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Problematizing the "Natural": The Internal/external Distinction and Technology

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Abstract

Nanotechnology, human cloning, and genetically-modified foods are issues which raise profound ethical questions. Any technology which appears to be so unnatural that it falls outside the bounds of what humans ought to explore usually leads to the charge that scientists are dangerously "playing God" with "unnatural" investigations. But making sense of such concerns and discerning what it means for a technology to be "unnatural" turns out to be quite difficult. This essay will explore possible commonalities in worries about the "natural/ unnatural" and the "internal/external" distinctions, and see if either distinction can bear the moral weight often placed upon them.

Keywords: internal/external enhancement, ethics, genetics

Introduction

An oft-heard complaint in technology ethics is that the technology in question – whether nanotechnology or human cloning or genetically-modified foods – is so unnatural that it falls outside the bounds of what humans ought to explore or, at least, raises profound ethical questions. This type of complaint usually falls under the familiar charge that scientists are dangerously "playing God" with such "unnatural" investigations (1). But making sense of such moral worries (indeed, even carefully delineating what it means for a technology to be "unnatural") turns out to be quite difficult.

A related issue is the moral weight often attributed to the "internal/external" distinction, particularly as regards human enhancements; technologies that are seen as morally unproblematic when external to the body (say, a smartphone with internet access) are seen as morally problematic when they become an enhancement internal to the body – say, if that smartphone becomes a brain-machine interface that turns the wearer into a cyborg, with the human mind having direct internet connectivity. But why should a smartphone outside your ear be morally different from one inside?

The moral intuitions behind worries based on these two distinctions may be connected; after all, the morally unproblematic smartphone is both external to our body and artificial, whereas we are used to thinking of morally "natural" things being internal to the body; our moral intuitions often make us wary only when there is a conflict in the correlation – such as an artificial technology internal to the body. So, moral qualms often seem to arise from an object or situation that raises a conflict between the "correct" sides or correlations of these two distinctions.

This essay, then, will explore possible commonalities in worries about the "natural/ unnatural" and the "internal/external" distinctions, and see if either distinction can bear the moral weight often placed upon them. I will conclude with a look at some implications that will result from problematizing these distinctions and their ethical import for enhancement and other future ethical debates.

But I begin with a recent court case in which the "natural/artificial" distinction, along with the "internal-external" distinction, was tremendously important: should we patent genes?

Patenting genes and cDNA: the failure of the natural-artificial distinction for debates about molecular biology

In a 2013 US Supreme Court (USSC) decision (*Association for Molecular Pathology et al. v. Myriad Genetics, Inc., et al.*), the Supreme Court ruled against Myriad Genetics and their patent on the BRCA1 gene, used in tests to detect a propensity to develop breast cancer (2). In explaining and attempting to justify their decision, the USSC made clear that the natural-artificial distinction remains important in the law; the Court ruled that artificial genes, the product of technology, can be patented, but not natural genes. The Court held that BRCA1 is a "natural" gene, and so its patent was overturned; but the Court's interpretation means that the law still allows artificial (= not naturally occurring) genes to be patented.

To understand the 2013 decision, a brief history of the import of the "natural-artificial" distinction in the context of patenting life is in order. In *Parke-Davis v. Mulford & Company*, 189 Fed. 95 (1911), Judge Learned Hand concluded that an "isolated and purified" form of adrenalin deviated greatly from the substance in its *natural* form; that novelty made the substance patentable. That is, the purified substance did not occur *naturally*, and "unexpected or extraordinary results" accrued when it was isolated and purified (3). So the test of *naturalness* versus the mechanical means of "isolation and purification" became a key criterion for determining patentable substances.

In the case of *Diamond v. Chakrabarthy*, 447 US 303 (1980), the USSC overturned the Patent Office's refusal to allow a patent on a new bacterium, created by Chakrabarthy to "eat" hydrocarbons (3). The Court held that while "laws of nature… are not patentable, respondent's claim is not to a hitherto unknown natural phenomenon, but to a nonnaturally occurring manufacture or composition of matter--a product of human ingenuity…" (3). So in this decision, the USSC further enshrined the "natural-artificial" (or "natural-unnatural") distinction into patent law. The Court thereby opened the door to the patenting of genes; by December 1980 the USPTO granted Stanford and UCSF the first 3 patents on genes. Later on, the courts would recognize patents on life up to the complexity of the "oncomouse" known as the "Harvard mouse" (4), all based on the idea that such life forms were "a unique form not found in Nature" (5).

