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# The Modern Cyborg
## Cybernetics as it Relates to Biohacking/Body-Modification

## INTRODUCTION

"In a properly automated and educated world...It may be that machines will do the work that makes life possible and that human beings will do all the other things that make life pleasant and worthwhile." Acclaimed science fiction novelist, Isaac Asimov wrote this in his theoretical piece *Robot Visions*. Asimov predicted that through symbiosis of man and machine, humanity could reach enlightened heights. Machines, he believed, were the next evolutionary step. Humans as a species have been working hand in hand with their technology since the Neolithic Era, but only recently has the bond between man and machine achieved the levels of intimacy Asimov imagined; cell phones, personal computers, smart watches, and all other personalized devices that have become an integral part of the individual's life. Soon, they may even become a part of our bodies. Despite the ethical controversies surrounding modification of "Adam", biohacking pioneers present the human body as the next technological frontier; they argue that society can only evolve and progress past its current stagnation through a merger of our selves and our techno-digital lives.

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## MAN-MACHINE EVOLUTION

### *CYBERNETICS*

**History & Impact**

Some scholars argue that for as long as man has been shaping his environment with tools—even the earliest, most rudimentary tools of the Oldowan and Acheulean eras—man has been a "cyborg". Although human's fascination with man-machine symbiosis predates its inception, the study of cybernetics is the core of modern cyborg movements. Gregory Bateson describes the theory of

cybernetics in the classic problem of the blind man and his cane. Bateson asks readers, "where does the blind man's 'self' begin"? Stick-tip, handle, hand? How do we separate the tool from man, when its function is an intimate extension of the senses (Latham 423)?

Cybernetics, defined as the "science of communications and automatic control systems in both machines and living things," came into existence as the brainchild of the interdisciplinary Macy Conferences from 1943 to 1954 ("cybernetics"). The crossing of disciplines between information theory, human neural circuitry, game theory, self-replicating, cellular automata, and anthropology birthed the rhetoric surrounding the man-machine conceptual bond (Latham 420). It was defined then as the "level of abstraction at which both mechanical and organic systems could be described," in other words, the striking similarity between living and mechanical systems (420). At the time, drawing attention to this "boundary breakdown" was both controversial and essential to the advancement of biomedical technologies (421). Today, cybernetic thought has application in a wide variety of disciplines from bionics and neuroscience, to robotics and cellular automation, and from ergonomics to systems engineering and cognitive psychology.

*Biomedical Technologies*

Stage one, the original inspiration for cybernetic technology arose from "adopters," disabled persons who desired a "more powerful prosthetic device" to either augment or supplement weak or missing elements within their bodies (Caliguri 42). Cochlear implants for the deaf and ocular prosthetics for the legally blind are two prominent examples of current research, in which mechanical aids provide direct stimulation and simulate real hearing or sight (41). Non-sensory applications include devices to contract paralyzed muscles and assist with bladder control. It is quite possible that within the 21st century, researchers will see computer chips "implanted within the human body to replace, augment, and enhance" even "memory and the ability to reason" (41).

*Military and Miscellaneous Advancements*

Stage two curently is comprised of non-disabled users who desire to augment or enhance pre-existing faculties and senses (Caliguri 42). Scholars predict during this stage, cybernetics will begin to reshape the world's military forces. The potential for modified, whether temporarily or permanently, soldiers could one day mean less men would be required to fight in wars. Enhanced soldiers connected to interfaces will granted great advantages due to connections with military positioning satellites and advanced weaponry. The beginnings of this can already be seen in the emergence of single crew/single drone ops and single/multi-crew/multi-drone ops, operating together through a graphic user interface.

Lastly the third stage of cybernetic advancement involves the development of a "collective mind" (Caliguri 42). In order words, a hive mentality could result from new abilities to "share information, skills, and perceptions in unprecedented forms," whether through uploading of memories or the potential for thought sharing. This last stage, which is still theoretical, could lead to the spread of organizational expertise, fast access to procedural and problem solving schematics, and memory development (Caliguri 42). It is important to note that while body and mind modification is directed toward the individual, in reality it is "society as a whole which has become increasingly integrated" (Caliguri 75). While individuals modify themselves, they are doing so in an increasingly interconnected cyber society. The changes of one will have impact on all the rest. This explains why "biohacking" pioneers have come under both scrutiny and applause during recent decades.

