieryn 1983; Star 2010). This is evident in the context of juridical persons. However natural personhood can also be understood as a process or discourse that creates a hybrid structure, rather than being solely modelled on the concept of an inner self based on the Kantian idea of autonomy and the will of the individual. Kant's fundamental influence on liberal societies is reflected in how much the notion of individuality and the impenetrability of the human continue to be valued (Taylor 1989). On the one hand, the *persona* makes the inner self visible. It provides a type of freedom and subjectivity regarding the inner realm. Yet simultaneously it corrodes authenticity and individuality (Loick 2015, Hegel 2008). On the other hand, valuing individuality requires that we recognize that these liberal ideas were never separable from economic considerations in any practical sense (Hayles 1999). As such, the juridification of personality opens pathways of assetizing the inner sphere. It is not only about emotions, thoughts, or desires. It also signifies reputation, identity, and public image which are easier to define in economic terms.

One reason why neurotechnological integrations with human bodies are problematic, from a legal perspective, is that they shake these liberal foundations of personhood. The psychological and phenomenological consequences of human-machine interactions challenge our idea of self as the technology becomes part of the authentic person's identity as well as how the person experiences the world (Quigley and Downey 2022).

Modern personality rights are Roman in how they are historically and functionally intertwined with property relations. Similar to the civilian tradition, the rise of the free individual in common law followed the rise of absolute property (Davies and Naffine 2002). The Roman roots of legal personhood was based on a particular social hierarchy that keeps its relevance today (Hegel 1977). Similarly, Blackstone's commentaries in the eighteenth century define property in Roman terms (Macpherson 1962). It is the sole and despotic dominion which one man claims and exercises over the external things of the world, in

total exclusion of the right of any other. This retrospective view of Roman law highlights the relationship between freedom and property.

This view of freedom is understood as a function of being able to have property which is about exclusive control. Yet, there are different types of property and ownership models when it comes to their significance to personhood (Radin 1994). Private law theory places 'the self' within the category of *res extra commercium*: the things which cannot be subject to private property (du Plessis 2020). Historically this category referred to various subcategories including the body, *res communes omnium* (common heritage of mankind), public goods, and sacred goods. In the seventeenth century, famous Dutch jurist Hugo Grotius used this theory to re-examine the concept of property whereby he established his famous principle of freedom of the seas (Grotius 2004). Grotius' attempt was to use private law theory to justify and legitimize Dutch naval expansion over Indies. In the age of bio and neurotechnology, we are facing similar contemporary interactions between technology and society which establish new types of ownerships (Arendt 1958; Parry 2004).

This dialectical understanding of property echoes Roman philosophy to the extent that a human is a 'person' in his or her capacity as a proprietor. Even after modern laws decided against slavery and humans were freed from feudal estates as part of the enclosure movement and the introduction of Code Napoléon, asymmetrical relationships remained in the contemporary socio-political ecology (Davies and Naffine 2002). The dialectical understanding of property demonstrates the relevance of the inner self in its relationship with the body. The flip side, however, is the devaluation of autonomy, objectification of human beings, and exploitation. The displacement of Kantian monistic ethics and concerns over its implications surround bio and neurotechnological developments. In the following section, this paper considers this displacement in terms of the question: should developments in neurotechnology be understood as a reflection of '*dominica potestas*'?

Part 2 Neurotechnology and neurohacking

A standard view of the relationship between law and technology is to depict the former as 'lagging behind'. On the one hand, technological progress is generally perceived as quick and legislative practices fall behind the socio-technological realities. On the other hand, law is sometimes seen as a constraint on innovation and as disincentivizing technological progress (Cloatre and Pickersgill 2020). It is in this frame that special exceptions are provided for fostering crucial areas such as medical technology. Yet, even this boundary between law and technology is artificial, lacking a deeper understanding of a co-dependent relationship of law with science and technology. They co-exist and co-produce. They borrow from each other, and they are built on each other in multiple ways (Jasanoff 2007).

