Cyborg Technologies: Controlling Evolution or Abomination of Man?

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Starting as early as the 1930's, man has considered the possibility of augmenting himself with the power and capabilities of machine. According to Tara Abraham, by the end of the 1930's scientists of the Rockefeller Foundation had found two successful methods of cerebral localization, utilizing electrical stimulation and causing brain lesions in animal subjects (Abraham 556). This advancement eventually lead to a great step in cybernetic study, where, according to V I. Gritsenko, beginning in the 1960's persisting through to the present, cybernetic studies have evolved and continue evolving from hypothetical models to functional physiological systems that are able to be integrated into the human system (Gritsenko 626). Through these impressive steps, many new ideas have emerged from intrigued minds. From science fiction writers come such fanciful concepts of the cybernetic organism as RoboCop, Darth Vader, and the Six Million Dollar Man. According to Maartje Schermer, the average layman has difficulty discerning between which technologies are science fiction, which are science fact, and even which are theoretically possible. Schermer warns that researchers will produce much hype in order to acquire better funding for their research; however, there are truly incredible technologies being produced presently (217). It behooves everyone to wonder the extent of technology today, and what may be produced tomorrow. Awareness of potential technologies is important not only for the sake of curiosity, but for the sake of caution. Almost every science fiction movie ever written warns of the potential dangers advancements in technology can hold. Cybernetics, more

so than many, has great potential for both the advancement, as well as the destruction, of the human race. Current advancements aid those with disabilities; however, the potential to take control of our own evolution produces much hype as well as fear of the hypothetical dangers. Before getting carried away in negative possibilities, it is important to first look at what is currently happening in the field of cybernetics.

Cybernetics and Cyborg Sciences: State of the Art

The first point one must understand as it pertains to cyborgs and cybernetic technology is the broadness of the term. Many come to the image of a half man half machine creature. While this is one example of a cyborg, it is one of many. The definition of a cyborg is a person whose physiological functioning is aided by or dependent upon a mechanical or electronic device. According to Moore, the term cyborg covers even those who are aided by "the use of contact lenses, eyeglasses, hearing aids, or dentures…" as this represents "technological augmentation of human functioning" (41). While this misconception leads many to opposition, disbelief, or even ridicule, the reality of it is that cyborgs represent the majority of a typical population. According to Linda Moore, Transhumanits such as Kevin Warwick believe research into cyborg and cybernetic technologies should proceed unhindered by ethical concerns. More believes this is primarily due to the belief that the human race is already becoming more cyborg-like, due to our growing dependence on our external technologies rather than those we were born with (42). Moreover, Warwick proposes our options are embracing cybernetic technologies to improve upon ourselves, or otherwise reject cybernetic technologies and instead continue improvement on other technologies to the point our technologies become superior to us (133).

With this ultimatum in mind, Warwick infers cybernetic technologies will continue advancement regardless of skepticism, comparing the topic to wishing away an incoming missile (132).

However, for the time being, cyborg technologies are primarily used for the repair or replacement of disabled human body parts.

One cybernetic technology surprisingly few people believe to be actualized is the visual prosthetic. According to Peter Walter, the concept of all visual prosthetics is that electrical signals are fired by the optic implant through electrodes connected to the visual system as though it had received the signal through the traditional route. Providing further detail, Walter describes how, in this system, a camera attached to the outside of the retina will send captured information to a processing unit which determines the pulse pattern that is sent (516). There are many types of visual prosthetics being researched today. Walter describes one such prosthetic, the retinal implant as a device designed specifically to treat the loss of photoreceptors within the optic system. He explains that diseases such as Retinitis pigmentosa can cause complete loss of photoreceptors, causing complete blindness. In cases like this, Walter claims retinal implants of sixteen to twenty five electrodes can create enough visual stimulation to provide minimal to moderate visual awareness. In some cases, only central photoreceptors are damaged, leaving peripheral receptors intact. In these cases, an implant of more than 500 electrodes can be used that may allow as much visual functionality as reading and face recognition (516). Another form of visual prosthetic Walter describes is the epiretinal implant which, like other implants, consists of an image capture device on the outside of the eye; however, the epiretinal implant's external apparatus is also responsible for data processing and encoding, data transfer, as well as energy supply. Inside the eye is the part which carries the electrodes to the receptors. Transferring information from the two devices can be done through a physical or wireless connection (516). The next type of visual prosthetic Walter describes is the subretinal implant. A Subretinal implant consists of thousands of microphotodiodes under the retina which convert light into a

current serving to activate the postsynaptic neurons. Epiretinal implants can be built larger than subretinal implants, increasing the potential field of vision. The process of implanting a visual prosthetic is relatively new; therefore, safer methods of surgery are constantly being explored. The primary issue is attaching the electrodes to the eye. Tacks are commonly used, and while this achieves high stability, other complications may occur. Research into special glues to remedy this is well underway (516) In his article "Implants for Artificial Vision", Walter goes on to explain in detail all of the forms of visual implants currently in development (516). While that goes beyond the scope of this paper, it is clear this field of study has great potential for those suffering blindness. Many might speculate, there is the potential for expanding the technology even beyond what is possible for those with the best vision.

