



Article

# Superhuman Enhancements via Implants: Beyond the Human Mind

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**Abstract:** In this article, a practical look is taken at some of the possible enhancements for humans through the use of implants, particularly into the brain or nervous system. Some cognitive enhancements may not turn out to be practically useful, whereas others may turn out to be mere steps on the way to the construction of superhumans. The emphasis here is the focus on enhancements that take such recipients beyond the human norm rather than any implantations employed merely for therapy. This is divided into what we know has already been tried and tested and what remains at this time as more speculative. Five examples from the author's own experimentation are described. Each case is looked at in detail, from the inside, to give a unique personal experience. The premise is that humans are essentially their brains and that bodies serve as interfaces between brains and the environment. The possibility of building an Interplanetary Creature, having an intelligence and possibly a consciousness of its own, is also considered.

**Keywords:** human–machine interaction; implants; upgrading humans; superhumans; brain–computer interface

## 1. Introduction

The future life of superhumans with fantastic abilities has been extensively investigated in philosophy, literature and film. Despite this, the concept of human enhancement can often be merely directed towards the individual, particularly someone who is deemed to have a disability, the idea being that the enhancement brings that individual back to some sort of human norm. Cochlear implants, artificial hips and even deep brain stimulators for Parkinson's disease are all good examples of the sort of technology designed for a specific group need. This form of enhancement is not the main subject of this paper. Rather, here we concern ourselves with human enhancement which takes a human (norm) as a starting point, employs technology by means of an implant in some way and as a result realises a superhuman.

When looking at ideas from science fiction, the fundamental concept of the superhuman tends to be limited by the restrictions of the imagination of the creator of an idea and/or those who will take on board what has been suggested. Hence, many ideas of the superhuman ignore the capabilities of technology today, never mind technology of the future, and produce superhumans with a pretty limited set of capabilities—for example, the Hulk, who is bigger and stronger, and Superman, who can fly and has enhanced hearing and cold breath or superspeed; coupled with that, the script writer will most likely be limited in terms of their knowledge as to what is technically possible and what is not. Further, for popular media, it usually has to be possible to visualize (on a screen) and understand any enhancement employed, and this eliminates a plethora of possibilities.

An example of such restrictions at this time might be useful. Consider the film of the story *I, Robot* [1], starring the actor Will Smith. Essentially, the control of physical robots in the world is taken over by a computer system, thereby causing havoc amongst humans. Each robot is

itself not particularly intelligent—nothing wrong there—but the computer system which controls them is. But firstly, the robots all look like metallic versions of humans, whereas that is not what most machines/robots actually look like or would need to look like. Secondly (and more importantly), the computer system turns out to be one big supercomputer in one specific building, which of course our hero Will Smith can gain access to and destroy, thereby saving the world. Even now, we have cloud computing (was a version of that filmed in *The Terminator?*), and it is network-based (how could we switch off the internet even now really/practically?).

In the next section, I have a brief look at some therapies that can be modified into some sort of enhancement and then very quickly mention available technologies and where they might lead, if anywhere. Following this, I focus more on such technologies as growing brains and direct connections into the human brain and nervous system specifically for enhancement. Subsequently, I briefly discuss some of the ethical issues, in a realistic way, and finally, rather than trying to draw some conclusions, there is a meandering discussion.

## 2. Therapy

Deep brain stimulation is a procedure employed, in terms purely of therapy, for the treatment of Parkinson's disease, Tourette's syndrome, epilepsy and clinical depression. Electrical signals at a frequency of 150 to 190 Hz are applied into the thalamus or subthalamic nucleus of the brain. The effect of these signals is to counteract the original problem. The deep brain electrodes can also be connected bi-directionally with a computer such that electrical activity in the brain can be monitored. Using AI techniques, a better understanding of the nature of Parkinson's disease has been obtained [2]. It is also possible for the monitoring computer to be located remotely from the patient, e.g., in a different country. Hence, signals within the brain can be tracked in real time and fed into a computer. The computer can analyse these signals and generate alternative signals that are fed directly back into the brain. Effectively, in this example, part of that person's brain resides not only outside their body but physically in a different country.