In the recent *Myriad* decision, the Court again attempts to ground their findings against the gene patent on a "natural-unnatural" distinction; to do so, the decision has the justices attempt to do biology. In particular, an opening section of the ruling explains the "central dogma" of molecular biology, focusing on which reactions in protein production are (or are not) done "naturally." But the judges' understanding of the implications of the central dogma is faulty. To explain their mistake and its relevance to the "natural-artificial" distinction, we first need to review some basics of molecular biology.

The central dogma holds that the process by which information in DNA is converted into proteins includes two fundamental steps: transcription and translation. In eukaryotes (such as humans and other animals) transcription involves DNA being transcribed by RNA polymerase, which generates a substance called precursor messenger RNA. At the next step, the "junk", termed the "intervening regions" or "introns", must be spliced away, leaving the good stuff (termed "expressing regions" or "exons") to be linked together to form mature messenger RNA, or mRNA. This mRNA is what leads the genetic machinery to produce the eventual desired result, functional proteins. The introns, in this dogma, are unimportant sequences whose only function is to be removed from an unspliced precursor RNA in order to generate the functional mRNA.

To understand the issue, one must know that, unlike eukaryotes, single celled prokaryotes (including bacteria) do not contain introns in their cellular DNA, and so cannot form messenger RNA. Their translation and transcription procedure is simpler, but that missing step means eukaryotic DNA cannot be cloned directly into prokaryotic cells in order to make eukaryotic DNA. But for practical and ethical reasons the synthesis of human genes is not done within humans, and so molecular biologists make human and other animal genes within bacteria routinely. How can they?

The old (1990s) answer is a process called "reverse transcription". First, the mature eukaryotic mRNA must be isolated and used to make DNA that contains no introns. An enzyme, reverse transcriptase, is then used to convert

this isolated eukaryotic mRNA into full double-stranded DNA. The term for such cleaned-up, exon-only DNA is "complementary DNA" or "cDNA" (6).

So in reverse transcription, the genetic information for the animal's functional proteins contained in the RNA is converted back into a DNA form, but missing all the original introns. The resulting cDNA can then be cloned into a prokaryotic (bacterial) cell; the genes cloned as cDNA can then be transcribed and translated by the bacterial cell machinery to make many, many copies, without the eukaryotic need for mRNA.

This method, once *de rigueur* for molecular biology, is still used, but is no longer required for artificially creating a gene – that is, a DNA sequence. The rise of synthetic biology and total gene synthesis and the advances by companies such as Blue Heron mean that scientists can now create suitable bespoke DNA without bothering with reverse transcription; all one has to do is send a gene synthesis company the exact sequence desired, and by cloning, chemical unraveling, or other techniques (still including reverse transcription) they can create an identical stretch of base pairs – that is, a gene (7). All that really matters is the information content of the DNA that codes for the functional proteins – the exact same information carried by the artificially manufactured cDNA.

But, one may ask, if one can patent cDNA, then why wouldn't a patent on the relevant (intron-free) cDNA be ruled to cover any such artificially produced intron-included DNA? That is, for the courts, is the key consideration that the DNA sequence was produced "artificially", or is the key that the result is a stretch of DNA identical to a "naturally occurring" gene? In other words, if cDNA can be patented, why not regular (intron-included) DNA, whether it was produced synthetically or naturally? After all, if for some reason it was desired, one could use these techniques to add the introns back to cDNA to produce DNA identical to that found "naturally" within a body. In general, patent law allows further business modifications to existing patents to also be patented… but would this hold even if the end result of the manufacturing process is identical to a "natural" part of a living organism?

