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# The Neuropolitics of Brain Science and Its Implications for Human Enhancement and Intellectual Property Law

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**Abstract:** As we learn more about how the brain functions, the study of the brain changes what we know about human creativity and innovation and our ability to enhance the brain with technology. The possibilities of direct brain-to-brain communication, the use of cognitive enhancing drugs to enhance human intelligence and creativity, and the extended connections between brains and the larger technological world, all suggest areas of linkage between intellectual property (IP) law and policy and the study of the brain science. Questions of importance include: Who owns creativity in such a world when humans are enhanced with technology? And how does one define an original work of authorship or invention if either were created with the aid of an enhancement technology? This paper suggests that new conceptualizations of the brain undermine the notion of the autonomous individual and may serve to locate creativity and originality beyond that of individual creation. In this scenario, the legal fiction of individual ownership of a creative work will be displaced, and as this paper warns, under current conditions the IP policies which may take its place will be of concern absent a rethinking of human agency in the neuropolitical age.

**Keywords:** human enhancement; intellectual property; copyright; neuropolitics; brain science

## 1. Introduction

In 2019, researchers announced a noninvasive experiment using the human brain to control a robotic arm through a brain-computer interface [1,2]. In addition, in 2019, Brainnet, the first successful brain-to-brain direct interface for problem solving was announced [3]. In September of 2020, Finnish scientists reported what they believe to be the “first study to use neural activity to adapt a generative computer model and produce new information matching a human operator’s intention”, meaning that using a brain-computer interface (BCI), the scientists were able to generate images of what the humans in the experiment were thinking [4].

Related efforts to enhance the capabilities of the brain include Elon Musk’s Neuralink, a project looking at how to create a future where the brain seamlessly and telepathically integrates with technology [5]. No longer science fiction, these examples show that technological advances have brought us to a present where it is possible to link the human body and brain with devices and to network brains via computer. As we enter this particular technological future, it serves us to think critically not just about the technologies we are creating but how we are shaping these technologies and the ultimate implications such conceptualizations will have on creativity and the ownership of creative works under intellectual property (IP) law. When scientists can now pull images from your brain and draw them as graphic depictions of what you are thinking, what does originality mean and who is doing the creation?

Technologies that enhance the human brain have the potential to vastly expand our creative capacity. However, as we will argue, such technological enhancements can also be a threat to individual autonomy by further decentering acts of innovation and creativity as belonging to an individual. Certainly, claims of ownership that ignore the social nature of innovation in favor of individual assertions of originality are problematic. However, even more concerning is the possibility that when the very boundaries of the human body are disrupted by technologies that reimagine how we communicate with each other, what has been considered the creative or innovative work of an individual can be more easily appropriated by those who own these enhancement technologies.

This article seeks to make a futures-inspired intervention into understanding the political economy of the enhanced brain and the possible futures for IP control that emerge through such enhancement. We discuss human creativity in the context of neuropolitics, where the underlying assumptions of what it means to be an autonomous individual are challenged and rethought because of what we are learning about the brain and human consciousness [6]. We argue it is important to take seriously how brain science influences the assumptions used to construct public policy. One central question we raise is who will own the output of creative work in the neuropolitical future; that is, in a future in which human enhancements contribute to work typically deserving copyright or patent protection?

When thinking of possible futures, what if, for example, a pharmaceutical company already primed to aggressively assert ownership over its patents, and one that already requires employees to sign over any intellectual property they create, develops a cognitive enhancing drug designed to amplify human creativity. It only takes a small shift in interpreting copyright law and a creative contract to claim ownership in the resulting innovation for the company. After all, companies already assert ownership over a wide range of intellectual property created by their employees.

Further, what if a company requires the use of cognitive enhancing chemicals in order to secure a more productive and innovative workforce—a work made for hire doctrine on steroids? How will we demarcate the distinction between humans integrated into machines and the work of machines as independent creators? The next generation of software that writes creatively or enhances the creative work of a human author may include a click-through license with language requiring rights to the final product or coauthorship at the least. When humans are the mere raw material for the output of brain-computer interfaces, now integrated into all technological devices, will their creative contributions even be acknowledged? Unless our understanding of human autonomy within the context of modern capitalism and legal schemes changes, the future is most likely one of dystopian corporate control, one where human enhancement benefits those who have engineered them as they increasingly claim the work done by others.

As a work of future envisioning, we seek to follow the threads of the present into possible futures where what seems mostly harmless (or unlikely) today could take on new and more sinister meaning. In doing so, we first look at the current state of intellectual property within the context of authorship and ownership. Second, we will look at how theories of extended mind allow for claims of ownership by those owning the technologies of extension rather than the individual who has used these technologies for creation. Third, we articulate the theory of a neurochemical brain—the brain as enhanced by modern chemistry—to posit yet another possible future where an individual's ownership of their creative work is undermined by alternative claims to who has made the creative contribution.