In another vein, in the 1950s, Olds and Milner [3] implanted electrodes directly into the lateral hypothalamus of the brain in several rats. Each electrode was connected to a stimulator that was activated by the touch of a button. The electrical stimulation was aimed at causing feelings of pleasure. The rats were taught how to press the button themselves, giving them the feeling of pleasure. They were then given the choice between the pleasure button and a button that resulted in them being given food. The rats continually chose the pleasure button even when they were hungry and starving. Very similar results were obtained when rats were replaced by monkeys.

Consider that a brain implant can be employed to overcome clinical depression; when it is switched on, the patient can feel as though a black cloud is leaving them. The individual person is being given positive feelings. It is essentially acting as an electronic drug. Indeed, as the human brain operates electrochemically, drugs can potentially take on either form—electrical or chemical. It is merely a matter of conformity that thus far, almost all drugs are chemically based. In the years ahead, this could change dramatically. Possibly even headaches will be removed by electronic means in the future, as this would be more direct with potentially fewer side effects. Conversely, this could readily be extended for the computer to bring about positive feelings under certain circumstances and negative feelings in other cases.

Communication is vitally important for humans. Philip Kennedy developed an operable system which allowed an individual with paralysis to spell words by modulating their brain activity. Kennedy's device used two simple electrodes: The first was implanted in an intact motor cortical region and was used to move a cursor among a group of letters. The second was implanted in a different motor region and was used to indicate that a selection had been made [4]. As the patient thought about moving their fingers, these signals were translated into signals to move and stop a computer cursor. The patient could see where the cursor was on a computer screen. They could choose when to stop thinking about moving. In this way, words could slowly be spelt out letter by letter or hearing and lighting could

be simply controlled. Although initiated as a therapeutic experiment, the recipient of the implant exhibited abilities that were beyond the human norm.

Another good example is that of Neil Harbisson, who is otherwise colour blind and has a camera which is attached to his skull. Different colours cause the frequency of vibrations to his skull to vary. As a result, he has learned a very high degree of colour discrimination. The technology translates colour frequencies into sound frequencies [5] which are translated into vibrations via an actuator. Initially, Harbisson memorised the frequencies related to each colour, but subsequently he decided to permanently attach the set-up to his head. The project was developed further so that Harbisson was able to perceive colour saturation as well as colour hues. Software was then developed that enabled Harbisson to perceive up to 360 different hues through microtones and saturation through different volume levels. What is particularly interesting about Harbisson's experience is that his discrimination between different colours has improved over time as his brain has adjusted to the different vibrations experienced. Clearly, the extent of brain adaptability is a pointer to what can be expected in general with regard to either extending the present range of sensory input or rather inputting a complex range of new sensory input information into the human brain that until now has not been possible. It is another example of a therapeutic treatment that results in the recipient having abilities beyond the human norm.

Perhaps the most commonly encountered brain-machine interface is the cochlear implant, intended to repair an individual's hearing by connecting electrodes to directly stimulate the auditory nerve fibres. It is estimated that there are at least 600,000 recipients thus far. At first, the person realises electronic signals that may have little meaning, but gradually, their brain adapts to the signals input and learns to recognise them as specific sounds. In some cases, it may be that the individual can comprehend certain higher frequency sounds for the first time in their life. Ordinarily, the frequency range input is aimed at mimicking as much as possible the normal human frequency input. However, there is of course nothing stopping a different frequency range from being input for the brain to learn and/or for the auditory nerve to be stimulated directly from a network rather than from sound waves.

Arguably the technology which has proven to be of the most practically successful in this area is the microelectrode array, currently referred to as the BrainGate. The array is made up of 100 silicon spikes which are 1.5 mm long with a platinum electrode on each tip. The electrodes are linked with platinum wires, and in this way, the array can be employed to both monitor neural activity and also apply stimulating currents. Several trials have been carried out using human studies. In experiments, the array has been fired into either the human brain or nervous system. In the first set of these experiments to be considered, the array has been employed in a purely recording role for therapeutic results.