**The Inception of Cyborgs**

*Comics, Movies, Novels*

Literature and film have no shortage of classic cyborgs: Robotman, The Reavers, Ladytron, The Brain, Metallo, Ironman, Deathlok, The Terminator, and more. Techno-dystopian novels and shorts are even more abundant (Buxton). The earliest cyborg-type ideas date back well past the industrial revolution in Europe. Typically more-machine-than-man characters are villains, portraying the

dystopian fears of the genre. In *Neuromancer* by William Gibson, the main character Molly Millions has artificially enhanced vision, a modified nervous system and "electro-prosthetic razor blade fingertips;" "for her, body modification is an endless process of customizing and upgrading" (Pitts 151). *Neuromancer* is considered a category defining-text in the history of science fiction because its dystopia focuses not on the integration of machine and man, but on the potential consequences of commercialism in an era where body enhancements are no different than vaccinations: common and necessary for survival.

From the 1980's onward, and especially during the past 15 years, huge advances in real "post-human body" transformation have taken place within biomedicine and cosmetic surgery. Body modification communities, such as tattoo parlors, are the best place to observe "cyborgian human experiments" and the "denaturalization" of the body (Pitts 153). Proponents offer that because humanity is so ethnically and culturally diverse, it is a perfectly malleable medium for the creation of new identity.

*Cyborgs Defined*

The official definition of a cyborg is a "person whose physical tolerances or capabilities are extended beyond normal human limitations by a machine or other external agency that modifies the body's functioning; an integrated man–machine system" ("cyborg"). During the 1960's Manfred E. Clynes, the Chief Research Scientist at the Rockland State Psychiatric Hospital in New York and Nathan S. Kline, Rockland's Director of Research co-authored a paper for a military conference on space, originating the word "cyborg" (Kline 331).

Cyborgs have always been considered organisms that interact with technology through information and feedback control. Clynes solidified this definition with his experimentation on the cyborg mouse, which he injected with an osmotic pump to create a "cybernetically extended organism" (Kline 332). Clynes coined the term "cyborg" as a body that "deliberately incorporates exogenous components extending the self-regulatory control function of the organism" to artificially extend homeostatic control "in order to adapt it to new environments" (Kline 332). Prior to their radical theory that man should be altered to fit his new environments, theorists had been conceiving of ways to adapt space to human needs i.e. gravity fields, space activity suits, etc. Clynes wrote:

> "If man in space, in addition to flying his vehicle, must continuously be checking on things and making adjustments merely in order to keep himself alive, he becomes a slave to the machine. The purpose of the Cyborg, as well as his own homeostatic system, is to provide an organization system in which such robot-like problems are taken care of automatically and consciously, leaving man free to explore, to create, to think and to feel" (Clynes 27).

In their minds the solution to the environmental challenges of space and the dependency on external machinery, was transitioning over to integrated internal machinery that adapted the human body to space. This idea is the origin of the debate between wearable cyborg materials and surgically implanted cybernetic technology.

Cyborgs and other cyborg technology are typically integrated into four main fields: prosthetics, bioastronautics, bionics, and technology policy (Kline 336). Nonetheless, the concept of cyborg as Clynes described it, is also relevant to society as a whole. Clynes and Kline's revolutionary theories are a potential solution to the debates taking place in science currently today. Scientists and researchers are troubled by environmental issues, and the destructive way in which humanity interacts with its environment. Adopting Clynes' theories could reshape humanity's existence.

*Bioastronautics*

When Clynes and Kline originally developed their concept of the "cyborg," modifying the human body was a way to break free from any reliance on cumbersome space suits and other machinery necessary for extended spaceflight. By creating an artificial homeostasis through injections regulated by computers, use of temporary artificial organs, etc. astronauts could hypothetically free themselves from reliance on external machinery and instead, integrate with internal machinery (Kline 338). They called

it "participation evolution" and now, 50 years later, the idea has become less and less radical (Kline 338). Astronauts are, by the standards of cybernetics, already "cyborgian" but Clynes' and Kline's concept of external technology as a burden has become one debate defining modern cyborgs: does wearable, interact-able technology make you a cyborg, or does the machine have to become a part of the body itself?