## **2. Grounding Intellectual Property in the Individual: Authorship and Ownership in the Age of Cognitive Capitalism**

Copyright and patent law in the U.S. are designed to balance the interests of the individual author with the larger public good. Both copyright and patent law are based upon assumptions about the origin of creativity and innovation in the mind of an individual who produces or invents something. The protection of IP exists to incentivize this individual to share their creation with the larger public by extending limited monopoly rights to them. The romantic basis of authorship in the individual author or inventor is foundational to copyright and patent justifications worldwide [7–10]. While

Europe tends to recognize the moral rights of authors in a more detailed matter than the United States, the utilitarian nature of American copyright law makes it far easier to disassociate creative work from an individual creator. Even so, expression as unique to the individual and the idea that the individual expresses their creativity in isolation from others is critical to how both patent and copyright law justify the protections these legal regimes grant. Infringement is the appropriation of someone else's expression in copyright or someone else's invention in patent or an appropriation of some portion of their creative work. The law assumes the autonomous individual author and then plays referee between too much appropriation of what someone else created.

This underlying privileging of the individual author for the purposes of assigning rights under the law demonstrates the importance of the autonomous individual for how we tell a story about what intellectual property protects. However, from their inception, such rights were alienable and assignable [8]. Furthermore, while patent protection in the U.S. ends after only twenty-four years, copyright lasts for the life of the author plus 70 years, meaning numerous works of individual authorship are no longer owned by their creator but their relatives or savvy business partners. Such assignability means that we now live in a world of concentrated intellectual property wealth [11]. Thus, despite locating creativity in the individual, there are already mechanisms in place to assure that any creativity emerging from the mind of an individual can be appropriated and owned within the larger economic structure that is cognitive capitalism [12].

While scholars have critiqued the political economy of IP that allows for the concentration in ownership, such critiques have not fundamentally altered the basic rules of these IP regimes [13–15]. Thus, while in theory individual minds create, those creations are ultimately owned by others, either through the assignment of rights or through the law itself.

Copyright, for example, includes the work made for hire doctrine that assigns ownership of copyright to a company for the work of its employees and allows for corporations to “stand in as the sole author” of such works [16]. While patents must list the human inventors, patent rights can and are assigned to companies who fund the inventive work [16]. Both patents and copyrights can thus decenter the individual author by assigning ownership of copyright not to the creator but to a company for whom such a person works.

To look at how individual authorship is decentered from a different angle, copyright in the U.S. defines the author in statute, thereby providing legal authority to add or remove what kind of authors can assert copyright protection at all. For example, legal decisions are not works of authorship under the law [17]. Additionally, the 9th Circuit recently held in the infamous monkey selfie case that animals do not have statutory standing under the U.S. Copyright Act and so cannot sue as authors [18]. The Copyright Office agrees that animals cannot be authors. When updating their compendium on copyright practices, the U.S. Copyright Office specifically precluded copyright from extending to animals or to works created by machines, indicating that to be registered for copyright protection “original works of authorship must be created by a human being” [19]. These are interesting decisions but do not directly address the issue of copyright or patent ownership for works or inventions produced with the aid of a cognitive enhancement.

Given the statutory nature of authorship, the interpretation of what constitutes original authorship and who contributes can shift over time. The claim we make in this article is that as we learn more about how brains function and as additional enhancements for human creativity make it clear that it is not the autonomous individual working alone that creates but rather the networked and chemically altered human that creates, the boundaries of ownership (which have always been a legal fiction) will become even less solid. Into that space will come additional claims of ownership by those facilitating creation because as our new understandings of the brain demonstrate and new technologies make possible, the human brain is no longer isolated within the body. The brain has been extended, chemically altered, and reproduced in ways that will further undermine the already tenuous ownership rights individuals assert over “their” creativity.

The prevailing political approach to IP is to increase punishment for infringing IP rights and to further concentrate ownership over the world of ideas [11]. How the law is shaped in the future to further enhance such ownership may draw upon how we understand originality and creativity. New scientific innovation displaces that creativity from the individual author and places it onto networked minds or technological enhancements. Thus, this article suggests that we ought to be cautious about where the paths of research take us as we enter a neuropolitical future lest we become the monkey in future copyright calculations—not the originators of creativity because, as the argument will go, such creativity is located in the alterations we have made to our brains not in the individual human brain at all.

### 3. The Extended Mind

In the late 1990s philosophers Clark and Chalmers put forward the idea of the extended mind, arguing that cognition went beyond the brain to include devices used by individuals to retain knowledge and help them engage in daily life [20]. While the initial thesis used the notebook of a man (Otto) with Alzheimer's disease as an example, the logic of the extended mind is easily translatable into contemporary usage of technologies not envisioned in the 90s, including the ubiquitous adoption of "smart" phones, tablets, computers, Google searches, and much more.