Below, the examples of neuroprostheses and hacking in neuroscience will be elaborated on as explanations. This builds on what STS has repeatedly demonstrated: that the epistemic authority of law in defining boundaries is weak. Law's relationship to such cyborgs and the figure of the hacker brings into focus the sovereign power's relationship to nature, innovation, and technology. Specifically, the standard view of privacy and responsibility needs to be reconsidered in light of the premise that the relationship between social and scientific is increasingly unstable. Law as derived from

sovereign power appears in a position where it is constitutively incapable of deciding (Agamben 2005).

On neuroprostheses

The example of implanted neuroprotheses can help to re-introduce the previous analysis of legal personality. Law considers the neuroprosthesis either as a body part or a thing. This is a matter of 'status', and it can be changed over time. However, the prosthesis is also a boundary object; it is a body part and a piece of property at the same time, and all the time. The difficulty revolves around hybridities, facing how digital and neurotechnology change the understanding of what inner and outer mean as well as how to maintain the boundary in between. For example, Haraway explains that when the machines in question are prosthetic devices, they become 'intimate components' (Haraway 1985). This means we will not only have our boundaries delineated, but we will exist within them. At first glance, it seems counterintuitive for technology regulation to reject dualisms and embrace hybridities. Yet, private law's constitutive power and creativity have been particularly visible when it comes to hybrid boundary objects.

Haraway's theory is about the intimate experience of boundaries; their construction and reconstruction demonstrate that there is not any fundamental, ontological separation in our knowledge of technology and ourselves. These in-between zones of indecision between law and life presents us with, as Agamben puts, a state of exception (Agamben 2005; Tamminen and Deibel 2019). When the physical form of the human deviates from the standard model on which modernity and modern legal systems are based on, the situation becomes unclear. Law's ultimate indecision about where the inner self is located and its legal and ethical significance causes a fracture between norms and their application. For instance, the need to reevaluate the protection of the aspects of the inner self, such as privacy, identity, and dignity, in the age of neurotechnology.

Consider the example of AI and how it can be seen as entailing a return to the law of slavery, from Roman law to the type of boundaries that Haraway foregrounds (Boyle 1997). As a historical analogy, the topic to consider is cybernetics, as it revolves around an intertwined relationship between humans and machines. Rather than the non-hierarchical thinking about feedback loops, interactivity, and circularity between humans and machines, a different type of hierarchy emerges in law and society. As was the case in Roman law, the relationship between humans and things reveals the resurfacing of a patronage relationship with the master. The cyborg, within this context, refers to a contestation of the status of the patron.

The same applies to biology and its extension to how neuroprostheses impact the experiences of the user. Some locations in the body, such as the brain, are seen as identity-constituting (Foster and Jonathan 2017). This means that intervening in these locations would have a special effect on the perception of the recipient (Quigley and Downey 2022). For example, the closed loop DBS technologies used in neuropsychiatric disorders detect neural biomarkers and deliver a calibrated intervention. The closed loop system is not modified by the human intervention but uses feedback control to adjust therapeutic parameters. This means the device might have a degree of control over the inner self of the user, including his/her psychological state, moods, emotions, thoughts, and desires (Bublitz 2022). Effectively, human consciousness is sustained and reshaped

by the integration of the artificial system with the biological. As there is not any possibility to differentiate the source of the stimuli, the boundaries between the authentic human experiences and technological response disappear, and the inner self is distributed within fragmented realms.

It is possible to simplify and think about this example in terms of the potential adverse effects of neurotechnology, such as concomitant impulse control disorders. Such concerns are important and put neurotechnology in the same group as pharmaceutical interventions that might cause similar effects. Accordingly, the adverse effects on bodily integrity can be said to have certain metaphysical consequences. For example, a child with a limbic tumour often acts more aggressively (Foster 2011). Such a diagnosis, however, relies on an assertion of the same split between the inner and outer, prioritizing the external artefacts as the causal agents. This overlooks the interactional factors that could challenge our sense of agency and the meaning of personhood as moral agents (Boyle 1997).

