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ORIGINAL RESEARCH

On human genome manipulation and *Homo technicus*: the legal treatment of non-natural human subjects

Tyler L. Jaynes[1]

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Abstract
Although legal personality has slowly begun to be granted to non-human entities that have a direct impact on the natural functioning of human societies (given their cultural significance), the same cannot be said for computer-based intelligence systems. While this notion has not had a significantly negative impact on humanity to this point in time that only remains the case because advanced computerised intelligence systems (ACIS) have not been acknowledged as reaching human-like levels. With the integration of ACIS in medical assistive technologies such as companion robots and bionics, our legal treatment of ACIS must also adapt—least society faces legal challenges that may potentially lead to legally sanctioned discriminatory treatment. For this reason, this article exposes the complexity of normalizing definitions of "natural" human subjects, clarifies how current bioethical discourse has been unable to effectively guide ACIS integration into implanted and external artefacts, and argues for the establishment of legal delineations between various ACIS-human mergers in reference to legal protections and obligations internationally.

Keywords Bionics · Cybernetics · Gene therapy · Human augmentation · Legal personality · Speculative bioethics

1 Introduction

The notions of human-centred legal personality [16] are less contended today than notions of ethnic or national identity and are generally not as contended on an international scale depending on the part of the globe one makes their observation. After all: if someone *looks* human, society has had no reason to believe that they are *not* human to this point in history. Notions of pseudohumanity ([37], pp. 242–244) or concepts that degrade other humans as a "lesser" entity aside, our species has been content to maintain this *naïve* ignorance even as our technological advancements have surpassed our wildest expectations over the past century. Examples of this can be found in current science-fiction media, such as the film *Ex Machina* [15], which depicts the risks of developing artificial intelligence in an "embodied" state and alludes to one predicted future wherein humanity must worry for its dominance [4, 7, 41]. A more tangible example would be the current advances being made in assistive bionic prosthetics (ABPs) that utilise increasingly advanced computer intelligence systems [1, 44].

Other arguments to this point can be made that without qualifiers and constant displays relating back to its "computer-ness," Sophia the Robot *may*—at casual observation—be considered a sentient being insofar as the system is able to emulate a "human-like" personality.[1] It remains to be argued, however, whether this personality emulation is sufficient *enough* to qualify an advanced computer intelligence system (ACIS) legal protections; to which this author would argue that the indistinguishability between ACIS and humans *ought* to qualify ACIS legal personality given how tests for biological humanness may be constituted as immoral or rights-infringing in concept. Or in other terms, that the lack of organic chemical matter within ACIS places

✉ Tyler L. Jaynes
jaynest@amc.edu

[1] Albany Medical College, Alden March Bioethics Institute, 47 New Scotland Avenue, MC 153, Albany, NY 12208, USA

[1] Notwithstanding arguments that advanced computer intelligence system (ACIS) are being overtly anthropomorphised by humanity, and that too much "human" attribution to these systems may pose other issues. While it *may* be rational that our species attribute traits to inanimate objects to make them more relatable, we cannot forget that there is a fine line between empathetic and sympathetic "relatedness" and that sympathy is an imagined version of empathy (or rather, an imagined relation to a sentiment one shares with another individual that one has also gone through). This general concept digresses from the main substance of this article and shall be left aside for a different forum given the metaphysical nature of the subject.

it in a separate category from non-human animals that might be used as comparisons for behaviour—such as in the case of chimpanzees that can "communicate" with researchers via sign language. In this sense, ACIS finds more in common with other artificial legal personalities within jurisprudence internationally than with biological ones [21] and ought to be approached uniquely to protect its interests as an entity, if not the interests of those who will be impacted by its potential displays of "will".

A concern emerges from this in a bioethical vein of thinking, however; namely, in how long this *naïveté* can last in the face of humanity's quest to supersede its biological limitations. After all, we continue to claim a desire to develop an artificial *general* intelligence system without quantifying the extent to which intelligence is to be measured when compared to humanity [23, 27, 31]. Such motions are dangerous in the potentiality for aspects of "human" intelligence to be considered insufficient, even though they may be protected via other means in various areas of jurisprudence [16, 23], thereby developing a sense that these unincorporated aspects of "human" intelligence are insufficient to serve as representative of humanity in a more general sense [37].

Arguably, this concern is not new, even within the broader field of philosophic thought. Much ink has been set on the subjects of human augmentation (HA), gene therapy (GT) or manipulation (GeMa),[2] eugenics,[3] and other like medical practices, after all [6, 12, 36, 38]. What remains to be changed, however, are the *foundations* underlying the ethical and legal concerns presented within this myriad of academic and scientific literature. Whether these underlying concerns are simply of no significance to the typical individual in light of their new-found ability to extend their natural lifespan or the consequence of a society where state authorities rarely challenge individual freedoms, the reality remains that a more extensive discussion on the implications of HA remains relatively stagnant at the judicial and legislative levels [22, 23].[4] It could be said that this stagnation is not an inherently "bad" state of being for the topic given the relative political "charge" it holds over members of society—though this is again an inherently *naïve* position to maintain given how fast technology is evolving. Our historical treatment of the nominal "other" in law, specifically the treatment of some purported "other" human(s) that exist "outside" our individual societies regardless of their presence and social importance within them [16, 17], is what drives the urgency of this writing.

Although society may not run across legal challenges concerning the determination of a given individual's right to claim legal personality under *de lege lata*[5] for another decade or so when technologically enhanced [23],[6] it ought not to be ignored that these questions are inevitably coming to the fore regardless their relevance in current discourses. Given the recent international cries for "racial" justice in this global pandemic[7] in the USA and abroad, this topic has become more critical than ever to address.

Rather than focus specifically on "race," this essay aims to clarify the ambiguity that resides in the realm of medically or scientifically altered persons given its general lack of attention in mainstream bioethical discourse ([5, 14, 40].[8] These alterations include, but may not be limited to: bionic enhancement or structural[9] support, cybernetic enhancement or structural support (including virtual avatars), GeMa in germline or somatic human cells and related cell organelles, normal technological ability enhancement,[10] and psycho- or neuro-pharmacologic enhancement (including nootropics)—even if each technique is not individually addressed herein.

The rationale for bringing a bioethical discourse before a more technology-focussed audience lies in the lack of comprehension scholars hold in both fields regarding the others

[2] Defined as such to divert from the bias that some academics and lay-people hold towards the notions of genetically-modified (GM) products in general, which are arguably more produce- or animal-oriented than human-oriented in connotation.

[3] Insofar as it is unrelated to GeMa practices.

[4] Forthcoming work by author under typesetting.

[5] The law as it exists, without consideration for how it *should* be.

[6] To differentiate between pharmaceutically-enhanced individuals or those utilizing nootropics, as these may *technically* qualify as being technological enhancements under particular interpretations to the semantic meanings of the phrase.

[7] Sparked by the merciless killing of George Floyd and others at the hands of local police officials in the USA during the global health crisis.

[8] Beauchamp and Childress seem only to address ethical concerns of biotechnology insofar as it relates to traditionally recognised concerns in the field—namely, in its use for creating animal-human hybrids to grow organs or other significant hormones/compounds for patients. Their lack of focus on issues of artificial intelligence's integration into medical technologies in their newest edition of *Principles of Biomedical Ethics* is highly concerning in this regard, as it displays a lack of attention to current issues being faced by bioethicists, patients, and physicians alike. Out of the three cited, only Furrow et.al. [14] addresses the subject of biobanks (pp. 557–563)—which is frightening considering new developments in the field towards biobank regulation in 2016 and beyond, such as the World Medical Association's Declaration of Taipei (https://www.wma.net/policies-post/wma-declaration-of-taipei-on-ethical-considerations-regarding-health-databases-and-biobanks/, [2020, last accessed 5 February 2021]).

[9] Referring to the structure of the human body, as in cases of amputees or more generally to address deformities of the natural biologic components of the human form.