The theory of the extended mind acknowledges that the brain/body/world barrier is artificially constructed and much more permeable than advocates for autonomous individuality might wish to make it [20]. This model takes as its starting point an integrated connection between the human and the larger world. Such a connection acknowledges that the human brain is already deeply integrated into technologies that undermine the brain/world barrier. While use of the Internet and data storage and retrieval systems come to mind quickly as evidence of the extended mind, other layers of brain/world interactions such as neurocontrolability via architecture can also explain how the extended mind may come into being and the possible controls over it.

Later work by Clark defended the extended mind theory in the context of cognitive tools outside the self, and used the concept of "ecological control", where we see ourselves "as biologically-based (but not biologically imprisoned) engines of ecological control" which "may help us to develop a species self-image more adequate to the open-ended processes of physical and cognitive self-creation that make us who and what we are" [21]. The extended mind hypothesis along with even more radical conceptions, such as Wendt and Kauffman's quantum mind hypothesis, insist on preserving the concept of mind as distinct from brain [22,23]. Thus, the brain of the extended mind is materially situated and no longer confined within the body.

The extended mind thesis is difficult for many to accept because it displaces agency, but it is also quite compelling because we all engage in daily "outsourcing" of cognition to the devices in our possession and the institutions that structure our lives. As a result, Clark and Chalmers' thesis caused considerable debate amongst cognitive scientists, philosophers, and others. Some sought to defend a more unitary sense of individual cognition and worried about "cognitive bloat", where everything became labeled as part of our cognitive processes once the brain/body barrier was disrupted [24]. Because the extended mind thesis undermines the centrality of the individual mind in the cognitive process, much of the debate about this thesis can be characterized as either affirming how lines between the individual and others are blurred or, as an effort to shore up our belief in the supremacy of individual cognition as distinct from external factors.

Some scholars offer objections to the thesis arguing that an "external device" cannot store a "person's beliefs because the stored statements do not have intrinsic intentionality" [25]. Others take on the concept of social cognition and argue against the notion that the Internet (or other devices) can function as an external mode of cognition. While we may have become reliant upon Google to seek out and store information for us, Huebner argues that it is merely a "contextual factor that affects the operation of an already existing cognitive system" [26].

More recently, efforts have been made to refine the concept of the extended mind. Gerken suggests the concept of outsourced cognition as an alternative hypothesis to the extended mind thesis [27]. Outsourced cognition retains the notion of the individual but acknowledges that some cognitive tasks occur outside the individual. However, unlike the extended mind thesis where cognitive parity is assumed between the human mind and external agents, outsourced cognition assumes a disparity with the human mind remaining central and in control of cognitive processes [27]. Gerken sides with those who reject the extended mind hypothesis, while also acknowledging the interrelationship of the individual to his or her external environment. Others seek to understand the larger social environment and its role in cognition.

Gallagher, for example, pushes the concept of the extended mind further and proposes the concept of a socially extended mind [24]. The socially extended mind takes into consideration the importance of social institutions as modes of cognition—legal institutions, cultural institutions, and so forth [24]. Institutions are part of our cognitive process and have been collectively created to help store human memory [24]. While institutions (beyond actual technological devices) serve a role in structuring human cognition, Gallagher seeks to avoid the accusation of cognitive bloat by suggesting that only when an individual engages with a specific social institution does it take on a cognitive role [24]. As a related example, Susan Goldin-Meadow and her team at the University of Chicago showed how the use of simple finger gestures can help “offload” some of the cognitive load during mathematical grouping exercises. Those who used their hands in the calculations were faster and more accurate than those who did not [28,29].

Another avenue of critique and extension of the extended mind theory comes in the form of questioning the way memory is conceptualized [30]. Is external “memory” as described by Clark and Chalmers really memory at all? Michaelian argues that external memory and biological memory are distinct and both cannot be considered “memory” in the same context [30]. Clark and Chalmers use a relatively simple analogy of how memory functions to set out their thesis, positing that using a notebook to remember is the same as using one’s own biological memory. However, a notebook or computer “remembers” very differently from a human [30]. In fact, as others have pointed out, memory itself is inherently faulty [31]. Michaelian argues that instead we need to focus on the interactions between biological and external memory, given that the categories are so different [30]. That being said, he supports the conclusion that devices external to the person are cognitive aids but questions if they can be called memories.

One question raised within the context of the extended mind is where we should place “epistemic credit” for forming beliefs [32]. Given the notion that cognition happens outside the individual or can be attributed to different agent’s and their influences on the individual, it may be that the credit for knowledge generated must be assigned outside the individual mind [32]. What Proust calls dynamic coupling means that processes outside the brain may be responsible for new memories, skills, or knowledge and we must then ask what type of credit needs to be attributed to these external forces in cognition and the formation of beliefs and ideas [32]. To Proust, an individual working within a “social scaffolding” must give “epistemic credit” to the social structures that makes their cognition possible. Those who work outside a given social scaffolding can take additional epistemic credit for themselves. Such epistemic credit and social scaffolding set up a different method of ascertaining ownership in any type of intellectual property.

