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Cyborg (Cybernetic Organisms)

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Abstract: ***In the years ahead we will witness machines with intelligence more powerful than that of humans. This will mean that robots, not humans, make all the important decisions. It will be a robot dominated world with dire consequences for humankind. Is there an alternative way ahead? Humans have limited capabilities. Humans sense the world in a restricted way, vision being the best of the senses. Humans understand the world in only 3 dimensions and communicate in a very slow, serial fashion called speech. But can this be improved on? Can we use technology to upgrade humans? A Cyborg is a CYBernetic ORGanism, part human part machine. In this, we will go through Kevin Warwick's amazing steps towards becoming a Cyborg. The story is one of scientific endeavor and devotion, splitting apart the personal lives of himself and those around him. This astounding and unique story takes in top scientists from around the globe and seriously questions human morals, values and ethics.***

Keywords: targeted muscle reinnervation, brain cranial direct current stimulation,Brain computer interface

1. Introduction

From a cybernetics viewpoint, the boundaries between humans and machines become almost inconsequential. Self-imposed human subject boundaries are seen as being nothing more than historical and philosophical dinosaurs that arise from evolved human mental states. The human and machine together become an integrated system, a Cyborg, part human part machine. The question then arises as to what exactly is and what isn't a Cyborg. Some could regard a blind man with his cane (Bateson 1972) as a Cyborg, the cane feeding important information on the local environment, to the man. Meanwhile a hearing aid for a deaf person or even a pair of worn glasses could come into the same category. More recently some researchers in the field of wearable computers have become self-professed cyborgs (Pentland 1998). We have witnessed many intrusions into the human body beautiful. Cochlea implants are now relatively common, as indeed are hip replacements; and heart pacemakers, whilst not being so prolific, continue a trend in which technology is readily accepted as being a necessary intrusion. But each of these, and the list is not conclusive; represent modifications intended to compensate for deficiencies (Hayles 1999). Even in these instances the establishment of conceptual limits and boundaries becomes a complex process. The situation lands up on more difficult terrain when, rather than repairing the ineffective parts of a human body, technology is employed to enhance normal functioning. Many examples of this already exist, particularly in the military domain, such as infrared night sight incorporated into weapon sighting systems or voice controlled firing mechanisms introduced into the helmet of a fighter pilot. In her seminal work (Harraway 1985) "A Manifesto for Cyborgs: Science, Technology and Social Feminism in the 1980s," Donna Harraway discussed these issues as part of the cyborg's disruption of traditional categories. Clearly the Cyborg violates the human/ machine distinction. But should such entities, if indeed they are truly cyborgs, present an ethical problem? Surely they are no different to a spider using a web to catch a fly or a chimpanzee employing a stick with which to extract termites from a mound, which can be seen as vital functioning for those creatures. In each case, although the individual's physical capabilities take on a different form and their abilities are possibly enhanced, their inherent mental state, their consciousness, their perception, has not been altered other than to the extent of itself concluding what the individual might be capable of accomplishing. Where the cyborgs represent a powerful ethical dilemma is in the case when an individual's consciousness is modified by the merging of human and machine.