The point, however, is that we should move beyond how both personality and property rights invoke a boundary that is imposed on the extra-legal (Radin 1994). This boundary ends up having a defining impact on our sphere of influence over the self and the objects under control. They create an area of 'no trespassing', suggesting absolute protection against third parties (Davies and Naffine 2002). Correctly, Nedelsky criticizes this type of boundary metaphor as it provides a wrong focus for exploring human autonomy and argues that private law should instead highlight the patterns of relationship and their intricacies (Nedelsky 1990). For example, there is an extensive STS literature on patenting biotechnological inventions, wherein the definitions of personhood, things, and in-between concepts are seen in terms of a wider context: as an overall terrain of cooperation, conflict, and value generation in the life sciences and related fields. This refers to approaching intellectual property law as part of a process of creating and marketing bioproducts in a broader ecology of norms, rules and regulations that also involve start-up companies, venture capital, stock markets and related types of speculation (Cooper 2008; Sunder Rajan 2006).

It is in this more complex sense that 'status' is not only a Roman relic; it is embedded in our legal frameworks and political designs, and it has agency in modern law as a process of 'boundary work'. It refers to negotiations over the multiplicity of exceptions to the exclusive rights that establish ownership. This becomes particularly crucial when it comes to the assetization of the self. Mitigating this is difficult, as our self-relation and external relations are already mediated by various metaphors of property (Davies and Naffine 2002). As a result, discussing legal personhood today demands that we are approach new illustrations of enslavement with histroical nuance. On the one hand, bio and neurotechnological developments sustain inventive efforts and contribute to further medical research that guarantee right to life and health. On the other hand, they run the risk of undermining subjectivity as they have potential to alter one's ability to be 'oneself'. This creates the tension of original subject v. produced object, emphasizing the boundaries between the inner and outer self, as well as opening the pathway to commodification of both. The gap between human beings and their *persona* is integral to this tension.

As stated above, private law does not categorically take prosthetic body parts or implanted devices as components of '*persona*' or '*res*', locking it into either of these

categories. If body parts are permanently separated from the body such as hair, a tooth or a transplanted kidney, they would be considered to have an independent existence, as '*res*'. However, parts that are to be reintegrated and that are destined to perform a typical bodily function, such as sperm, remain as parts of the '*persona*'. The personality rights over them continue to exist (Neethling 2005; Resta 2014).

Consider, in this light, how neuroscience implies the integration of 'things' into the body. Such 'things' can contribute to the person's livelihood and impact their relationship to human dignity. From a Kantian perspective, dignity relates to one's inner worth. It reflects the legislative status of the man, his authorship, and identity (Foster 2011; Habermas 2003). The Kantian ban on the instrumentalization of humans is above all covered within the legal framework protecting human dignity including human rights and bioethics (Foster 2011). Yet, such body parts might be easily replicated and moved around from person to person. They might be loaned as part of employment contracts or transferred by inheritance. This complexity and hybridity show that these 'things' could end up playing a role in legislative decisions, epseically in private law relationships.

Such concerns are not unique to questions of neuroscience and neurotechnology. Rather, current technological advancements areintensifying discussions that began decades ago. A famous example is the landmark decision *Moore v. University of California*, a well-known legal dispute between Mr. Moore, who had agreed to the removal of his tissues for treatment purposes, and UCLA where researchers conducted further research on his samples and later developed and patented a cell line. Although his genetic material was not unique, the cell line was unique in its composition. Therefore, Moore claimed non-proprietary interests in his tissue, which he argued was part of his identity. Additionally, he claimed that he had proprietary interests arguing that the research conducted on his tissue was profitable (Hardcastle 2007).