Proust compares Sally, an experimental psychologist, to Srinivasa Ramanuja, a self-taught mathematician. Sally received an excellent childhood education, enjoyed an “epistemically favorable environment”, was trained in using software such as MatLab and educated in how to conduct appropriate experiments. As a result, “epistemic credit should be spread to all the agents, machines and software that contributed to her mind being shaped “in the right way” for significant outcomes to be produced [32]. Ramanuja, in contrast, is “a self-trained mathematician from India, contributed major results to mathematical analysis, number theory, and many other mathematical domains” [32].

With a much more limited social scaffolding in place, more epistemic credit ought to be extended to Ramanuja than to Sally according to this logic.

Such questions of attribution, prior to the extended mind thesis ended at the individual. While the individual might acknowledge the support and help of others (remember the classic quote from Newton, “If I have seen further, it is because I stand on the shoulders of giants”, it remained unquestioned that it was the individual who was responsible for the creative act. No matter which permutation of the extended mind, or extended cognition thesis you accept, once the brain/body barrier is broken, the range of agents from social structures, individual educators, technological devices, cognitive enhancing drugs and much more, become relevant to any claim of creativity and hence ownership. Thus, the extended mind thesis opens up new options for claiming ownership in the context of IP laws. In an era of cognitive capitalism such arguments merely ensure enhanced inequality as ownership is concentrated even further by those owning the contemporary means of production [12].

If indeed individuals owe some amount of epistemic credit to the extended cognitive and social structures that make their knowledge possible, we might want to be more cautious about who, what, and how patents over neurotechnology are granted. Between 2010 and 2014 neurotechnology patents rose dramatically, from 800 in 2010 to 1600 in 2014 with the biggest patent awardee being the consumer-research company Nielsen [33]. Nielsen and other advertising companies are preparing to dominate in a neurotechnological age where they can control (via patent ownership), “ways to detect brain activity with EEG and translate it into what someone truly thinks about, say, a new product, advertising, or packaging [33]. Other companies are also patenting neurotechnological innovations. Microsoft, for example, holds patents “that assess mental states, with the goal of determining the most effective way to present information. If software knows a user’s attention is wandering, it could hold back complicated material” [33]. Or consider Microsoft’s patent that “describes a neurosystem that claims to discern whether a computer user is amenable to receiving advertisements” [33].

In each case, the symbiosis between a technological device and the individual human brain is clear. As part of an extended mind, an individual using such software becomes part of Microsoft’s or Nielsen’s neurosocial order. If Microsoft controls how you access and view information based upon feedback from your brain, but does so in a way that further enhances your ability to think and produce, what portion of that productive product can they claim? Take for example, the use of the AI algorithm GPT-2 that a business graduate student used to write his term papers. He contributed an outline and a few sentences and the algorithm did the rest [34]. It only takes a few additional sentences in the end user licensing agreement to assert copyright control over the final product produced with the help of next generation technology tools that do most of the cognitive work for its human user. While the graduate student using GPT-2 indicated the quality was merely adequate to get a passing grade, it is only a matter of time before quality improves. In fact, the newer version of GPT-2, GPT-3 was recently given a byline in *The Guardian* for writing an essay on why we should not fear AI, an essay where the human contribution was a few sentences with the AI writing the rest [35].

Brain scientists are now able to view images a human mind is creating, tapping directly into the brain to do so [36]. Scientists can view movies the subject has already seen and these scientists believe this technology “paves the way for reproducing the movies inside our heads that no one else sees, such as dreams and memories” [37]. If scientists can pull from our brains internal thoughts and memories, how might we construct ownership over the resulting images? So, for example, in a profit-oriented technologically driven world, what stops an enterprising company from harvesting these thoughts and memories for future creative work owned and produced by them? Imagine a company using the work made for hire doctrine to tap into its employee’s minds to mine for creative works.

In yet another possible scenario, scientists have now successfully established brain-to-brain communication using the Internet, both with a human/rat interface (where the human was able to move the rat’s tail) and a human/human interface [38]. A recent effort at collaborative problem solving using networked brains is “Brain Net” [3]. While still more science fiction than science fact, research is being done to establish neural communication possibilities that further integrate the human mind with

future nano-based technologies [39]. What happens when we do not modulate our IP laws but IP is literally streaming through our heads via the neuronet of the future? Such a world takes the concept of piracy to an entirely new level.