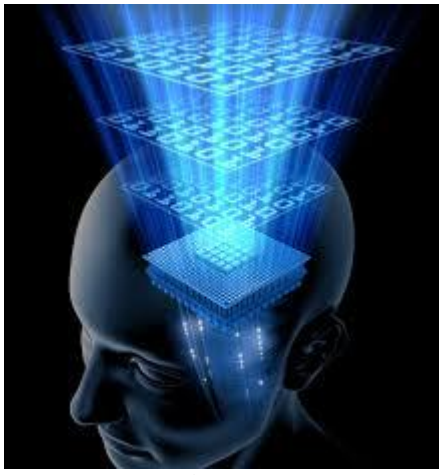

Figure 1

Essentially it is not so much the physical enhancements or repairs that should be our cause for concern but where the nature of an individual is changed by the linking of human and machine mental functioning. In the case of a human this means linking technology directly with the human brain or nervous system, rather than by a connection which is either external to the nervous system but internal to the body or even one which is external to both. To be clear, the type of cyborg considered in this paper is one in which the cyborg is formed by a human, machine brain/nervous system coupling. Whilst this does refer to a relatively narrow definition with respect to all cyborg possibilities, much of the arguments that follow are dependant on such a definition. Connections between technology and the human nervous system not only affect the nature of the individual, raising questions as to the meanings of 'I' and 'self' but they also directly influence autonomy. An individual human wearing a pair of glasses, whether they contain a computer or not, remains respectfully an autonomous being. Meanwhile a human whose nervous system is linked to a computer not only puts forward their individuality for serious questioning but also, when the computer is part of a network or at least connected to a

network, allows their autonomy to be compromised. It is this latter class of Cyborg that is the subject of this paper. The main question arising from this discourse being: when an individual's consciousness is based on a part human part machine nervous system, in particular when they exhibit Cyborg consciousness, will they also hold to Cyborg morals, values and ethics? These being potentially distinctly different to human morals, values and ethics. Also, as a consequence, will cyborgs, acting as post humans, regard humans in a Nietschian like way (Nietsche 1961) rather akin to how humans presently regard cows or chimpanzees? Some may prefer to look through Hollywood-style, philosophical pink glasses (Harraway 1985) and see post-human cyborgs as being "conducive to the long range survival of humans." Surely it will be the cyborgs themselves that will make the ultimate pro-human, anti-human decisions. A missile heading towards an individual will not cease from its course and disappear, simply because that individual does not like the thought of missiles or does not exhibit the intelligence to comprehend them.

2. Father of Cyborg

Professor Kevin Warwick, the world's leading expert in Cybernetics, here he unveils the story of how he became the worlds first Cyborg in a ground breaking set of scientific experiments.

In the years ahead we will witness machines with an intelligence more powerful than that of humans. This will mean that robots, not humans, make all the important decisions. It will be a robot dominated world with dire consequences for humankind. Is there an alternative way ahead?

Humans have limited capabilities. Humans sense the world in a restricted way, vision being the best of the senses. Humans understand the world in only 3 dimensions and communicate in a very slow, serial fashion called speech. But can this be improved on? Can we use technology to upgrade humans?

The possibility exists to enhance human capabilities. To harness the ever increasing abilities of machine intelligence, to enable extra sensory input and to communicate in a much richer way, using thought alone. Kevin Warwick has taken the first steps on this path, using himself as a guinea pig test subject receiving, by surgical operation, technological implants connected to his central nervous system.

A Cyborg is a Cybernetic Organism, part human part machine. In this book Kevin gives a very personal account of his amazing steps towards becoming a Cyborg. The story is one of scientific endeavour and devotion, splitting apart the personal lives of himself and those around him. This astounding and unique story takes in top scientists from around the globe and seriously questions human morals, values and ethics.

Overriding everything, at the expense of a normal life, is Kevin's all-encompassing scientific quest and desire to be a Cyborg.

3. Technology Used

A. Brain Computer Interface

Neuroprosthetics is an area of neuroscience concerned with neural prostheses. That is, using artificial devices to replace the function of impaired nervous systems and brain related problems, or of sensory organs. The most widely used neuroprosthetic device is the cochlear implant which, as of December 2010, had been implanted in approximately 220,000 people worldwide.[4] There are also several neuroprosthetic devices that aim to restore vision, including retinal implants.

The difference between BCIs and neuroprosthetics is mostly in how the terms are used: neuroprosthetics typically connect the nervous system to a device, whereas BCIs usually connect the brain (or nervous system) with a computer system. Practical neuroprosthetics can be linked to any part of the nervous system—for example, peripheral nerves—while the term "BCI" usually designates a narrower class of systems which interface with the central nervous system.

The terms are sometimes, however, used interchangeably. Neuroprosthetics and BCIs seek to achieve the same aims, such as restoring sight, hearing, movement, ability to communicate, and even cognitive function. Both use similar experimental methods and surgical techniques.