Another form of prosthetic designed to aid the disabled is the prosthetic hand. The prosthetic hand is designed as a substitute for an amputated or otherwise absent hand. As Carroza describes, the problem, as well as the cause for ongoing research and development, is current artificial hands are little more than primitive grasping devices. They simply do not reach a standard amputees would expect (629). Some of these devices are controlled by subtle muscle movement, while others attempt to be controlled by intention alone (Carroza 632). While throughout history a hand replacement may be a hook or a simple grasping mechanism, Carroza states that today's prosthetic hands are based on biomechanical modeling of an actual hand, and are designed for both stability and judging the user's intent in order to respond appropriately (629). A system of complex subsystems is responsible for monitoring the interactions between the hand and any object the hand interacts with, as well as how that object interacts with the environment. Carroza goes on to explain that the hands are designed to supply a multitude of functionalities including reaching, grasping, exploring, minor manipulation, gesturing, and even

levels of sensation (630). It is easy to speculate that the not too distant future of hand prosthetics looks promising for those in need of such devices. This, along with the visual prosthetic, are clearly designed to improve the quality of life of a disabled person. However, there are prosthetics being developed and improved upon in the medical field designed for life and death situations, such as the pacemaker, which need to be considered thoroughly.

The development of a cybernetic lung has proved to be both challenging and essential for the purpose of respiratory support. According to Kristie Burgess, current artificial lungs are composed of small hollow fiber sacs within a container (117). Burgess goes on to explain that current artificial lungs are limited in their potential for gas exchange due to the size and shape of the fiber sacs. He states this presents the problem that the artificial lung must be larger than what the human body can internalize (123). However, researchers are developing a microfabricated biohybrid artificial lung which, due to its increased surface to volume ratios, is much more efficient than what was seen prior. The problem of biocompatibility is also eliminated as it is a biohybrid (Burgess 118). The drawback is the time consumption involved in producing this technology, while the motivating factor being a person potentially remaining under this artificial lung's support for several months (Burgess 125).

Judging from these facts, it becomes clear cybernetic study, as it stands today, has gone far in improving the quality of life for disabled individuals. However, the question remains, at what point is it acceptable to begin improving the quality of life for the average person. Is it acceptable to eliminate the need for a forklift by increasing a human's lift potential exponentially? What ethical concerns need to be explored before diving head first into the incredible concept of the human upgrade?

The Controversy: What Could We Do Versus What Should We Do

Cybernetic study has been a topic of great debate since studies began in the 1930's. The greatest roadblock in cybernetic advancement is the wide range of differing opinions on the topic, especially as it pertains to new and proposed technologies. While ignorance should not be tolerated it is also important to maintain a healthy level of skepticism. The technological imperative, which many scientists would defend, states that if a technology is developed, it must be used. Therefore, full consideration of ethical implications, as well as potential side effects implementation of these technologies may present, is necessary.

Finance is a huge issue concerning the ethics of cybernetic technology. According to Linda Weaver Moore, this is because, as new technology emerges, it will only be available in research facilities where the prices are high and insurance will generally not cover the expense. She explains, those with the deepest pockets will be able to afford these treatments, while those with the greatest need will go without. Moore goes on to provide an example stating, "such medical centers as those affiliated with Duke University and Oregon State University, come with price tags ranging from $20,000 to $40,000" (41).

Another issue of controversy, as Moore states, is that differing philosophical views on what it means to be human also has an effect on people's views on this technology (Moore 41). She continues, describing a group calling themselves Transhumanists, who believe a superior species of humans will eventually emerge from constant reengineering of the human body. They believe that being human, as a biological creature, is one step towards becoming something greater. Scholars holding this view believe cybernetic studies should continue unhindered by debate on whether or not such advancements are moral or ethical, as they believe this is simply destined to happen, or as Warwick states "I was born human. But this was an accident of fate, a

condition merely of time and place. I believe it's something we have the power to change" (qtd. in Moore 42).