When viewing the extended mind produced by technological enhancements to the mind, we are posing questions about what the future looks like with only minor adaptations to how we conceptualize ownership of IP. The groundwork is already set because while ostensibly built upon the romantic author, the individual has almost always been required to give up control of IP to the corporations that produce it. The insertion of enhanced extended mind technologies disrupts the barriers between human brains and the larger networks that inspire creativity and thus have the potential to further displace who owns creativity. In doing so a gap is opened where the companies that already benefit from ownership of IP will be set to further monopolize creative property of the future.

#### 4. The Neurochemical Brain

In 1781 Immanuel Kant published what is still the most robust philosophical description of what constitutes consciousness as an autonomous and unique capacity of the human species [40]. That there is knowledge from an inner world that is not merely contingent upon sensation is one of the most sacred conceptions of what it is to be human. Creativity, or the labor of creating new ideas, is conceptually dependent upon the philosophical foundation that the human mind is somehow above, or at least separated from, the matter that is its substrate for action, the brain, and its substrate for provocation—external reality [41]. The mind, for Kant, was categorically different from the brain and the seat of human freedom, creation, and intellectual capacity. To use phrases such as “intangible property”, or so-called “creations of the mind” is to invoke a Kantian proposition widely accepted since the end of the 18th century.

In establishing the mind as another world from material experience, both the creator and the substance of IP is invented. In no other economic era could Kant be as significant as to the era of today’s idea economy. What others have called cognitive capitalism is organized by the ability to monetize brands, ideas, processes, and even origins as protected assets [12]. In a world in which companies are often worth more before they exist than after, the realm of ideas, of mind, is essential [42].

However, the grounds on which Kant made his claims for a representational mind are quickly eroding in an era in which brain-to-brain emails have been sent without the use of language or meaning making [43]. The distinctions philosophers often make between states of mind and brain states seems less and less cogent after decades of psychopharmaceutical use as well as increasing research into the application and significance of psychotropics once thought recreational such as LSD and MDMA [44]. Chemical interventions into the brain combined with more refined research on electrical stimulation, such as deep brain stimulation used to treat severe depression, suggests that what we understand as the mind is plastic and malleable. Furthermore, the notion of self which we correlate to mind is not under its own dominion but can be altered as well as steered by means we would not think of as within the Kantian understanding of consciousness, meaning that the self is not changed through rational means of persuasion or self-discovery but through altering the very condition of possibility for consciousness itself [45]. To invoke the work of Catherine Malabou, the brain is plastic, it is an organ capable simultaneously of being altered and altering itself [46]. In fact, according to Malabou, it is precisely this torsion between being formative and formable rather than either independent or determined which allows for education, agency, and creation to coexist in the human brain such that something like intelligence can emerge [47].

In this section we will describe changes in the technological capabilities being made possible from the image of a plastic chemo-electric brain where the human self is reachable by means far outside the bounds of reason. The speculative extrapolations emanating from this type of contemporary research, we believe, demonstrates how the current conception of legal individuals on which property rights, particularly intellectual property rights rest, may come under significant stress as the individual comes

to appear much less singular and much less independent, not only from their external environment—the extended mind—but even from their internal environment—the realm of serotonin and neurons.

In June of 2019, Vetere, Tran, Moberg, et al., published “Memory Formation in the Absence of Experience” in the pages of *Nature* claiming that they had determined a means by which memories could be created in mice sufficiently complex to guide the future behavior of the mice. That is, the mice could remember experiences that they had not had, which then, upon the replication of the memory in the amygdala, created aversion or attraction to things the mice had not previously encountered. In the words of the researchers, “given this current level of understanding about how memories are localized and coded in the brain, it should be possible to reverse engineer this process and artificially implant a memory for an otherwise never experienced event” [48]. The process involves a combination of olfactory and electrical stimulation to coordinate the production of a neuronal pathway which can be recreated in the presence of a future encounter. Unlike the behavioral conditioning of Pavlov or Skinner, the mice in this study were being trained without the trial and error experience that would be either rewarded or punished. Mice in this experiment were being steered toward a future that did not depend on a present they had experienced. Or, to put it another way, the mice were learning from mistakes they have not yet made.

In the immediate aftermath of the announcement, ethical questions emerged about what this research meant for the future of humans. Neuroscientist Robert Martone penned an editorial for *Scientific American* suffused with dystopian peril and gloomy prospects for human accountability and the possible uses of these techniques by military agencies such as the infamous Defense Advanced Research Projects Agency [49]. The concern of Martone and others focused on the ways memories might be removed, particularly in the context of war, such that war crimes could be wiped from the brains of the soldiers that had committed them.

Certainly, the veracity of one’s own memory plays a significant part in one’s sense of responsibility. One can hardly feel guilt or remorse for something one has no memory of having committed. However, the moral panic over a world of malleable memories misses, we believe, the significance of this research on at least two counts. First, the emphasis on “deleting” memories is somewhat misguided. While it is true that the research discussed helps confirm theories about how memories are encoded and stored, which may be used someday for developing means of targeting memories, the techniques used in this study only work to create not destroy memories.