B. Transcranial direct current stimulation

Transcranial direct current stimulation (tDCS), is a non-invasive, painless brain stimulation treatment that uses direct electrical currents to stimulate specific parts of the brain. A constant, low intensity current is passed through two electrodes placed over the head which modulates neuronal activity. There are two types of stimulation with tDCS: anodal and cathodal stimulation. Anodal stimulation acts to excite neuronal activity while cathodal stimulation inhibits or reduces neuronal activity.

Although tDCS is still an experimental form of brain stimulation, it potentially has several advantages over other brain stimulation techniques. It is cheap, non-invasive, painless and safe. It is also easy to administer and the equipment is easily portable. The most common side effect of tDCS is a slight itching or tingling on the scalp.

Several studies suggest it may be a valuable tool for the treatment of neuropsychiatric conditions such as depression, anxiety, Parkinson's disease.

EEG:

The electroencephalogram (EEG) is a measure of brain waves. It is a readily available test that provides evidence of how the brain functions over time.

The EEG is used in the evaluation of brain disorders. Most commonly it is used to show the type and location of the activity in the brain during a seizure. It also is used to evaluate people who are having problems associated with brain function.

TArgeted muscle reinnervation:
The "bionic arm" technology is possible primarily because of two facts of amputation. First, the motor cortex in the brain (the area that controls voluntary muscle movements) is still sending out control signals even if certain voluntary muscles are no longer available for control; and second, when doctors amputate a limb, they don't remove all of the nerves that once carried signals to that limb. So if a person's arm is gone, there are working nerve stubs that end in the shoulder and simply have nowhere to send their information. If those nerve endings can be redirected to a working muscle group, then when a person thinks "grab handle with hand," and the brain sends out the corresponding signals to the nerves that should communicate with the hand, those signals end up at the working muscle group instead of at the dead end of the shoulder.

Rerouting those nerves is not a simple task. A Procedure known as "targeted muscle reinnervation." is used to implement this. Surgeons basically dissect the shoulder to access the nerve endings that control the movements of arm joints like the elbow, wrist and hand. Then, without damaging the nerves, they redirect the endings to a working muscle group. In the case of the RIC's "bionic arm," surgeons attach the nerve endings to a set of chest muscles. It takes several months for the nerves to grow into those muscles and become fully integrated. The end result is a redirection of control signals: The motor cortex sends out signals for the arm and hand through nerve passageways as it always did; but instead of those signals ending up at the shoulder, they end up at the chest.

To use those signals to control the bionic arm, the RIC setup places electrodes on the surface of the chest muscles. Each electrode controls one of the six motors that move the prosthetic arm's joints. When a person thinks "open hand," the brain sends the "open hand" signal to the appropriate nerve, now located in the chest. When the nerve ending receives the signal, the chest muscle it's connected to contracts. When the "open hand" chest muscle contracts, the electrode on that muscle detects the activation and tells the motor controlling the bionic hand to open. And since each nerve ending is integrated into a different piece of chest muscle, a person wearing the bionic arm can move all six motors simultaneously, resulting in a pretty natural range of motions for the prosthesis.

4. Applications

a) In Medicine

In medicine, cyborgs play a vital role. It is used widely as cochlear implants, retinal implants, artificialliver, artificial kidney, artificial stomach, prosthetic limbs, hip joint system, artificial heart.

Artificial pace maker:
The primary purpose of a pacemaker is to maintain an adequate heart rate, either because the heart's natural pacemaker is not fast enough, or there is a block in the heart's electrical conduction system. An artificial pacemaker is a small device that is put just under the skin of your chest (below your collar bone) to help your heart muscle pump blood regularly. Like your heart sown electrical system, it uses small electrical currents to stimulate your heart muscle to make it contract. An artificial pacemaker will not be rejected by your body. An artificial pacemaker has a pulse generator and one or more leads. The pulse generator is a tiny, sophisticated computer powered by a very reliable lithium battery (the type of battery used in cameras and watches). A pulse generator lasts many years and is about the size of a 50 cent piece

Hearing aid:
A hearing aid is an electronic, battery-operated device that amplifies and changes sound to allow for improved communication. Hearing aids receive sound through a microphone, which then converts the sound waves to electrical signals. The amplifier increases the loudness of the signals and then sends the sound to the ear through a speaker. An electronic apparatus that allows people with severe hearing loss to recognize some sounds, especially speech sounds, and that consists chiefly of a microphone and receiver, a processor that converts speech into electronic signals, and an array of electrodes that transmit the signals to the cochlear nerve in the inner ear.