Electrical activity from a few neurons monitored by the array electrodes, positioned in the motor cortex, has been decoded into a signal that enabled a severely paralysed individual to position a cursor on a computer screen using neural signals for control in combination with visual feedback. The same technique was later deployed to allow the individual recipient, who was paralysed, to operate a robot arm even to the extent of learning to feed themselves in a rudimentary fashion by maintaining sufficient control over the robot arm [6].

We later consider directly the use of this BrainGate implant in a set of experiments which were set up specifically to look at enhancement possibilities.

### 3. Off the Shelf—External Electrodes

In numerous research labs around the world, the concept of a brain-computer interface is actually realised by an interface between the experimentalist's scalp and a computer, see, e.g., [7]. In this method, weak signals from a brain (in terms of scalp-filtered averages from millions of neurons) are fed into a computer such that after significant AI processing, the individual concerned can learn to think in specific ways such that (typically) a connected truck will turn right maybe 8 times out of 10

when they want it to. This is of course purely a one-directional procedure, other than any feedback via the usual sensory route, e.g., their eyes.

It is not the author's intention to dwell on this area other than to acknowledge the research that is going on and to appreciate the possibility of monitoring a brain in this way to further understand what is happening inside with the hope of detecting neurological problems as encountered in cases such as epilepsy. Arguably several other scanning techniques provide similar or better such results. However, the method's big advantage is of course that external electrodes can be relatively easily attached to the outside of the scalp, which makes such research much more doable, thereby considerably reducing any potential problems of infection or rejection. It is interesting to note, however, that in many research papers on the topic, the same partial conclusion appears, which is [8]: "Instead of placing the electrodes on the scalp if they are placed in the cortex itself, it would provide a better result".

Rather, the focus of this article is fundamentally directed towards brain–computer connections involving an implant (or implants) in the brain or nervous system, thereby achieving a much higher resolution with the ability to extract signals from a handful of neurons. Importantly, such a technique is potentially bi-directional, meaning that both (efferent) motor signals can be monitored and (afferent) sensory signals can be applied.

#### 4. Some Future Possibilities

In this section, we look at two possibilities. The second of these is instantly more practical and is based on a set of successfully conducted experiments involving the author. The first, whilst also being based on the scientific experimentation of the author, is perhaps rather more speculative.

It is quite possible to culture networks of dissociated neurons grown *in vitro* in a chamber. The neurons are provided with suitable environmental conditions and nutrition. A flat microelectrode array is embedded in the base of the chamber, thereby providing a bi-directional electrical interface with the neuronal culture. The neurons in the culture rapidly reconnect, form a multitude of pathways and communicate with each other by both chemical and electrical means. Although for most research in the field thus far, the neurons are typically taken from rat embryos, it is quite possible to use human neurons instead once sufficient connections have been made between the neurons so that, in research, the cultured brain is given a robot body with the ability to sense the world and move around in it [9].

Humans are essentially our brains [10]. Our bodies keep our brains functioning, transport them, provide some sensory input and enable each brain to interact with the outside world. However, through evolution, our brains have largely become dependent on the bodies that carry them around. But apart from some limited transplants or artificial organs, when some physical feature malfunctions, then that may well mean the human dies, even though there is essentially nothing wrong with the brain, i.e., the essential self is well but it dies because a (possibly in the future) trivial physical element no longer functions appropriately.

Therefore, if we look to the future, theoretically for the moment, it seems sensible to consider directly keeping the brain alive, somewhat akin to the experimentation described, without its dependence on its physical body. As an example, if a person has liver cancer and dies from this, even though their brain was perfectly OK, it is an unnecessary death. Rather than considering further research into the treatment of such cancers and the like, surely it is better to consider ways to keep the brain alive outside of its present human body, as we presently do with culture experimentation. There is, though, the matter of scale—presently, cultures of typically 150 thousand neurons are supported, whereas with the human brain, we would need to support 100 billion neurons.