Second, there are many other ways to impede or destroy memories. Many methods of destroying memories are in fact natural to the body’s own mechanisms for protection. Trauma often induces the brain-body network to suppress memories or create false memories to help an individual avoid ones that might impede the ability to survive. There are also artificial means by which memory formation can be undermined, such as using beta blockers or other adrenaline suppressing drugs to alter how memories are formed and stored. Either internal physiological response or external interventions that already exist can significantly alter the capacity and accuracy of recall in ways that regularly undermine, for instance, the capacity of an individual to serve as a compelling witness in a tribunal or court room.

The ability to create memories seems very different from these concerns. If the concern over deleting memories is that one loses part of who they are, i.e., that you are what you have experienced, then the addition of memories could create opportunity for more agency or more freedom through the capacity to consider options and draw on knowledge you would not have otherwise had from direct experience. Of course, this assumes all knowledge is generative rather than constructive. One can imagine the crushing guilt created from the belief of having committed a heinous act you did not believe yourself capable of (and in this case perhaps were not capable of). However, such a false or additional memory does not diminish your faculties of remorse or responsibility as much as it misdirects them.

What is novel both philosophically and legally about Vetere, Tran, Moberg, et al.’s research is almost the opposite. It is not the erasing of a past but the creation of a different future at stake.

The creation of embodied memories without previous experience is a horizon of possibility for education that is simply unprecedented. Humans, with their capacity for scenario planning, that is the possibility of simulating the future in our conscious minds, certainly learn without direct experience of the things they are learning. We have the capacity to gain knowledge through the experience of reading, listening, or watching. Many academics even become experts in things for which they have no direct experience. The bedrock of the study of history, for example, is creating knowledge about events for which there is no possibility of direct experience.

However, it only takes one attempt to build a piece of Ikea furniture to determine that having read and observed the visual instructions is in no way tantamount to building the furniture. The observation of a basketball game tells you little of what it feels like to take a jump shot, much less prepare you to accomplish this act successfully. Similarly, the rapid reaction time of aversion and attraction dealt with among mice is not something likely to be gained without experience. Descriptions of hot stoves are rarely sufficient to prevent young children from touching them, certainly not to the extent of an actual burn.

What is important is that Vetere, Tran, Moberg, et al. present us with a very specific model of a chemo-electric brain that is programmable. Brain states can be stimulated, stored, and remembered through direct chemical and electrical influence bypassing the normal sensory inputs we associate with awareness and the conscious and unconscious sorting of that sensory data into something that goes as meaningful decision-making. While aversion programming in a mouse is potentially a long way from implanting a memory, not to mention an entire education, it does raise significant questions about how one would think about the legal status of implanted memories and, importantly for this article, the ownership of the results.

In the rest of this section we will discuss the significance of a potentially programmable chemo-electric brain. We are not arguing that we should infer from current research that all behavior can be directed—what used to be called mind control. Instead, what is at stake is how an experiential brain can be modified externally and artificially and what the ramifications of that capacity are for how we think of the creation and ownership of knowledge.

At some basic level we do not think of the use of knowledge gained from a high school textbook as plagiarism or theft because of how we understand the role of the learner, the individual reading the textbook, in the process of interpreting, altering, and reusing the information in question. If a major textbook publisher sued a teacher for teaching the quadratic equation the way they had learned it from a specific textbook, we would think the suit ridiculous. One could dismiss this example on the basis that quadratic equations are general knowledge. However, if the teacher were to photocopy the textbook and distribute the photocopied text to the students, the legal grounds for suit would be much different.

We presume in questions of intellectual property and copyright a kind of transmission variability in the processes of learning and doing as well as a kind of discrete and independent individual who does the creating or learning. However, what if the knowledge at hand was transmitted directly into the brain? The intellectual property or proprietary textbook was not learned but directly implanted. Recall and use would not be like accessing one's own knowledge but accessing someone else's. Would we expect the "user" to pay royalties? If what was implanted had not been authorized for sale or use would we think it was a reasonable remedy to remove knowledge from someone's brain?

To think about this in a context somewhat outside the sci-fi present confronting us, many early theories of property, such as those presented by John Locke, presumed that property was acquired through labor. Accumulation of land, for instance, for Locke came from the mixing of land with one's labor [50]. Developing or cultivating the land was the grounds for claiming it and disputing the claims of others. Beyond the ways in which this theory of property was leveraged and even designed to displace Native Americans who were thought to merely reside on the land rather than cultivate it, the western tradition of property is always indebted to a sense of labor. That labor is inherent in its congealed form as money, as well as in the exchanged form of a contract when one sells one's labor to

an employer, or in the making of something as in the case of craft or invention. At the heart of the concept of property is the individual's labor in acquiring or creating the property in question.