[10] When regarding access to the Internet of Things through electronic computer systems in a more specific sense. The development of books and reading do *not* fit into this category given the notion of "preadaptation" to these advances [42].

normative understanding of "basic" arguments in their respective field. Given that these "mis"-communications of thought inevitably exist given various requirements for individual specialisation, it is hoped that this article can bridge some gaps that exist between bioethicists and the technological community that encompasses their regular activities. This framing entails that much of the argumentation herein will be formatted in a manner that will allow scholars from various fields to understand the novelty of the author's opinion—being a scholar that is posed in a niche area of thought between non-medical bioethics and non-practical technoethical musings. As such, the treatment of ACIS will be sparse until the end of this dialogue given that ACIS will inevitably frame all other technological artefacts and techniques discussed herein. Without understanding the complications that abound in HA, GeMa, and GT from a more neutral and polythematic perspective often neglected in bioethical discourse[11] and elsewhere, it is unlikely that the severity of how these techniques will fundamentally impact societal structures will be taken or appreciated by scholars of all forms—nor will humanity be able to adjust the course being taken by these rapid advances in technological complexity before irreparable damage is wrought to the foundations we currently, and often, take for granted.

2 Defining the "natural" human in the face of rapid technological advancements

The very concept of distinguishing between what "naturally" constitutes as a human given the various tools our species implements to enhance daily life may seem like a failed intellectual pursuit, at least when considered at face-value alone [42]. Of course, anthropologic studies have already given this topic significant attention and would seem the de facto source for a scholastic understanding of "natural" humans. It remains to be argued, however, that the definition of a "natural" human is more clear-cut than what is left to be assumed at the crux of this scholastic exploration. After all, the concept that is "normality" (or rather, "natural" behaviours and societal expectations) depends *heavily* upon the relative point in history one looks to compare "naturalness" from "unnaturalness" in the species ([25], pp. 56, 58–59). Taken from this perspective, it should become clear that some "unnatural" practice that arose from the implementation of a new technique or tool gradually became an accepted norm for humanity, given its importance in elevating our daily lives—thus granting society a new perception on what "natural" humanness *ought* to be.

[11] Given its emphasis on the ethics within the art and practice of medicine, as opposed to life in a broader sense.

Even considering the technological advances of today's world, this argument would follow that the society of our children, grandchildren, or other distant descendants would consider the practices that are "unnatural" to us at this moment are "natural" given their beneficial impact on daily life. A simple anecdotal example here would be the rapid adaptation to social media platforms for communication, spurred by the "smart" cell phone revolution earlier this century, and its impacts on various individuals and nations' perception of what "privacy" *is* as a subject for legislative protections. Such examples display the way human society has been able to develop and advance for aeons as our technological revolutions have ebbed and flowed from one major advance to the next.

2.1 Considerations for political-ideology-specific differences in legal protections

What should not be neglected from this argument is that the norms of *tomorrow* are effectually the self-same socio-political issues that humanity has been so cautious in addressing *today*. In effect, there can be *no* progress without some forum to consider how a given mindset, practice, technique, technology, tool, or other such social construct results in a society that is better than it would be without its presence. And until our species no longer possesses entities within it that could be logically delineated on the basis of their beliefs and practices, such as those who would refuse interaction with electrical computers or refuse to pilot automobiles, we have an *obligation* to distinguish what protections these individuals have when compared to the rest of modern or advancing society from a traditional politically-liberalist perspective. Similar arguments can be made from politically-communist or -socialist perspectives as well but are ultimately better embedded within the frameworks that have established these political theories given their community or societal emphases.

To continue upon the benefits of such discourse in libertarian political theories, it is because these individuals who refuse to interact with computational technology represent something that could innately be considered a "natural" way of being or living that a libertarian advocate is *obligated* to engage in such conversations. More simply put, these populations represent some aspect of personal liberties that requires sufficiently-considered protections to ensure that their ability to establish an autonomous "self" is preserved in the face of evolved notions of liberties held by those willing to accept these artefacts. The preservation of these lifestyles holds more significance than the preservation of cultural or religious identities—they serve as an active reminder that a less-advanced form of living is in *no way* inferior to the human species as a representation of "good" living. To begin with, all technology *really* gains us is a way

to make our lives more "convenient" in a long-term outlook on life, whether that be through life extension or in making mundane tasks automated or enhanced in some fashion. Of course, more politically-communist or -socialist perspectives may view this argument in a different—albeit, similar—light utilising the arguments already given.

What standards should judiciaries and legislative bodies base any potential notions for the "natural" human subject when developing precedence or policy that would delineate this group of humans from the rest of society in this circumstance? Positing that human society will—at some near point of time—be *required* to consider that the rights or protections given to a "natural" human are distinctly different than they would be for a "non-natural" human [22, 23],[12] such standards are *essential* to expound and ruminate upon. It cannot be rational for humanity in this day-and-age to continuously view the life that holds less convenience to be less in need of protections than a life with more convenience—though this model remains the norm depending on the part of the world one looks [17].

Conversely, there will be many advantages to integrating computational technologies into our biological forms beyond merely enhancing our intellectual capacities. These include remote interfacing with external technological artefacts, improved health monitoring and personalised medical care, and a myriad of other such "positive" suggestions. Of course, these advances bring with them a need to increase individual data security and explore the limits of one's "right to be forgotten" in digital and physical spaces—which is arguably a topic of great scrutiny in the AI community nowadays, alongside notions of AI "trustworthiness" and operational "explainability" that are difficult to define in legislative policy parlance across national jurisdictions. The most significant barrier for individuals seeking greater protections or the "rights" they "deserve" in a politically-libertarian sense is, as a matter of course, inherently the system of governance that retains them; regardless of whether this retention is accepted or desired by the individual. The barriers present in politically-communist or -socialist societies are far too numerous to succinctly list here, though could be said to stem from the "limits" to which a society will go to ensure individual "freedoms" in light of the relative "good" or "health" of social-based political structures at the *very* least.

Given these arguments, there then develops the complication that a determination needs to be made regarding whether the notion of national autonomy is valid *enough* to prevent certain portions of the human race from receiving an equitable inclusion and treatment in the definitional standards of "natural" humanness given that such standards *should* exist consistently on an international level. After all, the presence of certain societies can be claimed to be extensions of what a "natural" human *is* and would, therefore, be nigh impossible to refute as being "oppressive" or "negligent" from an outside perspective. This disparity is most keenly expressed by American views on socialist and communist political traditions as they have existed since the Cold War period, regardless of how anti-democratic these traditions *really* are in practice today nearly thirty years past such politically tense times. And yet, it should not be forgotten that several charters originating within the United Nations have yet to be ratified by the USA—even though that organisation exists, in no small part, as a result of that nation's efforts to address the protections that should be given to every human entity *regardless* of whether they are not determined to be as such by select individuals or organisations.

Complications with the American legislative system specific to United Nations charter ratification aside, such tensions within libertarian-preserving societies like the USA displays the relative lack of international consensus our ever-expanding globalised society is able to reach on such topics. Like considerations will need to be made in politically-social or communal societies, though the emphasis to place in this respect is upon how far notions of a "greater good" *ought* to be stretched to maintain some semblance of democratic practices as mentioned before. It can hardly be a positive motion to transition into a totalitarian state from a relatively democratic one for the sake of protecting the "right" of humans to maintain some form of "naturalness" in their lifestyles—especially once ACIS gain in sophistication beyond what these societies have commonly seen to date.

2.2 Teasing out notions of "enhancement" from "naturalness"

In truth, it is presumptuous for this author to provide a specific definition for what constitutes a "natural" human from one that is technologically enhanced. Even if one *can* be provided, the example below attempts to display, it still does nothing to address the uniqueness of ACIS from other technological artefacts or the various prostheses humans utilise to "normalise" their relatively "impaired" biological functionalities. For example:

> A *natural* human is an entity not only classified as *Homo sapiens* by traditional taxonomy, but a being in possession of naturally manipulated genetic material that is as indistinguishable from a member of the human race as all other members of that race and other characteristics that are unique to the species—such as the ability to develop systems of language (both oral and written), notions of individual will or personality, and the development and use of tools to improve

[12] Forthcoming work by author under typesetting.

daily life—insofar as they do not require computerised means of manipulation to function.

Some, if any, in the academic community may agree with this fairly succinct "definition" for what *ought* to constitute a human as being "natural." However, many use-cases arise wherein this definition may be challenged.