In this way, the body could be designed merely to fit around the brain. If something in the body functions incorrectly or stops working, then it can simply be replaced or upgraded. If a better body component becomes available, whether biological or technological, then the newer, more powerful option can be selected. The range of sensory input can be what you want, the abilities of the body can be designed to suit. Life expectancy would be much more enhanced as all of the body could be replaced as needed. A lifetime would be totally the brain's lifetime.

In a different vein, the author also carried out an experiment in collaboration with surgeons at the Department of Neurosurgery and Neurosciences at the John Radcliffe Hospital, Oxford [11]. During a two-hour procedure, a BrainGate array was surgically implanted into the median nerve fibres of the left arm of the author. The array measured 4 by 4 mm with each of the electrodes being 1.5 mm in length. With the median nerve fascicle estimated to be 4 mm in diameter; this meant that the electrodes penetrated well into the fascicle.

The array was pneumatically inserted into the median nerve such that the body of the array sat adjacent to the nerve fibres, with the electrodes penetrating into the fascicle. The array was positioned just below the wrist, following a 4 cm long incision. A further incision, 2 cm long, was made 16 cm proximal to the wrist. The two incisions were connected by a tunnelling procedure such that wires from the array ran up the inside of the left arm, where they exited and connected onto an electrical terminal pad which remained external. The arrangements described remained permanently in place for 96 days. During that time, a series of experiments was conducted.

The terminal pad was directly linked to a computer terminal either by hard wiring or preferably by means of a wireless connection, which enabled mobility. By this means, a ready connection was arranged with the internet. The link was bi-directional such that motor signals due to hand movements could be monitored and decoded whilst, via the same implant, sensory signals from a remote source could be applied to stimulate the nerve fascicle and thereby be fielded by my brain.

A number of different trials relating to human enhancement were successfully realised. These were:

1. Extrasensory (ultrasonic) input was used to detect the distance to objects:

It took approximately two weeks for us to find a stimulating current that my brain could reliably recognise. All we had to go on initially was previous testing on chicken sciatic nerves [12]. Although the waveform was similar, we needed a stronger current at a voltage of 50 v. I wore a blindfold and heard a click; sometimes a stimulating pulse had been applied to my nervous system, sometimes not. After 1 week, I correctly detected 70% of pulses (50% would be the same as guessing); however, after 2 weeks, it was 100%. During that time, for about 2 h every day, we were doing the click testing in the lab. But then, we linked ultrasonic sensors on a baseball cap to cause the stimulation. The closer an object was, the more the frequency of pulses increased. My brain made sense of this immediately: Even with a blindfold on, I knew how far away objects were. So much so that when Iain, one of the researchers, suddenly moved a board quickly towards me, it was very scary—I could detect that something was coming towards me very quickly but I did not know what it was. It felt like a reactive response.

2. A wheelchair was driven solely by motor neural signals:

It was pretty straightforward from the early days of the experiment that we could detect neural signals by means of the implant. Neural signals are very different to, for example, noise or muscular signals, so it is not such a difficult signal processing problem. Understanding what those signals actually mean is a more difficult proposition. However, it did not take a complex algorithm to link neural signals with hand-opening or hand-closing movements. We were working on the project with two hospitals and had obtained a wheelchair from the National Spinal Injuries Centre in Stoke Mandeville Hospital. We then used a simple menu device to link the neural signals with wheelchair operation. By opening and closing my hand, I could move down the menu to my selection—e.g., forwards, backwards, slow, fast—and the chair would follow my wishes. The point is that this would operate exactly the same way, with the same implant, for someone with a spinal injury but with the implant in their motor cortex. It could of course be a car, or any vehicle, rather than a wheelchair.

3. The behaviour of a group of small robots was altered by motor signals:

We were fortunate to have a lab full of little robots. These could exhibit different “emotional” behaviours via ultrasonic sensors. Thus, on detecting another robot, they could act as though they were

scared and try and escape or conversely act aggressively and try and catch the detected robot. This was simply linked to my neural signals such that when my hand was closed, the robots acted in a friendly way, whereas when my hand was open, the robots were aggressive. It was a simple experiment and merely went to show how powerful such an implant can potentially make the recipient.