In the case of implanted memories one can imagine quite easily that the people receiving the memories would be thought of as consumers or users rather than producers or laborers. Imagine being required by a job to undergo job training which was implanted. The specific procedures or techniques needed to perform the job would be added to one's brain. Maybe these procedures are proprietary, highly specific industrial processes which are closely guarded and legally protected. If you were to leave the company would you be required to "give them back" or have them removed in some way? If you invented something at home, during your off hours, would you find yourself in litigation to determine if the invention had made use of the proprietary memories that belonged to your employer? How much would you need to demonstrate you had altered or recombined the proprietary memories with new knowledge or individually unique insight before the court would accept that your invention was yours?

In October 2020, Moreaux, Yatsenko, and Sacher, et al., proposed what they called a "new paradigm" for brain imaging [51]. Unlike the clunky and often disputed significance of functional magnetic resonance imaging scans (fMRI), Moreaux and his team proposed the implantation of neurophotronics deep in the brain which would be capable of recording neuronal activity at the scale of the single cell and in real time. The new paradigm they speak of is one in which the implants would be capable of recording and mapping every brain cell's activity continuously. Combining the increasing knowledge of how memories are formed and stored, as well as the ability to read those memories, could lead to a legible mind. These would be brains that could be read and monitored without the clumsy use of communication, much less language to mediate between brains.

If technology matures that can record and map memories at their inception as well as their external or extended mind origins, what becomes of concepts of creation and ownership? In what ways will companies make claims upon their employees in a commercial environment that has already normalized extensive surveillance of their employees. Imagine current efforts to prohibit memory sticks from coming and going at secure facilities like the NSA becoming even more invasive. Is it possible to imagine ideas you are only allowed to have in your brain at work? Or that as long as they were in your brain you were, legally speaking, always at work?

In more concrete terms, if neural mapping reaches the ability to lift the black box from the generation, as well as application, of ideas, and humans are able to map and monitor in real time "where" ideas come from, what is left of the concept of originality? Following Ashby, every act of creation must be a form of neurocognitive mimicry as the "environment" is our "dictionary" [52]. Will every new expression ostensibly created originally by a unique human mind in reality be yet another nonoriginal remix [53]? Imagine a neural map of Jimmy Page playing Led Zeppelin's "Since I've Been Loving You." Every lick from every measure echoes and recombines what are likely thousands of memories of blues standards heard played and replayed by any number of other musicians. With the capacity to track and even tag the neurological structure of every combination of notes, stripping out all that is not original, what would it be that Led Zeppelin would claim as its own? Ironically, Led Zeppelin has recently settled with the families of blues musicians that were able to demonstrate in court that there was intellectual theft [54]. Irrespective of what kind of practical legal regime emerges amidst such technologies, what is certain is that the "intangible" and "incorporeal" will be shown to have been technical not metaphysical problems. Brain scans will become evidence of nonoriginality.

Consider the legal dispute between Bruce Springsteen and the Donald Trump re-election campaign over the use of the song "Born in the USA" [55]. Could an artist demand the return of the ability to perform songs based on moral turpitude clauses where the licensed musician who used the memories of how to play "Born in the USA" was caught on video making racist remarks or sexist remarks? What theory of property could account for such possibilities? As Grove has written previously:

One can already imagine the intellectual property (IP) disputes between the next generation of Steve Jobs and Bill Gates when the ideas in question were created via linked brain

communities or research being done on a wireless neural net. How ideas, concepts, processes, and techniques of all kinds will be recorded and tracked or altered in such a world boggles the mind but will no doubt play a significant role in politics, military affairs, and the economy. As philosophically specious as the creator or inventor myth is, innovation in brain research will materially alter debates around freedom and personhood in ways that mere argument simply could not [45].

Our common conceptions of creativity are inherited from notions of consciousness that presume the mind to be a substance or world apart from the brute mechanics of metabolism and bodily process. Even those of us who have given up on a notion of the soul or think ourselves firmly in the brain rather than mind camp still trade on metaphors to describe human distinctiveness that are indebted to dualist understandings of mind as distinctive. Our property regimes are dependent on these metaphors for conceiving of the individual as well as the creative labor we imbue with individuality and vice-versa.

In such a brave new world it would not just be inventors but companies as well that would make claim to anything in the realm of knowledge as proprietary. A race to hoard ideas could ensue depending on how new property regimes emerged to adjudicate conflicts. Would we see the use of machine intelligence to attempt to generate all possible ideas in advance in an attempt to gain legal protection before it was determined that a particular idea had merit? If this sounds absurd, this is precisely what Noah Rubin and Damien Riehl attempted in 2020 when they designed a platform to generate and record all 68 billion possible melodies in 12 tone Western music, though they fortunately donated the results to Creative Commons [56]. Similar things have been attempted in genetic coding, though the impracticality of sorting and determining the application of such randomized codes has proved an obstacle. However, such obstacles may be solved as machine learning advances.