The Supreme Court of California ruled that Moore could not claim ownership over his tissue samples, as the laws governing biological materials treated them as *sui generis*. Accepting otherwise would have regarding the human vessel as a commercial commodity (Hardcastle 2007). Consequently, the Court based this reasoning on human dignity and protection of personhood, a result that is paradoxical given that patenting already implies appropriation. To deal with these complexities, the Court also followed a law and economics logic and decided that tissues cannot be subject to private property because, if accepted, a strict liability regime would apply, which would have a disincentivizing effect on important medical research. Boyle characterizes this approach as imperialistic: recognizing proprietary interests of those whose bodies are mined for genetic information will destroy research, as property is inimical to free exchange. Yet, property rights must be given to those who are mining (Boyle 1997; Haraway 1997). This example shows that the distinction becomes arbitrary when dealing with boundary works.

The paradoxical situation that law is facing continues when considering neuroprostheses, which are extending human minds. Seen in terms of their components, such technologies are not unique; they are replicable and fungible. However, when integrated with humans they form unique entities in their composition. On the one hand, if artificial body parts of new enhanced selves are regarded as property, less advantageous groups could face economic pressures to sell their commodified selves (Davies and Naffine 2002). On the other hand, if they are not differentiated from the organic components of the

human body, the proprietary interests that are integral to personhood might be jeopardized and the human body becomes open to being 'mined'. For instance, bio and neurotechnology companies might derive disproportional commercial benefits. The broader societal interests should be part of the discussion when law tries to find a fair balance, rather than simply classifying the neuroprosthesis as a body part or a piece of property.

There are civilian legal techniques that might address the concerns. One of these is establishing a quasi-contractual relationship between the owner of the personality interest and the party who claims profits from it. In this case the nature of the claim is different from that in delictual protection, as a quasi-contractual relation allows for the disgorgement of profits the profits even though the owner of the personality interest does not experience any material or immaterial personality harm. The complexities that lie in the centre of this ongoing discussion are only going to increase when neurotechnology becomes part of the everyday life.

The figure of the hacker in neuroscience

One particular risk that the advancements in neurotechnology might pose to the protection of the personhood is the potential for unpermitted access to the mind. Hacking in neurotechnology might refer to both third party bad faith hacking of another's medical device and DIY neuroenhancements. The private law implications of third party hacking *prima facie* crystallize on the violation of privacy and liability for damage caused by unauthorized access. The new generation devices are predicted to be vulnerable due to imprudent design choices such as hardcoded passwords (Matwyshyn 2019). Addressing future legal questions requires defining the status of the neurotechnological devices which integrate neurotechnology into the bodies and extend the minds.

A first example comes from a tort law perspective. The legal categorization that is chosen affects the nature of liability (e.g. whether it is fault-based liability or strict liability), the type of liability (e.g. product liability, *sui generis* liability, etc.), the amount of damages that can be claimed, or the correlative duties of others (Bublitz 2022; Ucaryilmaz Deibel 2021). For instance, damage to personhood usually attracts higher levels of compensation than damage to property (Quigley and Ayihongbe 2018). Damage to bodily integrity has higher moral consequences than a mere damage to property, as it is also related to one's inner sphere, identity and dignity. However, addressing only the private law implications of hacking does not properly capture its importance in future legal ecologies.

The figure of the hacker illustrates the instability of the boundaries. The hacker reflects the perspective which challenges institutional epistemic authorities. The popular understanding of the hacker is the ultimate outsider. S/he is the one that crosses boundaries of personhood or property without proper authorization. S/he is the one who possess the intention to break the law (Söderberg 2011). Yet, the metaphor of hacker has multiple sides. It also invokes the language of openness and access in addition to piracy and violation. In this broader sense, the ethical hacker becomes a symbol of the challenger who seeks to transform the scientific process constructively, who wants to be inclusive and communitarian for the benefits of the society.