4. A robot hand was controlled via the internet between Columbia University, USA and Reading University, England. Feedback from the fingertips was also obtained. I think that this experiment, more than any other, had a profound effect on me in that I never expected how I would feel at the time. As scientists, we were just rolling from one experiment to the next without thinking too much about the consequences. But this one was different. In New York, my nervous system was linked, online, with the internet. Security was so tight that we did not tell anyone what we were doing! As I opened and closed my hand in New York, my neural signals also opened and closed “my” robot hand in England. There was a noticeable fraction of a second delay in the process, but my brain did not seem to be bothered by it. As the hand gripped an object, signals from sensors in the fingertips gave me an accurate description of just how much force the hand was applying. I could see the hand by video link, but if I did not look, I could still hold on to an object and not apply too much pressure. Essentially, my nervous system was being stimulated by pulses, the frequency of which depended on how much pressure the robot hand was applying in England. In this experiment, I was trying to open and close my robot hand in order to get the pulses to die down to almost zero. This was very successful and made me realise just how powerful an individual is when their brain/nervous system is extended by a network.
5. A basic form of telegraphic communication was achieved between two human nervous systems.

I have something of a communications background, and for me, this was the icing on the cake. A volunteer assisted by having microneurography. Essentially, two very thin needles were pushed into the nervous system in their left arm. With this in place, we set up in the lab with a group of people around the volunteer and another group around me—we had a variety of different observers to oversee what we were doing. The volunteer and I were not able to see each other. We set the experiment up purely based on hand closures. When the volunteer closed their hand, I received a stimulating pulse on my nervous system, and the same happened vice versa. For me, it meant that my brain recognised the pulse. I shouted out “Yes” every time I felt a pulse, but only when I felt a pulse. Only the group around the volunteer could witness when they had closed their hand and when not. We achieved this with 100% success—the same being true in reverse. What I found exciting was that as the groups were splitting up, I felt a couple of quick pulses one after the other. Subsequently, the volunteer confirmed that they had done this. It was a “secret” message between the two of us, a new means of communication.

In every one of the experiments just described, the *raison d’être* could be heralded as being for therapeutic purposes, e.g., ultrasonic input for a person who is blind. However, in each case, the trial can rather be regarded as an enhancement beyond the human norm. Clearly, such enhancements throw up a multitude of intellectual and technological opportunities, but they also realise a range of ethical considerations. Indeed, there may be persons who do not wish others to exhibit such enhancements, whereas, on the other hand, individual freedom dictates that an individual can so upgrade themselves if they want. That said, individual freedom is not an absolute in many societies in the world today, and in any case, the freedom of one individual must be balanced with the effect of that individual on the freedom of others.

## 5. Enhancements

In this paper, we have considered the potential for enhancing humans, thereby creating superhumans, mainly in terms of upgrading the human brain. Practical examples, described in the previous section (in terms of implant experiments), have shown that it is possible to directly control, from brain signals alone, remote technology, with real time feedback also possible. It was also shown

how senses could be enhanced. Although ultrasonics was employed in the experiments, a plethora of signals could be attempted, e.g., infrared, X-ray or ultraviolet. How well the brain can employ such signals and how much use the signals would be remains to be seen. An old film considered a man with X-ray eyes [13], whereas we are “looking” here at the possibility of X-rays as an extra sense.

Perhaps the most significant achievement was a new form of telegraphic communication directly between the nervous systems of two people. When a similar experiment is achieved directly between two human brains, then this will be a sort of telepathy, a form of thought communication. It then remains for us to witness just how well this will work. The possibility is real for communication between humans in terms of feelings, colours, images, emotions, as well as the sort of message passing we have now. But speed and accuracy could be much improved in this enhanced way, and potentially, misunderstandings can be much reduced. Many of the problems in our present, poor form of communication can be overcome.

In our favour is the fact that the human brain is very adaptive and can learn to operate with extra abilities, even at an older age. It may well need to ground each extra ability in terms of how it already functions, what it knows, but expand in this way it can. What limits the potential forms of enhancement in the first instance is our limited understanding not only of how the human brain functions but also of the world in which we live.