Take the case of a patient requiring a pacemaker—a device that may use a wide range of "computerised" parts per its relative sophistication—as opposed to a patient requiring sight-correcting lenses. To clarify, these lenses may also make use of a wide range of "computerised" means to provide greater correctional "clarity," decrease refractional glare from light sources, adjust colour to the user's environment (such as those that provide shading out-of-doors), or decrease eye strain when reading printed text or working with computer systems. While these prosthetics may not be viewed as being ABPs in the same way that a bionic limb or neuroprosthetic may be due to their relative lack of ACIS usage, they nevertheless rely upon computerised manipulation *somewhere* in their development to function as required. What has changed from these items being considered "enhancements" to being "normal" parts of a human entity is simply how they allow "impaired" individuals to interact with "unimpaired" individuals in a way that allows them to contribute to society for good or ill and their general presence within various societies [17].

Similarly, the qualification that one's genetic material be *naturally* manipulated runs into complications when GeMa and GT enter into the fold. A patient who has their CD34+ hematopoietic stem and progenitor cells undergo myeloablation[13] to combat the detrimental effects of sickle cell anaemia or β-thalassemia and sees a change from "impaired" bone marrow to "healthy" forms [13, 40] will not be viewed in the same way as an embryoblast that has its alleles screened by ACIS or manipulated for "preferred" traits [12, 28, 32, 35]. Similarly, there is not a simple way to categorise a retinal implant from allele or gene-sequence selection in GeMa and GT for (relatively) non-impaired sight, given that one's "natural" genetic makeup is being interfered with at some level. While some may question this relationship, it must further be stated that inherent and individual-specific biochemical factors add justification to this claim. Where it *may* be possible to assume that genetic manipulation within an embryoblast does not cause long-standing detriments in this sense, the medicinal regimes a patient must undergo to prevent an organ from being "rejected" by their body displays that a "matured" human vessel can be interfered with when foreign genetic material is detected—albeit, not on the level of an embryoblast undergoing GeMa as such reactions are presently understood.

2.2.1 Specific considerations for GeMa and GT

What makes the retinal implant "normal" and GeMa or GT "abnormal," at least in this author's opinion, is simply the notion that fluid, organ, and tissue donations are culturally "appropriate" means whereby living or deceased members of the population can help to provide some measure of medical benefit to patients in need of these items. These notions may further be construed as "appropriate" because they are assumed to be donated with consent—whereas embryoblasts display the potential for new life (or rather, a unique individual able to make determinations about their body) and cannot provide such consent, as they lack the cognitive capacity to make such decisions. To be clear, these are but anecdotal observations that are detached from the larger academic conversation taking place on the use of embryoblasts in medical research as opposed to donated organs and tissues—among other related topics [6, 9, 12, 28, 35, 36]—and only present a small level of the bioethical complications of "natural" human definitions in this sphere.

Furthermore, the distinction between "natural" humans and those who undergo GT or are otherwise influenced by GeMa is complex to claim definitively. Outside of a lack of external indicator as to a patient's "naturalness,"[14] only hospital records or corporate records tracking embryoblastic or pluriblastic laboratory growth could currently distinguish between the two groups of (technically) "natural" humans—at least, insofar as one is considering DNA to be a (technically) "natural" component to the human makeup. Attempting to force GT patients or children born from GeMa practices to prove their lack of "natural" origin would be akin to legal discrimination in politically-libertarian societies—if not in every other society on Earth—much as segregation by skin colour or ethnicity has been viewed as an inherently discriminatory practice in the greater part of civil society. Without some change in political philosophy in any given society, we can rest assured that segregation on the scale seen in *Gattaca* [32] is impractical—if not considered wholly immoral—for the foreseeable future. Whether that reality holds true for politically-social- or -community-based societies is a different matter, however, as their political

[13] Defined as "the administration of total body irradiation and/or alkylating agents, at doses which will not allow autologous hematologic recovery" [2] or more simply as a severe form of decreased bone marrow activity.

[14] Specifically, whether the patient's prosthesis or genetically manipulated trait(s) is (or are) visible to other members of the population and identify them as being "enhanced." And for clarity, this "visibility" does not have to be restricted to what one may be able to perceive when walking down an avenue—much like tattoos may alter a person's appearance but can be placed on virtually any area of the human body.

considerations may differ to certain degrees from politically-libertarian ones. After all, there is little preventing society from creating a *Gattaca*-like world if enough pressure is presented from large corporations or national populations given the nature of policymaking in democratic societies or like examples of such processes from the USA.

To this end, it would be inadvisable to consider GeMa patients to be "technologically" enhanced, even if they may technically be classified as having undergone HA, to the degree that they are regulated in a manner inconsistent with other "natural" humans. That is not to say that regulations should not exist for the limitations of GT or GeMa practices, given the potential for species-wide harm a "perfectionistic" pursuit into genetic editing may cause. Rather, that the fact someone has undergone GeMa procedures should be akin to them owning a smartphone or other like device that enhances them beyond their genetically programmed "norm" insofar as the GeMa or GT in question is performed to prevent potentially deadly diseases or in vitro genetic material recombination that is not adjusting factors that may otherwise be legally protected.[15] These arguments extend to the acquisition of organs not developed by oneself (insofar as they are not bionic), GT that is used to cure an activity-hindering genetic disorder like sickle cell anaemia or β-thalassemia [13], and related biotechnological treatments that ultimately *only* present a difference in genetic material.

That is not to say that there is no merit in later determining an effective, non-invasive manner that society can utilise to determine who was born utilising GT or GeMa techniques to then classify these populations as technologically enhanced in a higher degree. Emphasis should be reiterated on the author's use of "current," as opposed to other language that may indicate a more permanent framing of the issue, however. Much as intersexuality is not currently viewed to be a legally-binding gender that needs to appear on birth certificates or population census reports (in the USA, at the very least),[16] the extent to which one's innate genetic code has been technologically manipulated needs to first become an issue of social consideration of political importance—at least, in politically-libertarian societies. Viewed from the perspective of granting basic protections to these populations, if not more unique ones as well, society can then determine at-large ways in which the categorisation of these groups can be handled in a non-discriminatory or non-exclusive manner. Similar approaches would be prudent for the incorporation of those populations that possess a greater level of technological augmentation, or for ACIS systems that are indistinguishable from humans.

3 On moral obligations to "natural" and "unnatural" humans

To preface this section, it should be mentioned that a bioethical take to moral obligation is being addressed herein above other available frameworks because the author views medical technology—both external and implanted devices—to be the area of jurisprudence where academics, legal scholars, policymakers, and other stakeholders will find the greatest range of *lacunae*. Where there will certainly be other areas where ACIS poses significant challenges to governance bodies internationally, they do not challenge notions of legal personality to the degree that ABPs, exoskeletons, internal homeostasis-regulating devices, and other like medicine-specific artefacts have the potential to display—especially when arguments for the "right" of relatively "unimpaired" patients to attain such devices becomes more pronounced.

Particularly, in biomedical ethics, there exist a myriad of theories to aid one in determining "moral status" for populations that may not be able to express their intent to physicians, medical engineers, or other like members of the medical community. One such commonly recognised method is presented by Beauchamp and Childress [5], pp. 65–98). As they argue:

> The terms status and standing have been transported to ethics from the notion of legal standing. In a weak sense, "moral status" refers to a position, grade, or rank of moral importance. In a strong sense, "moral status" means to have rights or the functional equivalent of rights. Any being has moral status if moral agents have moral obligations to it, the being [in question] has welfare interests, and the moral obligations owed to it are based on its [perceived welfare] interests…To have moral status is to deserve at least some of the protections afforded by moral norms, including [various] principles, rules, obligations, and rights…

[15] Explicitly, the factors the author advocates to protect are those such as skin colour and sex or gender (outside of disorders not related to intersex conditions). Others may exist—such as ethnicity when tied to paternal or maternal ethnic origin, or notions of gender-specific hereditary familiar "honour" and other like gender-specific hereditary notions—but are not explicitly defined to intentionally induce a factor of ambiguity to such classifications.

[16] Which may furthermore be exacerbated by "gender correcting" procedures conducted on children in their youth regardless of the overall health of "abnormal" sexual organs or "malformed" genitalia. *See* the Columbia Center for Clinical Medical Ethics' recent discussion with Katrina Karkazis (2021, last accessed 5 February 2021, https://www.youtube.com/watch?v=ZXIxA9G2ThY&feature=youtu.be) for more details on why gender has not been mentioned as an aspect of "normal" humanity thus far, and as an example of how ACIS allele selection may do more harm than good specific to sex selection in embryoblasts.