*Prosthetics*

Norbert Wiener, a Mathematics professor at MIT was one the first to begin researching the potential of cybernetics, the meshing of humans and machines into integrated information systems. His work with early prosthetics like the Boston Arm, which was controlled by amplified electromyography signals from an amputated muscle, were the tipping point in the application of cybernetics to the human body (Kline 339). Among his many research interests, Weiner's vanguard work with the deaf became the foundation for the modern cochlear implant that has become an essential modification for over 300,000 people around the world (Park). Helen Keller wrote Wiener gratefully acknowledging his work as "the first constructive application of cybernetics to human beings" (Kline 338). Weiner's work with the cochlear implant is considered a notch on the scale for internal integration, and many users consider their implant a part of their own body (Park).

**Body Modification**

Body modification has become markedly more accepted since the late 20th and early 21st century. Tattooing, piercing, and cosmetic surgery once considered taboo, have become quite common and even emerging "into mainstream cultural visibility," while other practices including cutting, scarification, branding, and elongation are still marginalized (Latham 408). Practitioners of BM have generally belonged to a variety of subversive subcultures from queer s/m, fetish and body-art clubs to pro-sex feminism, cyberpunk, New Age Spiritualism and tattoo culture. They "position the body as a site of exploration as well as a space needing to be reclaimed from culture" (Pitts 7). In other words, body modification has traditionally meant pushing social limits, making political or cultural statements, returning to a more primitive form of spiritualism, and inventing new body technologies (Latham 408). "Modern primitivism", a term coined by Fakir Musafar embodies the movement as the "empowerment of people who are socially isolated, permitting them to reassert control over their bodies and beliefs" (Latham 408). The 21st century, despite the commercializing of tattooing and piercings, is an era of immense economic, social, and technological change; humanity's "ontological insecurities" could finally be resolved using body modification as a "vehicle for stating cultural identities" (Latham 410).

*The Punk Movements*

In the late 80's there was post humanist movement called cyberpunk that developed from the science fiction culture that resulted from the Space Race, specifically William Gibson's novel "Neuromancer" (Pitts 152). "'Punk' quickly became the default suffix for any perceived, proposed, or hypo theoretical aggregation of writers," and included biopunk, nanopunk, nowpunk, steampunk, etc. (Latham 65). Biopunk, for example, a variant of "ribofunk" (ribosome and funk) declared that the next scientific revolution would take place within biology (Latham 65). Most importantly, the punk movements of cybernetics drew a huge youth following, revamping the science fiction community and its ideals. Cyberpunk modification is unique in its aims to "escalate the literal deconstruction of the body's limits. Aesthetic for "futuristic, high-tech body projects beyond the limits of fashion, history, and culture" (Pitts 153). They are distinguished by their inventions, and discursively position the body as a "limitless frontier of exploration" (Pitts 153) Fashion assumes the technologized body is real and is the future.

Neil Stephenson, a leading science fiction community voice, wrote in 2011 to promote science fiction that inspired young researchers toward "achievable technologies--the 'big stuff' that Stephenson feels has been lacking in recent technological innovation" (Latham 68). He said it was "time for the science fiction writers to start pulling their weight and supplying big decisions that make sense" (68). In

Stephenson's mind, youth researchers and writers would fuel the concept of "techno-optimism," not the older generation still entrenched in a society whose values and culture was quickly becoming outdated (68). The spread of the biohacking movement and do-it-yourself (DIY) biology is the result of leading technology activists like Stephenson.

## *BIOHACKING & THE BODY MODIFICATION MOVEMENT*

### Biohacking

At its core the concept of biohacking involves hacking the human body, testing its limits, and tweaking it to find the perfect balance of modification. Biohacking developed from a debate that arose in the 1960's during the Cold War and the Space Race. The reigning scientific thought of the era had been alloplastic (terraforming environments to fit the human body's needs) until Manfred E. Clynes proposed a more autoplastic approach (modifying the human body to the alien environments) (Latham 411). An offshoot of cybernetics and biomedical technology, biohacking, dissected, applies a "hacker" mentality to biology. Although technically defined as the "unregulated manipulation of genetic material, typically as a hobby, with potential disregard of ethical standards, or for criminal purposes," scholars have yet to agree on a more modern definition ("biohacking"). Also referred to as "biopunk" (a combination of "biotechnology" and "punk"), it is a techno-progressive movement that experiments with DNA and other genetic aspects to improve human capabilities.