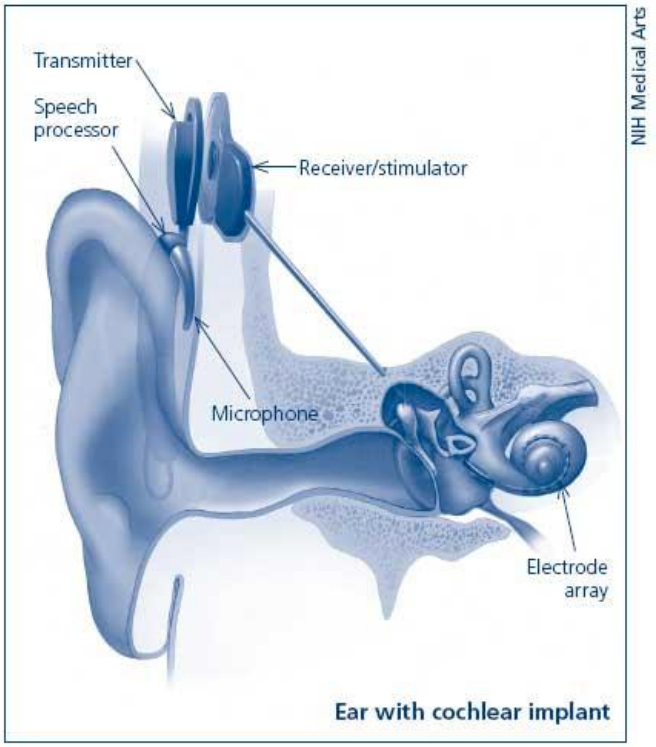

Figure 2:

b) Bionic Arm

A prosthetic arm that moves and feels like the real thing is now a step closer thanks to a new surgical technique which allows the owner to intuitively control her limb and regain her sense of touch. Most of the advanced prosthetic arms on the market are powered by myoelectric motors that respond to contraction of muscles in the chest and back. But these are limited, because they allow only one movement at a time, such as bending the elbow or opening the hand, and amputees must learn to contract their chest and back muscles to cause these movements.

Figure 3: bionic arm

In a commentary published in The Lancet medical journal, Dr Leigh Hochberg, a neurologist at Massachusetts General Hospital, said early results for the new operating system for the limb were "an important step forward in the seamless integration of replacement limbs into the body".

Dr Hochberg said the next stage would be for touch sensors on the artificial hand transmitting signals back to the re-routed nerves, allowing patients to have accurate sensations of touch, temperature and joint position.

Motorised hooks, hands, wrists and elbows are currently available but movement is usually slow and awkward. Scientists have long been working to create a limb that is controlled by the brain and works well while looking near-normal.In tests of her ability to put on make-up, eat, clean and do the laundry, the bionic arm helped her perform up to six times quicker.

c) In Military

Cyborg soldiers are a logical evolutionary link between humans and robots. Yesterdays soldier went into combat alone. Todays soldier is enhanced by human controlled robots. Tommorows soldier will be a soldier cyborg, a cybernetic organism enhanced by everything technology has to offer. The future of combat holds even greater prospects for autonomous robots that kill at.The US Army is experimenting with connecting neuro-physiological sensors to soldiers to assist them in cognition and sensemaking during tense warfare situations:

The augmented cognition system uses neuro-physiological sensors that assess a warfighter's attention by measuring and recording location, brain activity and body responses, including heart rate, and adapting to his preferred learning style.