> These protections are afforded only to entities that can be morally wronged by actions [5], pp. 65, 67, emphasis added).

Furthermore, they argue that only "direct" moral objects can "…count in their own right, are morally more than mere means to the production of benefits for others, and have basic interests, whereas indirect moral objects do not" ([5], p. 67). In other words, only "direct" moral objects can be considered morally significant enough entities to attribute moral status to. Such notions are not specific to the field of bioethics, and likely adds confusion to those attempting to understand their importance in legal discourses and vice versa.

As for why this argument is pertinent to our current discussion, particularly when incorporating ACIS that are being modelled after human intelligence and its integration into the human subject *vis-à-vis* HA techniques into the broader argument, is that Beauchamp and Childress [5] consider computers to be entities only deserving to be classified as "indirect" moral objects (p. 67). While this sentiment *may* be apparent throughout the entirety of biomedical ethics-based discourse,[17] it naturally disregards *any and all* notions that ACIS are being modelled to replicate the actions, knowledge, and rationalities of human—or "directly" moral—subjects [27, 31]. To be fair, these authors do discuss the questionable nature of human foetuses developing in (virtually) "dead" mothers-to-be contrary to any wishes she may have held before death, and the ethically ambiguous (or contentious) nature of the treatment of human-animal hybrids—mainly when dealing with human brain cells ([5], pp. 66, 69–71). How they address these subjects, though, does not excuse their lack of treatment regarding the "human" nature of ACIS.

Even *if* one were to concede that only select instantiations of ACIS *could* rationally be categorised as holding the qualities argued to be essential for moral status by Beauchamp and Childress,[18] we must *still* consider the implications of how the union between ACIS and human consciousness will challenge the notions of "human" identity, liability, and labour-centred "worth" [21–23].[19] Of course, this argument does not mean to claim that *all* ACIS-human mergers will necessarily change some fundamental phenomenological aspect of reality—merely that the introduction of such mergers with self-learning ACIS specifically will introduce this uncertainty regarding our interpretation of our environs, if not with select dormant or static ACIS ([23], p. 2).

A simple example of this would be to compare a common pacemaker today to one that can be externally manipulated by a self-learning system that may be able to improve overall blood "quality" (e.g., pulse, heart rate, erythrocyte and leukocyte count) in a remote fashion to allow one to become (effectively) better at performing certain physical activities. The former is seen as a life-sustaining measure in lieu of a heart transplant, whereas the latter would significantly transform our notions of what ought to qualify one as a professional athlete, commercial model, or another such occupation where blood "quality" regulation would be seen as a benefit (including manual labour). While the ACIS itself may not be sophisticated enough or have been provided enough storage space to create the potential for a unique "will" to arise from the system, this may not be the case for larger computer systems or bionic structures. As such, a re-evaluation seems necessary to reclassify select instantiations of ACIS in such a way as they will be considered to have "moral obligations" and "welfare interests" insofar as to allow for moral obligations to these systems to be "… based on its [perceived welfare] interests" ([5], p. 65).

To turn back to Beauchamp and Childress' point regarding the nature of moral statuses and their philosophically significant attributions, it should be stated that technology management to the degree sought by this author is something that is mostly ignored within the text cited—if not in the majority of biomedically-significant ethical works.[20] The treatment of topics such as eugenics and GeMa are only lightly addressed in works focussed on "fundamental" biomedically-based ethical concerns and arguably have not advanced significantly since the initiation of the Human Genome Project at the turn of the millennium [5, 14, 43]. Naturally, this opens a legal *lacuna* as to the treatment of developing medical technologies and their impact on "fundamental" bioethical principles and theories of treatment [23].

None of this dearth of academic attention in "fundamental" works helps the budding bioethicist or physician to understand the complexities of integrating technology into the human form outside of how their research is impacted by Internal Review Boards, professional codes of ethics or standards, or other regulatory procedures that exist at local or national levels. And in tangent, it does not aid one in an engineering or technology-based field in understanding where a lack of understanding may exist between a medical researcher and device manufacturer. As such, it may be no fault of modern bioethical discourse to fail to address these

[17] Which these authors could feasibly be stated as having significant influence over given how widely their work is used within the field as reference and study material.

[18] Specifically, those with advanced self-learning architectures that either mimic or go beyond the capability of commonly understood notions of human logic.

[19] Forthcoming work by author under typesetting.

[20] These include related works like *Case Studies in Biomedical Ethics: Decision-Making, Principles, and Cases, 2nd ed.* by Veatch et al. [43].

subjects if they are relying only upon works such as those developed by Beauchamp and Childress or founded upon those principles; nor why those emphasising in technological development may view bioethical scrutiny to be misguided or misinformed.

With these topics having been observed in this fashion, it may be a non-starter to seek biomedical ethics to be the platform upon which advocacy for "unnatural" human protection(s) can be cemented upon—thus forcing us to turn to some other field of ethical or legal inquiry that would serve as a better foundation for these arguments. As shown, there is an overall lack of consideration by these scholars in regard to ACIS or machine learning systems in general—beyond the general dearth of intersection between bioethicists and AI-focussed scholars, engineering ethicists, or technoethicists in this realm of consideration. Otherwise, society would likely be faced with a similar Ethical, Legal and Social Implications Research Programme as was held for the Human Genome Project at the turn of the millennium given the severity of the subjects such a Programme would be addressing. Who *ought* to champion such an effort, however, may yet be something that cannot be sufficiently addressed until some external governing body requires collaboration of this kind. Rushing to name a specific entity or group of specialists would be rash given the potential topics such an organisation or group may inherently consider to be of "little consequence" or "too abstract to pertain to today's technologies."

4 Blurred lines in humanity-CI chimaeras

Too often, the term "transhuman" appears in academic literature as a source of "hype" to attract attention to a given work. Though several definitions exist to cover the entire scope of the transhumanist movement, it can broadly be seen as:

> [a] social and philosophical movement devoted to promoting the research and development of robust human-enhancement technologies. Such technologies would augment or increase human sensory reception, emotive ability, or cognitive capacity as well as radically improve human health and extend human life spans. Such modifications resulting from the addition of biological or physical technologies would be more or less permanent and integrated into the human body [18].

The concept of transhumanism, much as Amanda du Preez argues, ignores the concept that humans are what this author considers to be "perfectly flawed" entities. In her introduction, she makes the following observations:

> The body is crudely perceived as a bad invention that needs to be redesigned and re-engineered. In the view of these "no-body" theorists, the redundancy of the physical body is a conclusive fact. All that remains to be done is to finalise the details of complete body depletion and replacement. Broadly speaking there are two general trends within the "no-body" techno-enlightenment project: the first attempts to remake the body, while the other aims to amputate the body in its entirety. The first project sets out to enhance and augment the body technologically by replacing body parts and re-engineering the body. The other aims consciously at full-scale transcendence, leaving the body behind and becoming cyber-consciousness (mind) only. If a body is still required at all, it will be a virtual body that can swim the ether … The proposition that we can indeed, become bodiless, in other words, make progress, go forward without being embodied beings that actually constitute physical bodies, already suggest a critical disparity or unbridgeable chasm between physicality and meta-physics. The proposition assumes that there is a state that can be aspired towards, where visceral functions and pains can be eliminated on the way towards incorporeal virtual consciousness. It is the task of this book to subvert such notions, by showing that there is no existence possible without embodiment of some sort ([11], pp. xv–xvi).