Despite its controversy, biohackers are achieving impressive advancements. Their goal of developing man-machine fusion through experimentation has produced pocket-sized DNA samplers, microchip implants, 3D printers for organs and bones, and more. In the field of medicine biohacking research and experimentation has aided in the development of contact lenses, pacemakers, breaks implants, and cochlear implants; in research it has advanced tissue, genetic, neural and pharmaceutical engineering. Biohacking however is also advancing the experiments of cybernetic body modification. The radical work in all fields is slowly but steadily filtering into mainstream application, and challenging norms about humanity and the human body ("The Body Hacktivism" 1).

#### *DIY Biology*

The media attention, both positive and negative, surrounding biohacking has drawn attention to the DIY Biology communities that have sprung up in the form of independent labs and sponsored clinics throughout the United States and Europe. DIY biologists have the potential to synthesize new organisms, research natural phenomena or experiment with pharmaceuticals (Blazeski 10). Although local institutions, museums or professional organizations fund some of these labs, the majority are supported and led by a few "dedicated enthusiasts" (Seyfried 551). The involvement of local artists, designers and the general public with these communities could lead to the creation of a new form of education process, "beyond the current producer-consumer distinction" (Seyfried 551).

Despite criticism from some academic circles, these avocational biology researchers are the driving inspiration behind the growing biohacking movement (Seyfried 548). In part because DIY biologists and biohackers are a new phenomena of the late 20th and early 21st century, and in part because of globally shared fears of bioterrorism, many "garage labs" have been investigated by local government agencies. Huge strides have taken place in recent years with the commercial availability of synthetic DNA and lowering technological costs (Whalen). Although it represents a major break in the DIY community, for government agencies, the still undefined and unclear regulations are a cause for concern.

#### *Legal Issues*

The question remains: "are biohackers a threat to national security?" (Whalen). In NY, the FBI's Weapons of Mass Destruction Directorate has been working hand in hand academia and industry to determine the best guidelines. All parties recognize that an open door policy is the best form of checks and balances (Whalen). The FBI also created a Biological Countermeasures Unit (Blazeski 15). Aside

from this interaction however, there have been no regulations. The US National Science Advisory Board for Biosecurity has recommended DNA companies begin screening purchasers for "nefarious intent," and that potential creators of new organisms should have to get a license (Whalen). Not everyone subscribes to this philosophy however, as George Church a genetics professor at Harvard Medical School equates garage labs with the older generations "home chemistry kits:" harmless inspiration (Whalen).

## MODERN CYBORGS

In literature cyborgs are often confused with android, robots, or other "artificially constructed, self-aware machinery with few, if any, organic components" (Caliguri 40). The difference lies in the distinction between cybernetic mechanisms, like the Terminator, and organisms like mice: the Terminator is at his core, a machine, whereas a cyborg is built from an organic creature. To Manfred E. Clynes and Nathan S. Kline, who defined "Cyborg" to be an "exogenously extended, integrated homeostatic self-regulating man-machine" altering man's bodily functions to meet the requirements of extraterrestrial environments would be more "logical that providing an earthly environment for him in space" (Caliguri 40, Latham 411). This concept of humans as "repairable" and modifiable" is the foundation for both the cybernetic body modification movement, and a wealth of scientific research on prosthetics, implants and more. The goal for all cyborg enthusiasts was that through symbiosis, humans could control their own biology and eventually even their own evolution.

A more modern definition cyborgs would be "a human being with an electronic device implanted in or permanently attached to their body for the purpose of enhancing their individual sensor abilities beyond the occasional use of tools" (Park). Over the past decades, devices have become smaller and closer to the body: "smartphones and wearables are ubiquitous today" (Park). The next stage involves integrating devices directly with the human body, raising two main questions for scientists: "how energy should be supplied inside the body and how electronic circuits should exchange information with the nervous system" (Park). The question whether or not to integrate is slowly disappearing, and being replaced with questions regarding how and when.