For example, the constant dissatisfaction with the functioning of existing diabetes technologies has led to DIY artificial pancreas systems working on open-source technologies (Dickson et al. 2021). Another example is the epi-pencil, an open-source

epinephrine autoinjector developed by the 4Thieves Vinegar Collective (Söderberg and Maxigas 2022). The innovations in medical neurotechnology address the concerns of individuals diagnosed with medically accepted neurological conditions. However, some stakeholders such as neurodivergent individuals or individuals struggling with addictions may be eager to experiment with techniques that will increase their quality of life. In addition, the concept of hacking also extends to the neuro-curiosity of *homo ludens* in the age of digital technology (Tamminen and Deibel 2019). The optional cognitive enhancement is already on the radar of technology companies, and it requires that many areas of law be prepared for potential risks (Matwyshyn 2019).

In other words, the process of hacking implies redistribution and reconfiguration of agency and subjectivity, and formulating alternative ways of acting (Cooper 2008; Söderberg 2011). At first glance, the metaphor of the hacker implies a threat than an experiment. This raises concerns about safety, particularly when it comes to technologies that extend to 'the mind', considering even secure research ininstitutional frameworks, such as the university, industrial laboratories, or government settings, is already difficult. The prospect of hackers who are mostly untrained amateurs working with engineering techniques opens the door to potential abuse (Church and Regis 2012). Similarly, neurotechnology software faces significant cybersecurity risks. These risks extend beyond third party malicious hacking; a serious hacker might desire to re-program themselves which can cause direct bodily harm or damage to property. Moreover, the potential risks are amplified when considering extreme interconnectivity between agents.

Hacking the body is generally referred as 'biohacking'. This contains biological investigations and interventions conducted outside of institutional scientific settings, driven by curiosity and the exploration of the limits (Tamminen and Deibel 2019). One illustration of biohacking that specifically targets the neurological system is 'neurohacking'. The wide range of DIY practices targeting the neurological system does not only refer to digital technology. It also includes chemical neuro-enhancements such as using nootropics (a.k.a. smart drugs), dopamine fasting, or brain stimulation for improvedconcentration, memory, attention span, or for a different experience of the outer realm. However, hacking is a term which invokes the language of computer sciences.

The figure of the hacker, as a metaphor, implies an analogy that suggests there is a significant continuity between life sciences and informatics. Biohackers have always been experts in digital environments. They reject the mainstream idea that the term hacker is defined by the computer sciences. Neurohackers, in this sense, are closer to the original meaning of hacker as they monitor computational data. The term biohacker is generally identified with do-it-yourself biology or garage biology, as cherished by the start-up culture. Both computer and biohackers share an epistemological position, which includes coding and programming as part of a remix of cultures that update a more traditional scientific ethos (Delfanti 2013). This is parallel to the narrative of freedom and openness advocated by open source and free software movements (Tamminen and Deibel 2019). These movements aim to democratize the generation of knowledge, create open networks of researchers, and gather enough contributors to the projects to benefit society.

The software and algorithms used in different types of neurotechnologies are protected by intellectual property rights. These IP protections determine which agent holds control over the neurotechnology. This includes the contractual freedom of individuals, referring to their autonomy of will in terms of having a say over modifications,

updates, or licences (Bublitz 2013). In the context of bio and neurotechnological developments, the IP law may treat the subjects as naturally occurring raw material, placing them in the public domain. This commercial potential of neurotechnology is especially risky for underrepresented groups, as it exposes them to exploitation and neuropiracy.

Creating personhoods restricted by IP rights will inevitably create hacker communities that place high value on autonomy and are willing to infringe these rights. Fostering autonomy and identity is also central for other types of hybrids. For example, the Cyborg Foundation's Cyborg Bill of Rights, includes the 'right to organic naturalization' (Bublitz, Chandler, and Ienca 2022). After all, personhood is not only a legal, but a political issue. It is about being an active participant of the *polis* (Arendt 1958; Butler 2012). The open-source philosophy in bio and neurotechnology helps differentiate responsible biohacking from its abusive and exploitative versions (Tamminen and Deibel 2019). However, all such practices carry the risk of raising cybersecurity concerns, as well as posing potential harm to bodily and mental integrity.