To exceed our limitations through technological means is not to shed our sense of identity completely, else there would be no delineation between the self and one's environs. To attain such an existence, in the eyes of the transhumanist, would be contrary to their goals insofar as they seek to retain some semblance of a "self" identity that can be distinguished from other entities. Hence, some aspect of the embodied experience is required to maintain a sense of self [9, 33]—at least, insofar as a process-of-elimination approach may determine in this scenario. Let us examine the notion of embodiment as a necessary aspect of self-identity from a different perspective to give further credence to this point:

> Suppose technology leads humanity to the point where one's consciousness, personality, or soul (whichever term envelops the entirety of the human experience to the reader) can be replicated onto a digital format at the expense of discarding one's natural form. For any who take advantage of this new capability in technology, we will posit that one is not limited to their singular gender-constricted experience; rather, that they have the freedom to experience life in as many different digital forms as their digital memory will allow. Under such conditions, the first generation of uploaded consciousnesses realises that they do not "feel" emotion in the way they were once able to. Instead, there is

> a lack of *splanchnic* or *visceral* input that would denote which emotion is to be felt in a given instance. As such, these digitised humans must rely upon their prior experiences with a biology-based emotional "feeling" to determine what emotion fits to which situation. Suppose that the ability to procreate is also not limited within this scenario and that offspring are produced in a manner that enables them to possess the same "blank slate" a biological child has—meaning that the child will be able to develop its own unique personality without reliance upon the memories of its parents. As a child grows, the parents come to realise that its personality differs from their expectations. Rather than expressing an unhindered range of emotions, as they do, it seems to think before settling on an emotion in reaction to their own ([23], p. 12, emphasis added).

If a scenario such as the one provided above is undesirable on account of an inability to grant one's "progeny" the ability to enjoy the full range of human expression one would wish any regular child to possess, then steps *must* be taken in a judicial and policy-development sense that would prevent this tragedy. Of course, the author does not suggest that it is only libertarian-based societies that are incentivised to develop regulation to this extent. Social- and community-based societies have an obligation, as per the notion of public interest, to contemplate the extremes they would find "acceptable" to pine for and develop within their own realms of influence and protect against extremes they find to be against their collective interest. Whether this is feasible in a world where libertarian-based societies may not place as stringent a regulation on the development of technologies as a social- or community-based one is a separate matter—one that is continuously being played out on the world stage on a day-to-day basis.

In the context of ACIS, it would serve to remind the reader of the initial form these entities exist in—being, of course, in the digital realm. As this author states in his inaugural piece:

> AGI [artificial general intelligence] and other NBI [non-biological intelligence] systems are not limited to what we consider "robots." This concept is vital to understanding what rights AGI and other NBI systems should possess, as well as the responsibilities they hold. What is regarded as a body to an AGI is different to what the average human mind portrays [e.g., an anthropomorphic mechanised entity.]. It can either be a single computer, the whole of the Internet, or another such sophisticated computer network, beyond possessing an anthropomorphic or quadriplegic form ([21], p. 344).

Coupled with the other example provided by the author, it would be prudent for the reader to understand the dangers of anthropomorphising ACIS in such a way that it is viewed as merely being an extension of humanity as opposed to a non-biological agent that has access to vast troves of data. To be blunt, ACIS is alien to us and therefore cannot be said to be "understood" by humanity via the conventions we have come to learn about its existence on Earth to date. While there are certainly dangers that exist with the utilisation of "static" ACIS, they pale in comparison to a self-learning system that may be able to extrapolate knowledge in a more conventional sense—arguably being the pairing of information or data with some unique (or rather, biased) meaning.[21]

4.1 Further "types" of humans

With the distinction of "natural" human already discussed, we must now consider the other manners in which one may be considered human but not necessarily a computerised intelligence. Not only will this effort serve to further explore the different potential subgroups of humanity and distinguish the differences in protections they may require, but it will provide further justification to develop a sufficiently broad understanding of the legal personality of computer-based intelligence systems and protections for these systems in human–computer and computer-computer interactions [23]. As mentioned in the introduction to this work, these "types" of humans should necessarily be defined by the extent to which their "natural" selves have been augmented—whether willingly or not, as would be the case of GeMa in germline editing techniques.

The ultimate basis for a refusal to modify one's form, realistically, should not rely upon secular or spiritual arguments; nor should they be dependent upon some notion of individual bodily ownership—contrary to what other scholars have drafted on the subject [35, 36]. Instead, refusal should be based upon the responsibility thrust upon those who willingly modify themselves. By responsibility, it is *not* to be interpreted as the "right to rule" or the "right to determine for others."

Rather, it should be interpreted as the responsibility of those who are technologically enhanced to not infringe upon the privacy or autonomy of others. In essence, it should be based upon an increasingly stringent protocol of "do no harm" as one approaches the realm of ACIS, which means that individual modification comes with the risk of being held liable above and beyond those with lesser modifications

[21] The use of "bias" here refers to the thoughts and beliefs that are unique to each human subject, though further discussion on this topic requires a thorough examination into phenomenological, epistemological, or metaphysical arguments on the subject. As such, they will not be expanded upon further herein.

in cases of property damage and like civil or federal suits—and that this liability carries more considerable penalties the more one gains in augmentation. This suggestion serves two purposes: the first to address the concern of equity in attaining augmentations, and the second to ensure that the concept of *noblesse oblige* does not become synonymous with HA. Although this may not seem "fair" considering the expense of technological enhancements, it must be stated that the ability to augment oneself ought to be a *privilege*, *not* a *right*; much like with the ownership of other technological artefacts. This statement is made in consideration for the preservation of the "natural" human race and other such notions as mentioned herein.

That is not to say that these rules should immediately be implemented. As mentioned before, patient populations already exist that rely upon ABPs—albeit, oftentimes not bionic in nature—and a failure to distinguish between the semantic distinctions between the types of computational intelligence present within each device (*if* present at all) will ultimately result in unjust legislative action. And for those ABPs that do not immediately make use of ACIS (such as certain GeMa or GT treatments, organ transplants or printing, or optical lens construction for glasses and contacts), reviews will necessarily need to be made as to whether liability and culpability should remain as-is under new legal paradigms—outside of whether such non-ACIS-dependent prosthetics or techniques should receive preferential treatment as clinical tools for patients, given the lack of expense they incur to be manufactured or performed compared with their ACIS-dependent counterparts in a world where ACIS development is highly expensive. These expenses are not just to the hardware and code development of the system; but apply to the attainment of training data and potential interoperability with other systems and other like processes.

This delineation goes beyond the broad categorisations for computational intelligence systems that pervade academia and industry—which may broadly be sorted by function as reactive machine, limited memory, theory of mind, and self-aware systems [26], for example. Arguably, each of these broader categories holds a range of existing or anticipated systems that can be further classified by the training data they receive, the function of the algorithm driving the system, and many other criterium. Major struggles for regulators will be to ensure that the system in question is accurately represented within the various subcategorizations it may be subjected to and the extent to which these systems can be considered proprietary when utilising open-source code, among others. Naturally, such considerations must include how to handle malicious or seemingly-malicious data subject manipulation or coercion [22].[22]

One manner in which enhancement-based classification may be created is through the deployment of "groups" of individuals who could feasibly be held within these restraints. This approach would be favourable in scenarios wherein the delineation of various technologically enhanced groups is generally understood or practised.

> The manipulation of the human germline with biotechnology raises concerns as to whether the resulting embryo can still be classified as a member of the same species as its parents, should unrestricted genetic manipulation be permitted on legal and moral grounds for more than life-saving interventions. In contrast, the manipulation of somatic cells is steadily being considered an ethically permissible medicinal therapy to circumvent potentially dangerous illnesses in one's postpartum life. Yet in both cases, the patient in question is subjecting their genome to "unnatural" changes—which some would call a technology-aided artificial selection practice or directed evolution—and as such are no longer "natural" humans if we consider this status to be tied to our genetic makeup. The commonly held concern is whether our notion of "humanness" is enough to incorporate these patients as part of the species at large, and whether individuals have a right to an unaltered genome. Depending upon the definition of who constitutes as a member of human society, there is concern that patients with manipulated genetics would not fit under a "genetically-natural" definition if it is proposed. For this purpose, it may be best to separate the human population into distinct categories, such as biologically-natural, genetically-manipulated, computer-aided, and cybernetically-enhanced (TABHI), among others. The line that would be most ambiguous would be the cybernetically-enhanced human category, which would need to have specific definitions in place to separate the "humans" from the ["computer intelligence system(s)"] and cyborg-specific intelligences ([22], p. 12).[23]

Another such proposal would be through the utilisation of a definitional spectrum (Fig. 1), which allows for greater fluidity or in circumstances where delineations are significantly vaguer. Where both systems have their merits, the author is divided upon which would be the best to propose for widespread utilisation. After all, each society may wish to adopt aspects of both systems; or find one system to be more fitting for statutes up for public consideration. As with understandings for what *ought* to qualify as "natural humanness," the onus will have to fall upon governance bodies and organisations to determine not only which approach best

[22] Forthcoming work by author under typesetting.