### *BODY MOD & BIOHACKING PIONEERS*

**Impetus**

Human enhancement through biohacking and body modification has stemmed from three different schools of thought. Bionics deals with the medical advancement, and has been integral to the advancement of prosthetics and other technology for "repairing" the human body. Biohacking has developed from the implementation of the hacker mentality to DIY Biolabs, treating the human body as new platform to tweak and modify. Body modification itself, is a time-honored tradition of social and political radicalism that relies on artistic and activist inspiration; cyborg and tech enthusiasts have spearheaded the crossing of man and machine in the 21st century. Various debates, some more controversial than others, have arisen in social, ethical, and religious circles, but the once-fringe fashion is picking up speed and gathering momentum that will carry it to the mainstream sooner or later.

*Amber Case: Cyborg Anthropologist*

Cyborg anthropology is a new field of study, built around the 21st century tech culture. As Amber Case said in her most recent TED Talk, Cyborg Anthropology takes apart the new form of homo sapiens, always "clicking on things and staring at screens" (Case). Although tools have been used for thousands and thousands of years, a physical modification of the self, technology today has enabled humans to mentally extend themselves as well. Case talks about two main concepts associated with her field. Mobile devices have become an integral part of human life, so much so that we are constantly checking our phones, our iPods, and tablets. This has led to what Case calls "ambient intimacy" because although we are not physically connecting with as many people as we once did, the amount of people we have access to any given time makes the "room" incredibly crowded (Case). This is the first time in

human history people have connected in this way, regardless of geography. The danger is that the connections never turn off, leading to a society of individuals never really alone with themselves; and this means there is less and less time for mental reflection. Case worries about the dangers of a button-clicking culture that cannot reflect, plan long-term, or advance past this point (Case).

The second phenomenon Case discusses is the concept of two adolescences: the analog adolescence with growing pains, acne, and hormones and the second adolescence online. This second adolescence happens at a different time depending on the age a person becomes involved with the web. For many young adults it proves challenging as professionalism approaches, and they have to manage the un-erasable history they have already created for themselves on social media and other platforms. For older generations, creating a brand new online identity can prove just as "awkward" as their teenage years (Case). Ambient intimacy leaves individuals with no time to reflect, meaning children never slow down and think about the consequences of their online presence, creating a vicious cycle. Case makes the point that as we integrate more and more technology into our lives, as we should, we have to be aware of how it is psychologically impacting our culture; because as she says the "most successful technology gets out of the way, and helps us live our lives" (Case).

**Wearable Bio Hacks**

Designers believe "wearables" are the next generation of computing. The questions remain, however, what the devices will be and "where on the body they will live" (Bilton). Smart Accessories are paving the way for a new market in tech industry. In the past, much of wearable technology emphasized "function over fashion" but that is beginning to change. Technology that interacts through monitoring bodily functions, or by physically "syncing" humans with their digital lives is now becoming a statement of individuality rather than a tool. As these tools begin to define people, society takes another step toward cyborg culture. Sensing this development, wearable tech companies have begun to proactively involve fashion designers with their projects. Notable examples include Fitbit's work with Tory Burch to create a fitness-tracking device that can be worn in its everyday form or in a brass hinged bracelet or pendant necklace for formal occasions. Ringly now sells a ring that notifies alerts, decorated with semi-precious stones. The new Apple watch allows wearers to send each other pulse messages, indications of heart rate, as a new level of personability and intimacy (Schmidt). Smart accessories, however, are only the first step in wearable tech.

Currently researchers are developing new breeds of wearable looks that deal with human skin. MC10, based in Cambridge, Massachusetts is designing computers that attach to the skin like tattoos. The difference they believe is that these computers are not like smart watches you remove at the end of the day, but become a part of your skin and a part of the user (Bilton). Chairwoman of Chicago's Art Institute, Anke Loh has been exploring the possibility of turning these flexible computers into body art, noting the possibilities of combining fashion and technology. Even more radical are the designs for "e-skin", a product of Tokyo University's labs. Like plastic wrap it is clear and flexible, and it sits on top of the skin; e-skin however, is designed as a functional screen, to interact with a touch-screen display (Bilton). Research is creating new divisions in wearable tech between removable and non-removable, even more scientists believe wearable tech itself, is just a stepping-stone toward surgical modification.