Today, medical devices are designed to facilitate third-party big data research, and this already poses a significant challenge to privacy. The cybersecurity vulnerabilities amplify this concern, as our confidential information is potentially compromised. Not only is our corporeal existence at risk, but also our digital exhaust our trackable actions, choices, and preferences are open to malicious attacks (Bublitz 2022). However, data collection through neurohacking goes beyond merely intruding into confidential information. It compromises the integrity of the private sphere and runs the risk of amplifying dehumanizing effects of the new economic order where people are increasingly becoming instruments for others. This becomes a Promethean effort to deprive someone of his/her uniqueness (Foster 2011). It also reminds us that *dominica potestas* may change forms, traverse, and produce new dynamics and discourses (Foucault 2003, 2008). The central issue will not be maintaining a sphere into which others cannot penetrate but fostering identity and subjectivity in this new hybrid society.

Conclusion

The modern overemphasis on the duality of 'subject–object' and 'personhood–property' fails to capture the essence of the relationships within networks of control. This is particularly relevant to neurotechnology which creates new symbiotic technological modes of living. Neurotechnology affects the authentic experiences of the self as the boundaries between humans and technology disappear. It extends the physical limits of the biological body and, as such, stretches the scope of the protection of personality as well as extends property relations into the inner sphere. The legal frameworks often treat emerging technologies as concrete objects. Nevertheless, reality is complex, and new technologies create liminal spaces where categories are fluctuating (Latour 2004; Sloterdijk 2016). This demarcation problem has important legal implications, especially in questions regarding privacy, dignity and responsibility.

When humans do not have exclusive control over their bodies, or when human bodies turn into forms of quasi-property, it defies the binary distinction between personhood and property. Adopting a critical and interpretative stance reveals that the European conception of the naturalperson is a fiction (Davies and Naffine 2002). A decisive paradigm shift would be based on an exaggerated and singular account of the future. However,

neurotechnology inevitably compels us to engage in an immediate discussion about personality rights, autonomy, and property. In the age of neurotechnology, the concept of 'legal personhood' is on the verge of a transformation.

The metaphors of the cyborg and the neurohacker are marginal examples through which we can examine legal personhood. On the one hand, they demonstrate how the law constantly invokes boundary metaphors. On the other hand, they present us with a contemporary equivalence of the dialectic between slavery and emancipation, illustrating how the gap between the fringes is closing.

The transformation of the power constellations from antiquity to today's biopolitics is not as drastic as it seems. Roman private law remedies are practically and critically relevant, as they show us how the political formation of subjectivity as well as materiality, can be non-dualistic.

Neurotechnology creates hybrid structures which emphasizes the same historical account: neither personhood nor property refers to fixed legal categories. Personhood does not have a stable meaning; it is context dependent. In this sense, legal questions regarding neurotechnology and neurohacking do not require a separate discipline of law and ethics that lacks intellectual continuity with existing principles. Moreover, a nuanced interpretation of legal history guides us in reconfiguring a new idea of personhood in a strategic relationship with the commodification of biological entities.

There is not any straightforward or decisive way in which neurotechnology is reshaping our lives and legal system. To address the compleixities of the subject–object nexus and its intricacies in private law, one must move beyond a one-dimensional view of law and technology, along with non-messy objectivity. This should not be understood as a complete rejection of categories, as that poses the danger of paralysing legal scholarship. Neither the insignificance of boundaries nor their absolutism is practical from a legal perspective. What needs to be acknowledged are relationships and patterns, and a critical examination of personhood is crucial for addressing the complexities of neurotechnology within contemporary legal discourse.

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ORCID

Talya Deibel http://orcid.org/0000-0003-4823-1628

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