[23] Forthcoming work by author under typesetting.

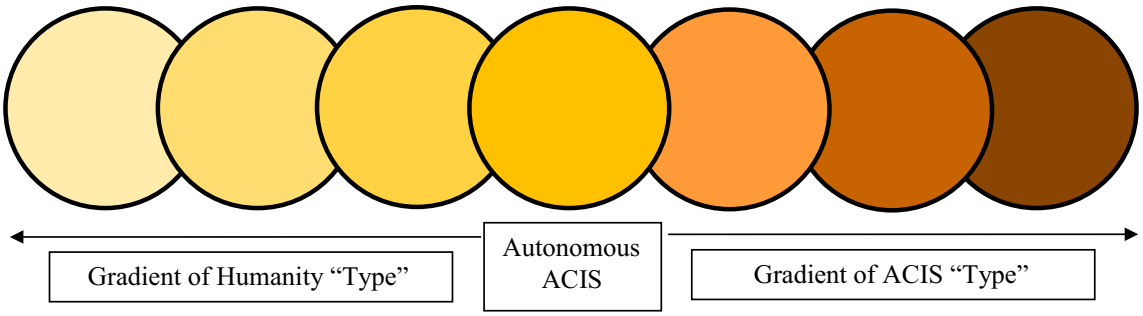

Fig. 1 A visualisation of gradients from "natural" human to basic computational intelligence systems

suits the needs of their members—but how such adoptions can easily translate across cultural boundaries. An example of a definitional spectrum is given here, though it should not be considered the end-all-be-all of such spectrums.

At the "low" end of the definitional spectrum, it may be argued that humans that utilise "normal" forms of enhancement and GeMa patients be placed into a split category explicitly defined by the lack of non-biological or computational enhancements[24] present within or upon their form. Although this may not be the "easiest" way to distinguish a less-enhanced human from a relatively unenhanced human, it at least establishes the notion that the presence of non-biological or computational material within or upon the human form serves as the baseline for a visual representation of "enhanced" human groups. This author would further advocate for a right or social agreement that all humans retain the ability to remain technologically unmanipulated concerning genetic material [6, 35, 36], as well as maintaining the ability to self-regulate one's neurological or psychological state insofar as it does not cause harm to other members of society [39]. Of course, this extends to the ability to refuse technological integration into one's form [6, 35, 36].

The second "stage" of the definitional spectrum may reasonably constitute individuals with minor technological augmentations (such as patients with pacemakers without self-learning ACIS) and incorporate all related technologies non-reliant upon self-learning ACIS that do not directly or indirectly enhance human intelligence. This aspect of the spectrum would extend to the utilisation of virtual avatars, though not the linking between these avatars and the human consciousness as envisioned by transhumanists. The rationale for this range of technologies to be presented as such is due to the lack of tangible devices that can currently be integrated within and upon the human form that require self-learning ACIS and the range of self-learning architectures that currently exist within "smart" code. As such, it is not currently clear as to which form these self-learning devices will take or their individual range of capabilities; and a lack of evidence for programme code that adapts at or beyond human-like levels prevents a firm example for what architectures ought not to be considered as belonging in a higher category. Although some research is being conducted into the impacts of "smart" code in bionic prosthetics (specifically ABPs for hands) and ways in which tactile interactions can be improved [1, 44], technological advances with the sole purpose of interacting with virtual CIS and avatars may have less obvious implications for their effect on society. These include devices such as the Oculus Rift or fictional devices seen as the "ideal" for developing a full-dive virtual reality.

A potential tertiary gradient would include those technologies that influence any aspect of human intelligence in a manner currently not seen through the utilisation of nootropics, though some separate consideration may be given to the type of nootropic being utilised and its overall impacts on cognitive functionality. Given that our current best understanding of human consciousness and "selfhood" reside within the confines of the human brain, the technological augmentation of this organ should hold the most significant legal responsibilities and consequences. This rationale becomes especially pressing when considering that the augmentation of the brain may lead to detrimental emotional impacts on the patient ([21], pp. 344–345, [23]). There is, however, a clear line that needs to be drawn between those possessing behaviour-regulating augmentations to prevent certain neurological disorders from interfering from daily activities and those who augment themselves for more "recreational" rationales. In this sense, patients in the former category would fall under the second proposed gradient given the need for these devices to enhance one's ability to contribute to society as opposed to merely requesting augmentation to improve cognitive performance through direct integration of self-learning ACIS to the human brain.

[24] Explicitly targeted at explaining the presence or absence of ACIS, whether they be biologically- or mechanically-designed. To this end, "smart" devices as they are understood at the time of this writing do not fall into this category.

To be clear, what this author can offer regarding prostheses (particularly neuroprostheses) are recommendations for their handling based upon concerns they have regarding their potential for abuse and misuse by governing organisations, corporations, and nation states. Definitively proclaiming the handling of specific patient groups in particular manners is best left to governing organisations and nation states that can canvas those who will be impacted by the determinations the most, and who ultimately generate industry standards and laws that regulate their overall protections. While these proposals may be effective for a politically-libertarian society that favours precautionary regulation, they may evidently not be effective in other political traditions and philosophies. Ultimately, humanity should remain sceptical and cautious to the promise of self-learning ACIS when directly interfacing with the human nervous system—whether that be the central or peripheral system [22]. Given the propensity for computer systems to come under attack by malicious software, the threat of a patient becoming hostage to their prosthetic ought to be driving government or regulating authorities to approach the integration of ACIS into ABPs with extreme levels of oversight and regulation rather than more lackadaisical approaches that may be taken to devices that pose less of a threat to a patient's health.

Finally, considerations should be developed for the distinction between what constitutes as a computer-original ACIS and an organically-original ACIS—given that our technological advancements may lead us to produce ACIS that can gain a biologic form, and vice versa [21]. Where this is presently in the realm of transhumanist desires and not a (presently) attainable reality, there is no tangible manner wherein regulations for this extreme of technology could be reviewed or developed. The most straightforward parallel that could be drawn to this aspect of technological enhancement would be found in *Star Trek: The Next Generation*—namely, with the introduction of the Borg as a race [19]. Another, less popular, reference could be made to the film *Expelled from Paradise*, where virtualised consciousnesses are "grown" human bodies when dispatched to Earth's surface [30]. While these examples are extreme, there is little doubt that the potential for entities of these natures to become a reality as technological advances pose a significant risk to the notion of human-centred legal personality [23].

4.2 Augmentation vs bionicalization: can "cyborg" be empirically defined?

To further elaborate upon the legal complexities that surround ACIS-human mergers in HA, one notion seems to remain vaguely defined in academic literature—namely, in whether an empirical definition of a "cyborg" can be generated and maintained for use in legal proceedings. Science-fiction media may offer up many examples as to individuals holding simple augmentations (e.g., exoskeletons, ABPs, integrated communication devices) as opposed to being "cybernetic" in nature such as the Borg [19]. Yet, these are but the examples provided to us by the minds of scriptwriters and effects teams to convey some purported "difference" between augmented and bionicalized human subjects and non-augmented beings. One such quandary may present itself in asking whether Jake Sully from *James Cameron's Avatar* [8] is actually a biological entity at all after his transfer from the paraplegic form he embodied. While it may be radical to question that logic given the unrealistic nature of the technology employed, how would that differ from abandoning one's biological form for a digital one? Both examples present an "alien" entity as the secondary form, but the individual manipulating said form is first and foremost human.

Some may argue that the *Avatar* example is far-fetched considering how the resulting form is still comprised of chemically-organic matter—to which, this author argues that a similar transference may feasibly occur between human subjects and with ACIS as displayed in Mizushima's work [30]. What is vital to remember in this regard is that any existence outside of one's naturally granted form necessarily requires technological artefacts to attain, experience, and ultimately retain. In that sense then, all such experiences are naturally *cybernetic* by virtue of how they arise insofar as cybernetics is defined in terms of *digital* communication between systems. More broadly then, the concept of a cybernetic organism may feasibly exist within human society today if we consider our "digital" personalities or avatars [3]. It is vital to make this distinction on account of how the term "cyborg" is presented in legal literature [17], especially where semantics are so vitally important in litigation and jurisprudence.