The USSC was apparently oblivious to such considerations in its decision. So, the "natural-artificial" (or, more precisely in this case, "naturally occurring" versus "isolated, purified, and manufactured") distinction was used by the USSC to rule that cDNA is patentable because it is not naturally present within human cells – and hence not "natural" – whereas "natural" DNA cannot be patented. The court explicitly ruled that existing cDNA patents (mostly from the 1990s) do not violate Section 101 of the Patent Act (though they "express no opinion whether cDNA satisfies the other statutory requirements of patentability"). But for the reasons just sketched, companies can now synthesize a DNA strand – a gene – identical to "natural" DNA without using cDNA. Can the end result be patented or not? The court ruling that cDNA can be patented while natural DNA misses the point. The focus on cDNA is particularly frustrating for contemporary synthetic biologists because the difference between cDNA and natural DNA is now considered a purely technical matter.

Patenting genes and cDNA: the failure of the internal-external distinction for molecular biology

If the natural-artificial distinction remains untenable for securing moral and legal distinctions in gene patenting, then perhaps future ethicists and jurists can turn to another one: the distinction between an external tool or technology and an internal one (8). As noted, an Internet-enabled smartphone is considered a mere tool, because it is external to our bodies; it can be stuffed in one's back pocket or a purse, but swallowing it would make it hard to use! That is, its normal functioning requires it being external to (though in close proximity to) the body.

Imagine, however, a near future in which technical advances enable a wireless internet-accessible computer chip to be implanted in one's head – one that that delivers the same capabilities as a current smartphone. The fact that this device would be internal to one's body seems to many to make a significant difference, in that it delivers "always-on" or unprecedented access to the tool—and competitive advantage from its benefits – as compared to using it as an external device (8,9). Many people believe that such internal technical enhancements are morally problematic in a way that technologies that serve as merely external enhancements are not.

So, a common moral intuition supports the importance (in at least some contexts) of an internal-external distinction. So, does the distinction have moral import as regards DNA, cDNA, and patenting genes? It is true that "natural" genes are found within bodies, whereas artificial or synthetic genes are usually produced external to human bodies (but commonly internal to another organism, a bacterium) – but this difference is a matter of convenience and other bioethical concerns (concerning human

experimentation), not necessity. There exists a consensus on many bioethical strictures for patient protection, such as the Common Rule from the Belmont Report, that limits or prohibits many types of human experimentation (10,11); these strictures indicate that creating new genes by experimentation *within* human subjects, while certainly possible, remains ethically problematic at best, even with fully informed consent.

Does this support the moral importance of the internal-external distinction for patenting genes? Not really. Human experimentation is not required for genetic research and applications to advance: there is work on stem cells and "embryoids" (12), as well as numerous human and bacterial experiments, that indicate creating genes internal to an organism – in the case of embryoids, even organisms with human DNA – is taken for granted by scientists, and that such research is not seen as morally problematic. Again, if what is morally important about genes is their information content, not how they are created, then logically the question of whether or not they are created internal to or external to an organism is (*ceteris paribus*) morally indifferent.

Hence, at least for genetic research, the internal-external distinction is likewise of no moral significance – a gene is but a coded sequence of the 4 bases of DNA/RNA, whether the information it codes for is created by evolution or by experiment, or whether it is found internal to a "natural" organism or located external to such organisms (e.g., in a petri dish, or even within a computer).

Accordingly, molecular biologists increasingly believe that the "natural-artificial" (or the "natural-synthetic") and the "internal-external" distinction between naturally occurring DNA and cDNA is scientifically and morally unimportant, even otiose. Whether or not it is naturally produced by bacteria (or humans), or artificially in a lab; and whether it is found inside a body, or in a bacterium, or an embryoid in a petri dish, a gene is just a type of coded information. James Watson, the famed co-discoverer of the structure of DNA, submitted an *amicus* brief to the court for the Myriad decision; in it he makes clear that the information content, not the method of production, is the real issue in patent disputes. His *amicus* brief uses the word "information" many times, but mentions cDNA not at all (13).