What is at least worth considering, depending on the maturation of already existing technologies, is that the model of the individual on which property regimes, particularly intellectual property regimes are based, will come under significant strain as well as produce novel grounds for dispute and regulation. Many of these disputes and regulation will cut to the core of the most intimate regions of our bodies and the grounds on which we currently understand our conceptions of self and individuality. Science ought not steer our political choices. Perhaps the notion of an autonomous individual should remain intact in the face of corporate-backed technological networks that would claim all innovation as their own. Legal individuals are always somewhat pragmatic and fictive. However, the appearance of connection to the world of experience is essential for the legitimacy of pragmatic fictions and as that world changes the grounds for legitimacy will also change.

## 5. Conclusions and the Futures of IP

We tend to think of ourselves as whole, intact, coherent bodies. However, the perception of inhabiting and being in a body in space arises from a complex performance of constant feedback mechanisms grounded in our nervous system. Maybe the most remarkable thing about this feeling of self-representation in a body is how universal and robust it feels, but at the same time how easy it is to subvert. Ramachandran's famous work on "phantom limb syndrome", where a person with an amputated limb can still feel sensations, often unpleasant from that nonexistent limb, demonstrated some of the previously unknown or poorly understood processes for the subjective experience of embodiment [57]. Alternately, those with neurological damage that impairs their ability to link sensory data with emotional responses can feel disconnected from their own "intact" body parts, often assigning notions of possession or remote control by sinister forces to the movement of their own limbs [58].

So, the mind (if it exists beyond the material brain) and body are locked in an intimate dance, with certain missteps causing major impacts on self-perception and feelings of embodiment. These tightly coupled feedback loops are also happening with other entities in the body, including the trillions of human and nonhuman cells executing their code inside of us—or more accurately, executing codes that turn physical matter into us. Uncovering these previously hidden communicative channels, perceptual pathways, and assembling machines has drastically altered the way we understand the

boundaries of the body, the relationship of mind to body, and our own sense of human identity. This understanding has had other effects as well, which are currently being manipulated for fun and profit.

The neuropolitical subjectivities emerging from new understandings of the brain-body relationship and the technologies that leverage this new knowledge fit uncomfortably within the current system of IP. A productive approach might be to embrace the noisiness and contingency of embodied cognition and build IP law and policy from these foundations rather than the simpler but ultimately misplaced notions of bounded individuality and mind-body independence. What we know about the embodied brain decenters our notion of individuality. However, there is a threat of decentering the human brain when that brain is situated within the contemporary political economy of cognitive capitalism.

A paradox of the neurocentric age as it interacts with IP is that while we may undermine the legitimacy of the individual as the location for creativity, contemporary legal structures have no problem assigning ownership to the already existing entities that control the vast majority of IP. The scaffolding is already in place to enhance nonindividualized ownership and control over creative work. Take as an example the proliferation over the last generation of noncompete agreements and the requirement that workers assign their IP over to their employer as a condition of employment, even if created on their own time. The neurocentric turn will simply push this ownership beyond the body/brain boundary more easily. Imagine the contracts of the future when employees are much more integrated into the technologies of their corporations and when mental processing can be farmed and appropriated more easily.

The military has already invested heavily in brain-related science. While research into how to cancel memories and subvert the impact of traumatizing experiences may be helpful to those with PTSD, other memory enhancement efforts are designed to control and recall memories for better military applications [59]. Imagine a world where the military owns not just your body but your memories as well [60]. Of course, technically, such memories already and inevitably fall under the category of classified and thus there is no need to resort to claims of IP for protection.

The implications emerging from this field of study may alter our understanding of what it means to be human and pave the way for our further integration into a technological future of human enhancement. The increasing sophistication of computers either integrated or stand-alone also raise questions about how we might draw lines around creativity in the future. In the final instance, the law is more a reflection of power and interest than “reality”. However, advances in brain science both enable new fictions and disrupt old ones, creating new opportunities for profit and power.

The futures we paint by focusing on human cognition and its enhancement via technology are not optimistic, in part because while the evidence suggests we are not autonomous individuals and our systems of IP have been built upon this faulty assumption, the alternative to individual autonomy allows for corporate ownership of creativity that is particularly disturbing. Furthermore, the technical revolution taking place in tandem to these shifting images of the brain will accelerate the pace of change and raise the stakes of inaction. All possible neurofutures represent a fundamental disruption to how we understand IP that exceeds the consequences to copyright ownership caused by digitalization and file sharing. If file sharing and digital copying let loose new modes of distribution and heightened calls of piracy and ownership, then the possibility of our neurofutures represent a revolution in the mode of production of ideas themselves. Any number of questions along these lines can and should be asked.

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