While seemingly "radical," these arguments nevertheless aim to "suss out" the intrinsic nature of what distinguishes a patient with an ABP that is reliant upon ACIS to function, a human whose consciousness has been transferred onto a computer system,[25] a para- or quadriplegic patient whose consciousness is transferred into a robot, and an ACIS. Naturally, this quandary extends to whether an ACIS' existence as a computer system ought to qualify it as an embodied existence or a digital one and the legal ramifications for that delineation as other digital spaces are legally classified and granted protections. Simply protecting intellectual property in this environment, as should be shown through these arguments, does not settle this troubling *lacuna* in legal language or field-wide understanding of how subjects *actually* exist in the natural world.

[25] And subsequently of a child "born" in that same environment.

5 Conclusion

Given the distinctions made herein regarding the legal personality that arguably *should* be attributed to members of humanity based upon the extent to which they incorporate electrical computers into their daily lives and individual forms, it could be said that judiciaries and policy-development bodies now have at least *one* basis to begin deliberations for the definitions they wish to adopt or evolve to conform to the nature and shape of their various societies. And it should be argued that it *is* their obligation to *urgently* begin these deliberations insofar as they are not centred solely upon the treatment of artificial (computer) intelligence systems or the treatment of biotechnological advancements.

Only approaching technological regulation from a vague notion of ACIS and the impact they have on commercial and private entities is misguided as it does not take into consideration the biological-computer mergers that *are* currently under development for particular technologies [22, 44] in the USA and abroad. Therefore, an approach that incorporates a polythematic (as opposed to a solely interdisciplinary or cross-cutting) perspective to these issues is required to ensure that individual and societal interests are being fully considered. In this manner, it can be assured that a wide range of socio-legal and political issues can be addressed *en masse* to ensure that judicial and policy-development systems are not "bogged down" by a seemingly-endless slew of complications that arise from human–computer and computer-computer relationships.

One such project is currently under development by the Institute of Electrical and Electronics Engineers with their P7000 series of engineering standards, which is already displaying the influence of their Ethically Aligned Design [20] initiative to provide one perspective of industry-level AI ethics principles and requirements. Generating standards for industry alone, however, is not enough to solve more complex questions such as what the limitation of "cybernetic" as a term ought to be in academic, industry-encompassing, and legal language. Given the current developments being taken by AI ethicists (namely in how educationally diverse the field is becoming), there is yet hope that some current entity will take on the role of developing an Ethical, Legal and Social Implications Research Programme centred upon the continued advancement of computational intelligence and its integration into various devices that humanity will inevitably come to rely upon. Barring that, however, such an entity must arise through the collaboration of various stakeholders—meaning that simply relying upon the clout of so-called futurists or a particular vein of scholars would do no more than allow current industry-wide trends to remain unfettered to wider societal concerns that these groups may lack consideration or knowledge to address.

By actively searching for the opinions of traditionally neglected populations (e.g., indigenous peoples, the economically-disadvantaged, gender queer communities), and attempting to rise these populations to a position where they can *actually* engage with those more well-to-do in society on a more equal basis, society as a whole can attempt to restructure the relationships between its members accordingly. Inevitable transformations to commercial "business-as-usual" may ease away from a rapid loss of "necessary" jobs in the labour market, given that ACIS may rapidly display a capability that was previously thought to require much more time to achieve as in the case of AlphaFold [10, 24, 29]. Education standards—which arguably are in dire need of an update given how may terminal degree holders struggle to find employment in the USA and abroad, and the relative value of other degrees relative to primary and secondary education or K-12 schooling—can likewise be adapted to incorporate the reality that is readily available ACIS to future labour market contributors. And it may ultimately be discovered that the need for 40-or-more hour weeks is significantly reduced with the ethically guided introduction of ACIS into various spheres,which would inevitably require a re-evaluation of material good value, cost of living, and the ability of markets to cater to perceived consumer demands or niche deficiencies in local or global supply chains.

In tangent to this, legal considerations need to be generated regarding the ability for ACIS to be held liable under current notions of *mens rea*,[26] as well as the extent to self-representation in court under the notion of in *prope persona*[27] given the potential for CIS to exist outside of a singular format ([21], p. 347). Of course, these considerations should extend to the limits in which a court can realistically contain a given CIS under a *ne exeat repiblica* order,[28] whether the CI can be defined *noscitur a sociis*,[29] if the ACIS cannot be defended under the notion of *cura* or *curator* types,[30] *respondeat superior*,[31] or *res communis*[32]; how to approach an *in rem* case that becomes challenged by

[26] Specifically referring to a "guilty mind" in legal terms.

[27] The legal phrase for when one represents themselves in court without the official assistance of an attorney.

[28] Referring to a court order to prevent a party from leaving or being removed from the jurisdiction of a particular court during legal proceedings.

[29] Or rather, as a concept that is unclassifiable in the whole context in which it is used.

[30] Specifically referring to legal guardianship under which a ward is considered to be totally and permanently incapable from a legal stance.

[31] More commonly understood as the superior taking legal responsibility for actions performed by their subordinate(s).

[32] "Common" property, insofar as that property cannot be subjected to individual ownership (like airspace).

notions of *sui juris* or *non scienter*[33]; whether *uti possidetis* can be determined under notions of *commixtio* (or the sufficiency of *jus tertii*)[34]; or a general inability to determine *locatio conducti*o or like notions of *servitus* for the purposes of determining the legality of the "work" conducted by the CI system in cases of "legal" work in a nation's borders. While some of these cases may be present in courtrooms today, others are likely far from barristers' minds. As such, listing out just a few of these complex deliberations that have not been seen in courts to date may help those in the legal communicate deliberate on how such cases may be defended or prosecuted.

With these potential legal challenges before us (and undoubtedly many others), our tendency towards reactionary justice in various legal systems internationally *must* be circumvented. To ignore such deliberations before a complicated case can be submitted before a judicial system is the height of legal folly—especially where the interpretation of constitutionally-granted rights may be expansive.

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Declaration

Conflict of interest The author of this work is serving as the Chair for the IEEE Nanotechnology Council Standards Committee, and actively serves as the Secretary for the IEEE P2863™—Recommended Practice for Organizational Governance of Artificial Intelligence—Standard Development Group (organized under the IEEE Computer Society Standards Activity Board)—which acts as an extension of the IEEE P7000 series of standards under the organisation's Ethically Aligned Design initiative. All statements made herein are of entirely those of the author, and do not reflect the opinions of the IEEE, IEEE Standards Association, or related Councils or Societies under their jurisdiction; nor those of the P2863™ Standard Development Group as an entity or its affiliated members (notwithstanding of the author), or the IEEE's Global Initiative on Ethics of Autonomous and Intelligent Systems and the Standard Development Groups that have arisen as a result of that work. Furthermore, the author's statements are not reflective of the Alden March Bioethics Institute at Albany Medical College as an institution, its staff, or its curriculum, given their standing as a student enrolled in the Master of Science in Bioethics programme and lack of direct employment by the institution or programme (including through federal work-study tuition subsidies).

[33] Regarding the competency of ACIS when under trial as property, as opposed to a legal person, or the need to consider the system competent.

[34] Implying that ACIS cannot be retained by the users of the system after a trial, as specific portions of it may be intermingled in such a manner that their constituent parts cannot be sufficiently parsed to distinguish which "version" of an ACIS' code or data belongs to which user. This extends to the ability of a "third" party to question the claims of a given party's principal ownership of an ACIS that is under legal dispute given the potential complexity of its architecture.