Warwick, a supporter of advancing cyborg technologies, has his own concerns. The true ethical dilemma, as Warwick sees it, is when the personality of the subject is altered by machine interaction with the cognitive process. This may become reality when the machine part of a cyborg's mind is connected to a network (Warwick 131). This scenario, Warwick describes, poses a threat to human individuality, and creates the possibility of taking control over another's body wirelessly. Warwick goes on to voice his contemplations on whether cyborgs will carry the same moral values as humans, as well as if cyborgs will regard humans as a sub-race due to their advanced processing skills (132).

Maartje Schermer's claim is that the primary ethical concern in cyborg technology is the effect it has on the brain and how that may affect our legal system. She states that while morality is defined as a shared system of norms, there are cases that suggest machine interaction with the brain may effect what we consider right and wrong. This poses the question of who is to blame when a machine component housed within a human body causes the host to break a law; people can be held accountable for their actions, whereas machines cannot (Schermer 221). Schermer insists it is becoming increasingly difficult to distinguish the line between human and machine, that we follow to our biological makeup as a computer would its software, and as such, free will is a myth. This concept implies there is no moral responsibility and man is simply a biologically motivated being who can be controlled through punishment and reward; furthermore, this would ask that our justice system be changed from a system of punishment to that of correction (Schermer 226). This shows a few of the most common ethical, political, sociological, and scientific concerns regarding cybernetic and cyborg technologies. However, the balance of

morality appears to be held by present applications of such technology. What tips the scale in favor of the cyborg may very well be the potential benefits the cyborg may present for mankind in the future.

Future of Man and Machine: Intertwined?

Transhumanist researchers like Kevin Warwick see great potential in the field of cybernetics, and more specifically, the augmentation of human ability through use of cyborg technologies. Warwick backs his commitment to the field by stating his claim that cyborgs, being of man and machine, have a potential processing power exponentially greater than that of an average human being. He compares the two, saying the calculations an average man could perform in a week, a computer could carry out in a third of a second (132). Further backing his claim, Warwick suggests a human brain linked with that of a computer may be able to acquire and utilize false memories, sense the world in ways otherwise impossible, communicate through thoughts in full duplex as computers do, and access internet databases faster than an average person could recall information (133). Kevin Warwick describes a famous experiment which he performed on himself in 1998, where he had a silicon transponder chip implanted surgically in his upper left arm. He emphasized that this was not for a medical purpose but merely because he wanted to know what it felt like to have implanted technology in himself. As he entered his office a radio signal, positioned in the doorway, would give power to the implanted chip, causing the chip to relay an identification signal. The identification signal would be received by a computer connected to a local network, which then would track his movement, supplying him with automatic access to his office, as well as such luxuries as automatically opening doors and customized greetings upon entry (Warwick 133-134). This is only a proof of concept experiment; however, the applications in the fields of security and entertainment should be clear.

In Warwick's 2002 experiment, again he surgically attached an implant to his left arm; however, this time it was connected directly to his nervous system. With this, Warwick was not only able to record the signals which were transmitted during arm motion onto the computer, but he was also able to play these messages back, from the computer to his arm, causing a majority of the original motion to reoccur (134). Warwick boasts that with continued research into these findings, he was eventually able to control a mechanical arm, located halfway around the world, simply by moving his own arm which was then connected to a global network (135). In yet another example of Warwick's unique experimentation, he connected an ultrasonic sensor, typically used as guidance in complex robotics, directly to his nervous system where he found he was consciously able to comprehend and utilize the incoming information (134). In other words, Warwick was able to guide himself with ultrasonic perception, a sensory technique that mankind has never known, simply by connecting himself properly to the technology.

Conclusion

It is easy to speculate a potential for increased overall life longevity, as the parts which most frequently fail us are more easily replaced or fixed. Within the next fifty years we may see an exponential increase in the average, lifespan, but while immortality seems to be the goal all sciences strive for, there are certainly some ethical concerns to be addressed before such an endeavor is achieved. Is it something left to the government, the military, or to whom then, to decide which of us is fit to live forever? Is this a technology best left for those who can afford it? It seems these are all questions that are nearly impossible to answer until they are brought to the awareness of our society which will likely not happen until such technology is made readily available. Some would believe this suggests that basing which technologies may be researched based on these questions seems to be an exercise in futility. Others believe waiting until the

technology becomes available will be too late, that a consensus of desire for immortality will override any attempt at control over such technology. Ultimately the decision comes down to awareness of what is being developed, and who and why it is being developed for. We must come out of the doubtful mind set ignorance has set for us, while avoiding falling into the mindset of the technological imperative. Technology can be neither good nor evil and therefore must be approached with respect, caution, and preferably good intentions.

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