What we are considering here is the creation of superhumans by linking human brains with computers, potentially artificial intelligence, thereby upgrading the functioning of the individual human brain whilst, at the same time, linking brains (both human and machine) together in a much closer way than they have been to this day. This will be brought about in terms of a port (or more likely a number of ports) into each brain—probably of a similar form to the BrainGate employed in the experimentation.

With a human brain linked to a computer brain in this way, that individual could have the ability to (1) use the computer part for rapid maths, (2) call on an internet knowledge base, quickly, (3) have memories that they have not originally themselves had, as has been investigated [14], (4) sense the world in a plethora of ways not possible to humans (e.g., ultrasonic, infrared), (5) understand multidimensionality, as opposed merely to 3D for the human brain alone and (6) communicate in parallel, by thought signals alone, i.e., brain to brain.

Although this list of enhancements is, to an extent, speculative, it is the sort of list that can be employed in terms of an hypothesis, the truth of which is to be discovered through experimentation. Thus, it may turn out that some items on the list do not turn out to be practically useful, whereas other items may turn out to be mere steps on the way to abilities that are more far-reaching.

Whilst each of the items on the list can be explored in more depth, some of them are more profound than others. For example, thought communication will no doubt bring about a raft of changes to our present human consciousness, a big issue here being how superhumans with such an ability will subsequently regard humans who communicate as at present. This is to be looked at further in the next section.

One of the items with far reaching consequences is number 5. Human brains regard the world around us in terms of a three-dimensional understanding. Of course the world is not three-dimensional; that is merely the complexity of model that humans use. Our beliefs around what is possible and what not are largely based on this limited understanding. Hence, we have major issues with space travel (we have to this time still only visited the Earth’s moon). Getting to the edge of the solar system might well take a human many years because of our 3D understanding. Clearly, this is not particularly practical.

But if our superhuman brains can understand the world around us in terms of hundreds of dimensions, which our part artificial intelligence brains will be able to cope with, then many things that are presently difficult or realistically impossible may well become quite possible and even relatively simple. As superhumans, we may be able to travel through the universe *Star Trek* style.

It is worth also dwelling a little on the successful experiment involving the BrainGate implant in which a robot hand was controlled via the internet including feedback from the hand's finger tips. Effectively, the internet was acting as an extension to the human nervous system. In a telephone call, sound waves are transformed into signals (initially electrical), transmitted over enormous distances and then reconstituted as sound wave signals. The sound waves themselves have very limited range, but in this transformation, their range can be much enhanced. The same is exactly true with the human brain and nervous system. What was actually achieved in the experiment was a monitoring of neural motor signals, via the implant in the nervous system. These were then transformed into information on the internet and reconstituted as motor signals in another country to drive a robot hand. The same procedure was true in the reverse direction for the touch sense.

Clearly, this opens up a wide range of future possibilities for enhanced humans. Whilst the person's brain (along with some sort of brain supporting body) is in one place, their new body can be anywhere the network is operational. A different continent certainly, but it could also be on several different planets at the same time. Perhaps, in the future, your brain can stay on earth, but your body will be able to travel to other planets, only to be reconnected on arrival. Importantly, as far as your brain is concerned, when you are fully connected, it will "feel" like it is your own body, which, for all intents and purposes, it will be. Although it will also be possible to swap or share body parts with other people.

I personally found that out with my brain in New York, USA and my robot hand in Reading, England; my brain had no problem with this even though there was a fractional time delay from the moment my brain thought about moving to the time the robot hand actually moved. Indeed, our brains deal with a time delay anyway due to the time it takes a signal from your brain to travel down your nervous system to move a hand or leg. In the case of the experiment, the time delay was a little longer, but my brain quickly adjusted to that.

A robot hand was employed in the experiment to show what was possible, but also to show how the technology could be employed for therapy for an artificial hand or leg in the case of an amputation. In reality though, in the future, the appended (network-connected) new body parts will not need to be legs or arms and hands but can be anything at all. Thus, it will be quite possible to have a building or a vehicle or a financial system as new body parts, directly connected with your brain—as far as your brain is concerned, it will be your body. How easy it will be for the brain to understand what is going on remains to be seen. It may take some time for the brain to adjust and fully implement its new body. But, as in Kafka's *Metamorphosis* [15], once your brain has adapted, it will be as though it is perfectly normal.