Using that data, the system will then influence the way the soldier gets information, according to a statement from the Army's Natick Soldier Center in Natick, Mass. The technology will help individual warfighters determine the most important information available and decide the best course of action in varying environments. their own discretion.

Another approach to implementing robotic weapons systems is to combine them with humans, whose bodies could be augmented with robotic technology. This concept offers the best of both worlds: the quick reaction times, precision, and strength of robotic systems and the control and superior cognitive abilities of humans.

DARPA's Land Warrior and its successor projects (Objective Force Warrior, Future Force Warrior, and now Warrior Web) aim to equip soldiers with wearable computers, advanced communications gear, helmet visors with night vision and head-up-display, and robotic exoskeletons for improved mobility. While the potential may be vast, such human enhancement has suffered the same setbacks and slow progress as the development of other robotic systems. The gear is still too heavy, and the exoskeletons that could enable soldiers to carry more and move faster lack a sufficient power source.

5. Advantages

- **Returning Function**

If you have had parts of you damaged, such as you are blind, you can have to eyes replaced with electromechanical devices that return function.

- **Increased Strength**

Assuming that it is possible to replace or enhance the human endoskeleton with metal and pneumatic/hydraulic pumps, the strength of a cyborg could be drastically increased above a normal human. A metal skeleton would even possibly allow you to even take hits a normal human couldn't survive (eg. A sledgehammer to the chest, or a gunshot to the head)

- **Added Functionality**

A cyborg does not have the limits of a standard human. For example due to increased weight, they could replace or add appendages such as a building a gun inside the arm, that can extend out and shoot, with there being less recoil thanks to weight and strength.

- **Possibly Longer Lifespan**

Because you are replacing a lot of your body parts, you are making some of your organs obsolete and since you aren't relying on them, it doesn't matter if they fail or are taken out. How ever until research into extended or replenishing the state of the brain, you will still only have as long to live as your brain will allow. Unless you could somehow transfer your conscience into the computer that eventually replaces your brain, you are screwed.

- **Increased Intelligence/ Computational Power/ Perception**

A possibility of a cyborg can be to add microchips to the brain, which would allow your brain to offload commands such as doing calculations to the chip, which could do the calculations Returning Function

6. Disadvantages

- **Possible loss of humanity**

Due to having microchips installed in your brain that can alter your behaviour, it is possible that you would lose or overwrite the parts of you, that make you who you are. When your brain dies, people aren't likely to let your body go to waste and will therefore replace the deceased brain with Artificially Intelligent computers, leading to your body becoming an android.

- **Expensive**

Unless you are being subjected to becoming a cyborg against your will by secret underground science teams, all this tech is going to be coming out of your pocket, and it will not be cheap.

- **Loss of Acceptable Appearance**

Assuming that you had your muscles mostly replaced with pumps, you aren't going to have all that much blood, so there won't be a whole lot keeping your skin (and your member) alive. This could be included under loss of humanity but it is important to know that you won't look the same.

- **Likely to Die in the Creation Procedures**

Adapting to cyborg life wouldn't be even nearly as hard as surviving all the surgery that you would have to go through to have entire parts of your body replaced. Unless research teams develop some way to replace body parts with other things in an instant, you will probably be dead before you know it.

7. Conclusion

Though bioelectronics has many advantages it may lead to negative arguments with the Invention of biological machines called "Cyborgs". As many scientists have eloquently argued, once a technology is out there, you cannot make it go away. There never was a technology that the human race ever abandoned wholesale, even the hydrogen bomb or other weapons of mass destruction with the power to wipe out all life on Earth. When human beings are offered the chance to utilize computers and electronic technologies within their bodies to achieve the same results, it is almost certain they will embrace them regardless of the risks. Based on this, it would be unrealistic to try and ban such technologies; however one might worry about their ethical and social consequences. A ban would only probably force them into a large, criminal black market, as illegal drugs and weapons already have been. It is probably imperative for society to assert that the scientists and engineers charged with creating this new technology exert the proper amount of social responsibility.

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