*Isa Gordon*

Isa Gordon is a cyberpunk artist, researcher, and clothing designer. She is also the creative director of the Psymbiote Project, a performance persona that aims to put Gordon and viewers at the "collision of bodies and machines" (Pitts 174). Gordon is interested in the progress of evolution, and with her technical director Jesse Jarold has been working since 2000 on a cyborg costume called Psymbiote. Their interest in human-machine interfaces led to the creation of a carbon and Kevlar exoskeleton, modeled on Gordon's body, which plays on cyborg stereotypes (Gordon). Although for the first few years the project did no more than produce random items of wearable tech, the suit now has an identity of its own, with sensors to send monitoring information, a commercial wearable system to read

scripts while maintaining audience eye contact, heart rate monitors, hackles, and mood lights (Pepitone). Nonetheless, Psymbiote is less about the "latest gadgets" and more about bringing the views of "intentional evolution to a broader audience" (Gordon). In Gordon's eyes, although Psymbiote is not actually a part of her body, she still feels a connection with the suit; she argues her project integrates tech closer with human lives, and that humans can extend their "selves" whether cyber tech is implanted or worn (Pitts 174).

**Surgical Experimentation**

There have been a variety of surgical procedures taking place within the body modification and biohacking communities. The majority of these procedures cannot legally be performed by a medical professional and therefore take place in tattoo parlors and back rooms *sin* anesthesia. Artists Steve Haworth and Jesse Jarrell developed magnetic implants in 2004. Made of a rare earth metal neodymium, the discs are often implanted on the sides of the fingertips to "respond to electromagnetic fields and waves" ("The Body Hactivism" 2). RFID-tags and NFC-chips are implanted beneath the skin to respond and connect with mobile devices, and even in some extreme cases, record body functions to communicate with home automation systems (Park). So far the movement is driven and motivated by individual experimentation, therefore, there are a multitude of cases to potentially discuss. Invisible earphones that use bone conductivity to transmit sound and sync with GPS software, LED implants, camera antenna, artificial vision, and more redefine the human body ("Entangled Agencies" 3, Nelson). Mike Featherstone, a professor at the University of London, denotes the transformation of both the outer and inner body. "Inner body cyborg technological developments" are a new level of control over the body and represent the next frontier of body modification (Pitts 174). Proponents of surgical modification look at the process as an even more intimate integration with technology.

*Neil Harbisson*

Neil Harbisson is the co-founder of The Cyborg Foundation, a nonprofit organization based in Barcelona that helps others by extending their natural senses, defending the rights of cyborgs, and "promoting the use of cybernetics in the arts" (*The Cyborg Foundation*). He himself is a pioneer in the cyborg community for his enhanced senses of sight and hearing. Harbisson was born with achromatopsia, the rare inability to see color. As a young man, he implanted a microchip at the base of his skull linked to an antenna at the top of his head. The antenna sees and recognizes colors, interpreting them as musical notes that it then plays in Harbisson's mind. Now he is not only able to recognize the 360 normal color scale that humans see everyday, but infrared and ultra-violet light as well. Harbisson says his whole perception of reality, and especially of beauty has changed (Pepitone). He listens to paintings, paints music in colors, hears security cameras and sunshine, and treats going to the supermarket like going to a concert (Harbisson). Most recently, his chip has become Wi-Fi enabled, allowing him to see file transfers of images directly into his mind and to hear the speaker of a one-way phone call (*The Cyborg Foundation*). The integration of his antenna into his body has become an extra sense to Harbisson, and is as much an integral part of him as a blind man's hands.

The Cyborg Foundation has several vanguard projects it has been developing since 2010, to enhance human sensory experience. Along with Harbisson's Eyeborg, the organization is developing a Speedborg for earlobes, enabling wearers to "perceive the exact speed of movements via vibrations." The Fingerborg, developed for a student who lost digit in an accident, is a prosthetic finger complete with mini camera to film and photograph. Finally, the foundation's other co-founder and choreographer, Moon Ribas has developed a pair of earrings that allow her to sense what is behind her through vibrations sent directly to her ears (*Cyborg Foundation*). Harbisson and Ribas believe that technology invention has stagnated, that the "app culture" is not sustainable and has reached its limit. According to Harbisson, it is time to stop creating apps for mobile phones, and to start creating applications for the human body: the next technological frontier (Harbisson).