So, given the state of the art, cDNA is but a tool, and no longer even a necessary one, in gene synthesis. Hence, either allowing or barring its use or patentability is essentially arbitrary; if banned or restricted by patents from using a certain form of cDNA, biotech companies now have other tools that can accomplish the same ends. An informed perspective holds that the information content of the genes, not the method of their production or their "naturally occurring" or "internal" state, is what the patents should or should not cover (6).

So at least in molecular biology, the lines between the internal and external, and between what is "natural" and the unnatural (artificial?) are hazy at best; and even worse for policy, their moral and legal import has been obliterated, as focusing on these distinctions misleads as to the relevant point at issue in our contemporary disputes. Hence, moral and legal decisions, such as those by the USSC, that depend on such a "natural-artificial" or "internal-external" distinction and remain ignorant of the latest technology are a source of ridicule by the more knowledgeable, as well as a source of unjust advantage to those who would take the letter of the law and stretch it, perhaps to their own immoral ends.

Is either distinction ever morally important? Or, why bioethics is not a "natural" science

The foregoing discussion indicates that these distinctions are unhelpful at best in contemporary debates over patenting genes. Is there then *any* sense of the "natural-artificial" distinction that does make scientific and moral sense? Perhaps disentangling exactly what the distinction means will help; philosophy begins with conceptual analysis. Presumably the "natural" in this distinction at least refers to the subjects of the "natural sciences". Can we be more precise?

To do so requires some sort of demarcation criterion, some way of stating what "natural science" is and is not, in order to know to what the "natural" in natural science refers (14). One approach is to ask: to what does this "natural" contrast? Unnatural science? Supernatural science? Artificial science, perhaps like artificial sweetener? None of these quite capture the contrast. The Germans use the term *Geisteswissenschaften* (or "science of the spirit" – a spiritual science?) to contrast to *Naturwissenschaften*; whereas in America the natural (or "hard", a term with

sexual overtones, worthy perhaps of a feminist analysis) sciences are contrasted with the social (soft) sciences (15). The contrast seems to be between studying the "natural" world as it works free of human causal influence, versus studying the social world that humans have made.

Accordingly, I propose a different locution for understanding the "natural" in natural science, to represent a different philosophical approach: natural science should be understood as *non-teleological* science, versus the sciences that have as part of their proper explanations agent-based causal analysis; using this terminology would help us understand non-natural, "social" science as a kind of teleological science. In other words, social sciences incorporate (human) agency and purpose (a *telos*) in their proper explanations, whereas natural sciences are those which idealize and abstract away from any such agency or purpose in their proper explanations (14). (I do not wish to address here the important topic of whether other non-human creatures – whether on Earth or elsewhere – can exhibit agency and purpose-driven behavior, and so would be proper objects and subjects of non-natural science. I merely take for granted that many humans do.)

When this demarcation is further developed, it should become clear that moral and policy implications are built into teleological sciences very differently than in non-teleological ones. That is to say, sophisticated inquiry into morality and politics can be eschewed by non-teleological scientists without harm to their disciplinary expertise; to understand planetary formation in the early solar system, or the details of binding energy in chemical reactions, does not directly involve ethical expertise (14). The conceptual key is the absence of human agency as an explicit causal factor in their proper explanations.

But the same will not be true of teleological (social) scientists. They will find that the boundaries of their discipline will have to enlarge to include expertise in areas normally considered non-scientific; in particular, it will require a certain expertise and wisdom in moral philosophy. In the teleological sciences, the boundaries of philosophy of science, the science itself, and moral philosophy will overlap.

Hence, in the natural/non-teleological sciences, the natural/unnatural (social) distinction is best understood as a claim about the type of causation being studied and disciplinary boundaries: such sciences involve studying the world in an idealized way, free of human influences. Whenever human agency becomes a part of the causal story, the inquiry has crossed the boundary of non-teleological science, and hence has become a teleological science – or else, not a science at all (15). The implications for bioethics are straightforward: insofar as bioethics concerns how human agency and scientific research interact, then in the sense just explained, there will be nothing "natural" about it at all – and so the "natural-artificial" distinction is irrelevant to any and all vexed issues in bioethics.