## 6. Discussion

The realisation of superhumans with significant powers over and above those of regular humans presents enormous questions that affect all aspects of human society and culture. When attempting to consider the possibilities, a plethora of positives and negatives appear. What is clear, however, is that standing still is not an option. On the one hand, if humans opted by some global agreement for a non-superhuman future (if that were possible), could the end result actually be an intelligent machine superculture as described in [16,17], leading to the handing over of control on earth to intelligent machines? On the other hand, if humans globally opted for a superhuman future, could society and culture cope with such a distinct nonlinearity in evolution? Maybe we should not worry about it anyway, as it would be a superhuman culture that faced the nonlinearity.

It could be felt that humankind is itself at stake [18]. A viewpoint can then be taken that either it is perfectly acceptable to upgrade humans, turning them into superhumans, with all the enhanced capabilities that this offers, or it could be considered that humankind is OK as it is and should not be so tampered with. Realistically though, humans have always gone for progress—indeed, it is part of our nature, possibly even in our genetic make-up. How would the not-for-progress humans, who want us all to remain as humans, be able to prevent the progress in any case?

As we have discussed in this paper, the most important issue is that we are considering a completely different basis on which the superhuman brain operates—part-human and part-machine. When the nature of the brain itself is altered, the situation is complex and goes far beyond anything encountered with mere physical extensions, such as the ability to fly in an airplane. Such a superhuman would have a different foundation on which any of their thoughts would be conceived in the first place. From an individualistic viewpoint, therefore, as long as I am myself a superhuman, I am very happy with the situation. Those who wish to remain ordinary humans, however, may not be so happy.

With a brain which is part-human, part-machine, superhumans would have some links to their human background, but their view on life, what is possible and what is not, would be very much different from that of a human. Of course, this would all depend on the newly acquired abilities and what effects these have on the mixed consciousness. Would all superhumans have similar abilities, or would it be a case of picking and choosing? Importantly, each individual's values would relate to their own life, and ordinary humans may not figure too highly. Different superhumans would most likely exhibit very different abilities. Some, such as thought communication, would be highly desirable, whereas others might be OK for some but not for others. Just how these differences pan out is impossible to say at this stage.

One aspect is that superhumans would have brains, which are not standalone but rather are connected to each other directly via a network. A question is, therefore: Is it acceptable for humans to give up their individuality and become mere nodes on an intelligent machine network? Or is it purely a case of individual freedom, i.e., if an individual wants to so upgrade, then why not? Would the network become the most important aspect with each node being of little value? It must be remembered here that we are looking at an intelligent network. Would there, as a result, be some sort of network consciousness?

Some questions are obvious. Should every human have the right to be upgraded? If an individual does not want to upgrade, should they be allowed to defer, thereby taking on a role in relation to superhumans, perhaps something like a chimpanzee's relationship with a human today? How will the values of superhumans relate to those of humans? Will humans be of any consequence to superhumans other than something of an awkward pain to be removed if possible [19]?

It is sensible to be clear that with extra memory, high-powered mathematical capabilities, including the ability to conceive in many dimensions, the ability to sense the world in different ways, communication by thought signals alone and having a networked body, superhumans will be far more powerful, intellectually, than regular humans. It would be difficult to imagine that superhumans would want to voluntarily give up their powers in order to satisfy the grumbles of mere humans. Indeed, why would superhumans, who can communicate just by thinking with each other, pay any heed to the trivial utterances of humans, based on serially modulated sound waves—very slow, very simple and highly error-prone?

The fundamental philosophy that underpins the concept of the future relationship between superhumans and humans comes straight from Nietzsche [20]. We need to look no further than humans' present-day relationship with other animals. Humans cage them, destroy their habitat and treat them as captives, slaves or pets. Thus, if we look to the future, the best that a human could hope for might be that they become the pet of a superhuman.

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