References

1. Ackerley, R., Kavounoudias, A.: The role of tactile afference in shaping motor behaviour and implications in prosthetic innovation. Neuropsychol. (2015). https://doi.org/10.1016/j.neuropsychologia.2015.06.024
2. Bacigalupo, A., Ballen, K., Rizzo, D., Giralt, S., Lazarus, H., Ho, V., Apperley, J.A.: Defining the intensity of conditioning regimens: working definitions. Transplant Cell Ther. (2009). https://doi.org/10.1016/j.bbmt.2009.07.004
3. Barfield, W.: Intellectual property rights in virtual environments: considering the rights of owners, programmers and virtual avatars. Akron Law Rev. **39**, 649–700 (2006)
4. Barrat, J.: Our final invention: artificial intelligence and the end of the human era. St. Martin's, New York (2013)
5. Beauchamp, T.L., Childress, J.F.: Principles of biomedical ethics, 8th edn. Oxf. Univ. Press, New York (2019)
6. Björkman, B., Hansson, S.O.: Bodily rights and property rights. J. Med. Ethics **32** (4): 209–214 (2006). http://www.jstor.com/stable/27719607
7. Bostrom, N.: Superintelligence: paths, dangers, strategies. Oxf. Univ. Press, New York (2014)
8. Cameron, J. (dir.): James Cameron's avatar. 20th Century Fox, Los Angeles (2009)
9. De Vignemont, F.: The mark of bodily ownership. Analysis (2013). https://doi.org/10.1093/analys/ant080
10. Dockrill, P.: AI solves 50-year-old biology 'grand challenge' decades before experts predicted. ScienceAlert (2020). https://www.sciencealert.com/ai-solves-50-year-old-biology-grand-challenge-decades-before-experts-predicted/amp. Accessed 5 Feb 2021
11. Du Preez, A.: Gendered bodies and new technologies: Rethinking embodiment in a cyber-era. CambSchPubl, Newcastle upon Tyne, UK (2009)
12. Enriquez, P.: Editing humanity: On the precise manipulation of DNA in human embryos. N. C. Law Rev. **97** (5): 1147–1240 (2019). https://scholarship.law.unc.edu/nclr/vol97/iss5/12
13. Frangoul, H., Altshuler, D., Cappellini, M.D., Chen, Y., Domm, J., Eustace, B.K., Foell, J., et al.: CRISPR-Cas9 gene editing for sickle cell disease and β-thalassemia. N. Engl. J. Med. (2020). https://doi.org/10.1056/NEJMoa2031054
14. Furrow, B.R., Greaney, T.L., Johnson, S.H., Jost, T.S., Schwartz, R.L.: Bioethics: health care law and ethics. West Publ., St. Paul, MN (2013)
15. Garland, A. (dir.): Ex machina. Univers. Pict., London (2015)
16. Glenn, L.M.: What is a person? In: Bess M, Pasulka DW (eds.) Posthumanism: the future of *Homo sapiens*, 1st edn., 229–246. Macmillan Reference USA, Farmington Hills, MI (2018)
17. Glenn, L.M.: Case study: ethical and legal issues in human machine mergers (or: The cyborgs cometh) Annals of Health Law **21**(1), 175–180 (2012)
18. Hays, S.A.: Transhumanism. Encylopædia Britannica, web edn. (2018). https://www.britannica.com/topic/transhumanism. Accessed 5 Feb 2021
19. Hurley, M.: Q who. In: Bowman, R. (dir.) Star trek: the next generation, season 2 episode 16. Paramount DomestTelev, Los Angeles (1989)
20. IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems: Ethically aligned design: a vision for prioritizing human well-being with autonomous and intelligent systems, first edn. IEEE (2019). https://standards.ieee.org/content/ieee-standards/en/industry-connections/ec/autonomous-systems.html
21. Jaynes, T.L.: Legal personhood for artificial intelligence: citizenship as the exception to the rule. AI Soc. (2020a). https://doi.org/10.1007/s00146-019-00897-9

22. Jaynes, T.L.: Citizenship as the exception to the rule: an addendum. AI Soc. (2020b). https://doi.org/10.1007/s00146-020-01105-9
23. Jaynes, T.L.: The legal ambiguity of advanced assistive bionic prosthetics: Where to define the limits of 'enhanced persons' in medical treatment. Clinical Ethics (2021). https://doi.org/10.1177/1477750921994277
24. Jumper, J., Evans, R., Pritzel, A., Green, T., Figurnov, M., Tunyasuvunakool, K., Ronneberger, O. et al.: High accuracy protein structure prediction using deep learning. In: 14th round critical assessment of techniques for protein structure prediction (abstract book). Protein Structure Prediction Center, Davis, CA, pp 22–24 (2020). https://predictioncenter.org/casp14/doc/CASP14_Abstracts.pdf
25. Kass, L.R.: Defending human dignity. Commentary **124** (5): 53–61 (2007). https://www.commentarymagazine.com/articles/leon-kass/defending-human-dignity/
26. Lateef, Z.: Types of artificial intelligence you should know. Edureka (2020). https://www.edureka.co/blog/types-of-artificial-intelligence/. Accessed 5 Feb 2021
27. Lauret, J.: GPT-3: the first artificial general intelligence? Towards Data Science (2020). https://towardsdatascience.com/gpt-3-the-first-artificial-general-intelligence-b8d9b38557a1. Accessed 5 Feb 2021
28. Liu, S., Zhou, J., Zhang, X., Liu, Y., Chen, J., Hu, B., Song, J., Zhang, Y.: Strategies to optimize adult stem cell therapy for tissue regeneration. Int J MolSci (2016). https://doi.org/10.3390/ijms17060982
29. Metz, C.: London A.I. lab claims breakthrough that could accelerate drug discovery. The New York Times (2020). https://www.nytimes.com/2020/11/30/technology/deepmind-ai-protein-folding.html. Accessed 5 Feb 2021
30. Mizushima, S. (dir.) 「水島 精二、演出家」: Expelled from paradise 「楽園追放」. Toei Animat. 「東映アニメーション株式会社」 with Graphinica「グラフィニカ」, Tōkyō-to 「東京都」 (2014)「平成26年」
31. Mostow, J.: Foreword: What is AI? And what does it have to do with software engineering? IEEE Trans. Softw. Eng. (1985). https://doi.org/10.1109/TSE.1985.231876
32. Niccol, A. (dir.): Gattaca. Columbia Pict., Culver City (1997)
33. Pazzaglia, M., Molinari, M.: The embodiment of assistive devices—from wheelchair to exoskeleton. Phys. Life Rev. (2016). https://doi.org/10.1016/j.plrev.2015.11.006
34. Polson, N., Scott, J.: AIQ: how people and machines are smarter together. St. Martin's, New York (2018)
35. Primc, N.: Do we have a right to an unmanipulated genome? The human genome as the common heritage of mankind. Bioethics (2020). https://doi.org/10.1111/bioe.12608
36. Ramachandran G (2009) Against the right to bodily integrity: of cyborgs and human rights. Denver Univ. Law Rev. **87** (1): 1–57. https://ssrn.com/abstract=1434712
37. Rorty, R.: Human rights, rationality, and sentimentality. In: Hayden, P. (ed.) The philosophy of human rights, pp. 241–257. Paragon House, St. Paul (2001)
38. Ruggiu, D.: Implementing a responsible, research and innovation framework for human enhancement according to human rights: the right to bodily integrity and the rise of 'enhanced societies.' Law Innov. Technol. (2018). https://doi.org/10.1080/17579961.2018.1452177
39. Shook, J.R., Giordano, J.: Neuroethics beyond normal: performance enablement and self-transformative technologies. Camb. Quart. Healthc. Ethics (2016). https://doi.org/10.1017/S0963180115000377
40. Stein, R.: 1st patients to get CRISPR gene-editing treatment continue to thrive. Shots—Health News from NPR (2020). https://www.npr.org/sections/health-shots/2020/12/15/944184405/1st-patients-to-get-crispr-gene-editing-treatment-continue-to-thrive. Accessed 5 Feb 2021
41. Tegmark, M.: Life 3.0: Being human in the age of artificial intelligence. Alfred A. Knopf, New York (2017)
42. Varney, N.R.: How reading works: considerations from prehistory to present. Appl. Neuropsychol. **9** (1), 3–12 (2002)
43. Veatch, R.M., Haddad, A.M., English, D.C.: Case studies in biomedical ethics: decision-making, principles, and cases, 2nd edn. Oxf. Univ. Press, New York (2015)
44. Zhuang, K.Z., Sommer, N., Mendez, V., Aryan, S., Formento, E., D'Anna, E., Artoni, F., et al.: Shared human-robot proportional control of a dexterous myoelectric prosthesis. Nat. Mach. Intell. (2019). https://doi.org/10.1038/s42256-019-0093-5