These two distinctions are likewise problematic in the debates over the ethics of human enhancement. Understanding the implications of the distinction between "natural" and "non-natural" science in terms of human agent-causal influence will make clear why. To explicate this point further, the following section is adapted from my (and my co-authors') recent report entitled *Enhanced Warfighters: Risk, Ethics, and Policy* (9).

Application: Why the distinctions fail for the ethics of enhancement

What is human enhancement? Any set of necessary and sufficient conditions that is meant to define the concept instantly takes us down difficult philosophical conundra, involving whether the enhancement versus therapy distinction is meant to be relative to species or to individual norms; and whether or not one's genetic inheritance alone should define the norm, or whether (a) typical environmental factors can affect what is considered enhancement, and so forth. Such vexed considerations help convey why a definition of enhancement has been so elusive, and also why some commentators deny that a single satisfactory definition can be found. To seriously consider the possibility that some enhancements raise novel ethical issues, though, let us assume that we can define enhancement, even if imperfectly, before we abandon hope for such a project. As I identify a few points of contention, they should help convey a sense of how difficult it is to nail down a definition of enhancement, and how the "internal-external" and "natural-artificial" distinctions do not help with the ethics of enhancement.

Suppose, as a first approximation of a distinction between enhancements and nonenhancements, we attempt to use the distinction between natural and unnatural (or artificial) (8, 16), even if it failed in our attempt to understand the ethics for patenting genes. Some support for using this natural-unnatural distinction to understand the difference

between enhancements and nonenhancements comes from certain aspects of our common word usage: medical treatments for the sick, moderate exercise, and typical modes of education (such as the "3 Rs") are often deemed "natural" activities, ones that have been species-typical throughout our recorded history. Insofar as ethicists who use the distinction presume that what is natural is good, these activities are not seen to be morally problematic. In contrast, amphetamines that would enable us to fly jets for 24 hours straight without sleep, or other drugs that would give us the endurance of Siberian huskies, or enable us to cycle faster than any previous human up a French mountain, all seemingly serve as enhancements that take us beyond "natural" limits of human functioning, and provide "unnatural" abilities. Certainly, at least some of the common public revulsion over the use of steroids and other PEDs in major league baseball also comes from the sense that the athletes are not content with developing their natural abilities, and instead resort to unnatural enhancements. In these senses, then, enhancements are unnatural, artificial aids, and what is unnatural should evoke at least caution and skepticism, if not outright moral censure – or so the distinction would seem to imply.

But never mind whether the natural-unnatural and enhancement-nonenhancement distinction can be both consistently correlated and morally relevant; the fact is, the natural-unnatural distinction, understood as above, collapses upon sustained reflection. In the sense adumbrated above, some trees and rocks are "natural", in that they exist independently of human agency or intervention, and an idealized science of them (such as botany or geology) could explain their causal roles and activities completely independently of any causal influences of humanity. It is also true that many if not all of the things we consider artificial (such as houses and computers) are non-natural in this sense, as their existence depends on human manipulation of materials.

But many things that common usage terms "natural" depend on external manipulation, such as a bird's nest or a beaver's dam. If we then retreat and stipulate that external manipulation means *only* human manipulation, then nothing created by – or even affected by – humans can be considered to be natural. Exercise, typical medical care, and education are all in fact thoroughly *unnatural* on such an understanding. In other words, using a natural-versus-artificial distinction does not get us closer to understanding what human enhancement is, according to common usage; everything affected by human agency – including all therapeutic medical interventions – would then be artificial and an enhancement. And whatever one thinks about the ethics of enhancement, this definition of enhancement is impossibly broad; the idea that education and exercise, cancer surgery and taking penicillin for an infection, are all *enhancements* is a farcical misuse of everyday terminology.

In the alternative, to the extent that humans arise from nature, there is a sense that everything we do is natural. But this conception suffers from the opposite problem of being too broad: then nothing we do can be artificial, and so this too does not move us closer to understanding enhancement through the natural-versus-artificial distinction. Where we consider mass education and high-tech exercise today to be natural, surely these would have been considered as unnatural at earlier times in human history, before the invention of smart classrooms, running-shoe technologies, and so on.

What, then, about the *external vs. internal* distinction? Could it be the key to understanding enhancements? The first problem: as previously discussed, we often consider "internal" technologies to also include tools that are closely integrated to one's body, since that too delivers an "always-on" connectivity that does not exist with external tools. Bionic limbs that deliver super-strength, for instance, are not internal to a body, strictly speaking, yet we may consider them to be enhancements; they are attached to a body and may become part of the person's identity. Military and civilian-use exoskeletons for now are mere tools, as they are bulky and cannot be easily worn for a long stretch of time; but if technological development allows them to become much more lightweight and unobtrusive, perhaps wearable like a shirt, then many people would want to declare them an enhancement.

Hence, the proximity of a device to the body (and resultant ease of use and "naturalness") may gradually create a difference in degree that becomes a difference in kind. Let me return to the discussion of external smartphones versus implanted chips. Compare a person who looks up information on Yahoo's search engine – on either a laptop or a mobile device – to another person who looks up the same information through a "Yahoo chip" implanted in their head. One would not say that the former is somehow smarter for reciting information they found online; at best, one might term them a good researcher. But note in the latter case, with a "Yahoo chip", the person may have functionally equivalent behavior – that is, also merely re-

gurgitating information found online — but the ability to do so at virtually any time, seamlessly, without detection by others, would make them appear more knowledgeable, a veritable savant with uncanny recollection of facts and even trivia (especially, say, when taking an exam in which no external aids are allowed).

Similarly, compare a person who uses Google Translate on their mobile device to communicate with the local population on their trip to a foreign land, versus a person with a Google translation chip implanted in their head. The former would be recognized by the natives merely as someone who knows how to use a computer; the latter, meanwhile, might well be taken as fluent in the foreign language, with whatever social advantages that would entail. In other words, when it comes to proximity of a technological aid to the user, the less visible the tool to outsiders, the better. Some ethicists thus attempt to defend the line between enhancement versus a mere tool in terms of internal versus external; and perhaps closely held or worn tools are "internal" enough, if the user is rarely without them.

But upon further reflection, this distinction too fails to capture crucial elements of the enhancement-therapy distinction required to make a moral difference. Take a dual-use technology that is internal-only: e.g., anabolic steroids taken by a muscular dystrophy patient, versus the same drug taken by a professional baseball player. Both are cases of a pharmacological intervention that is internal to the body, and the cases do not differ at all as regards the internal-external distinction. Yet we commonly term the first case therapy, and the latter an enhancement. Further, many critics strongly believe that the former case is morally uncontroversial whereas the latter is not; certainly, much of the public disdains such "PED" use by baseball players. Hence, the internal-external distinction also does not seem to account for any *prima facie* moral differences between enhancements and therapies.

Conclusion: two distinctions without a moral difference

Our survey of some of the ways the natural-artificial and internal-external distinctions have been used in bioethics indicate that the distinctions are either irremediably vague (and hence uninformative); or else, when they can be made clear, the distinction demarcates a divide that has little to no moral significance. Crucial moral issues in bioethics certainly exist; but understanding them in terms of entities being "natural" or "artificial", or as being internal to a human body versus being "external to" but connected to a body, fail to resolve these moral difficulties in any illuminating ways. Indeed, focusing on such distinctions often acts as a red herring in moral debate, drawing our attention away from the real moral issues in order to confuse us and our moral intuitions, formed against the history of old technology, when our background knowledge about what was biology and what was machine, or what was a natural, internal function versus what constituted an artificial, external tool was vastly different. Given "ought implies can", as our technology changes, new moral questions arise – as we *can* do more, new questions arise about whether (or not) we *ought* to. But remaining stuck with the assumptions formed when we could do *less* will only hamper our investigations about what we ought to do with our new abilities and new technologies. Astronomers may still use the words "sunrise" and "sunset", but they don't believe such pre-Copernican terminology has any remaining relevance for the proper conduct of their science. Likewise, it is time for applied ethicists to leave behind the natural-artificial and internal-external distinctions, as vestiges of an outmoded moral understanding.

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