**Tim Cannon**

In 2013, Tim Cannon implanted a microchip called the Circadia 1.0 into his forearm. One of the first procedures of its kind, it was performed in an unidentified location in Essen, Germany by another biohacking enthusiast, without the presence of a doctor or anesthesia. Circadia 1.0 connects to Android mobile devices on a completely open source platform, differing from external biometric-recording devices like Fitbit, and grants complete user control over data (Hoppenstedt). Cannon believes "our environment should listen more accurately and more intuitively to what's happening in our body;" when he has a stressful day Circadia communicates with his house, dims the lights, and turns on a hot bath (Hoppenstedt). DIY biohacking "upgrades" like Tim's are becoming more and more common, despite the continued government censure.

## SOCIETAL IMPLICATIONS

### *POTENTIAL BENEFITS*

**Changing the Stage**

It has been proposed, "the boundary between science fiction and social reality is an optical illusion" (Latham 409). Humanity is already living in era where the relationship between technology and humanity is mutually evolutionary. Young people today, are so in tune with their devices that in Japan they are called *oyayubi sedai,* the "thumb generation" (Tenner 266). Transgressive aesthetics involved in cyberpunk and cyborg fashions have crept into the piercing parlors, and have already begun to affect fashions and perceptions. For some, the movement brings potential. "Cyberpunk aesthetic often hails the modified body as a range of, and vehicle for, individual freedoms" (Pitts 155). As there is no way to stop "participant evolution," proponents believe society should welcome the innovation. If guided ethically, cybernetic biohacking has the potential to better many lives, create new industry, new jobs, spark invention and advance technology.

Biohacking has developed in open source platforms, meaning it would build collaboration and community on the world stage, and further equality. It could increase the individuality of each and every person, and help society towards its utopian goals (Kline 349). Although science fiction usually paints the future in a dismal light, cyberpunk science fiction has "created iconic, celebratory images of high tech body modification" rendered "as psychologically, physically, and intellectually super-heroic [beings created] through biomedical and electronic modifications" (Pitts 155). Changing the dynamic from "man vs. machine" to "man & machine" could create new avenues for expression and advancement. Some believe that humanity has been heading in this direction since the Industrial Revolution in the mid 1800's. They believe it is "our basic *human* nature to annex, exploit, and incorporate nonbiological stuff deep into our mental profiles;" the question is not if we will go this route, but how we will form new biotechnological unions (Clark 198).

### *CONTENTION*

**Cyborg Community: Debates**

Nonetheless as with any radical movement, there is a great deal of social controversy surrounding biohacking and cybernetic body modification, both within the cyborg community and outside of it. For those within the fringe movement, debates have already begun over a new definition of cyborg. Those with implants argue wearable tech does not qualify because it does not imply the same amount of symbiosis with technology. The same voices are growing louder as the movement's less transgressive practices are enveloped into the mainstream. Cyborgs worry that the movement's founding ideals of originality and individuality will be lost. Cyberpunk hackers, the force behind the movement, are by definition against convention, but even they predict that as soon as implants prove more useful and user friendly than wearables, they too will be incorporated (Park). As with anything in the free market, the more people jump on board, the more mainstream an idea becomes.

**Controversy**

*Health & Safety*

Participants of self-performed surgeries profess that as long as sanitation and procedural techniques are followed, the risk of complication is quite small (Duarte). Nonetheless, the absence of medical professionals has made a large portion of the community nervous. Many community leaders have demanded heavy restrictions on biohacking and body modification for similar reasons to the DIY Biology labs. Even with trained doctors and the correct tools, there is still the possibility of serious damage to cyborgs and potential cyborgs. In this sense it is logical to place restrictions on implant procedures. However cyborg activists have argued saying that restrictions will limit innovation. Unable to manipulate and experiment, biohackers will be forced to trust vendors, clinics, and health insurance providers. With government restriction comes commercial investment, and cyborgs predict that security and privacy issues will begin simultaneously (Park).

*Security & Commercialism*

Clearly there are issues of body integrity, control, and security to deal with. Cyborgs ask about the limits of surveillance and the possibility that, if involved, corporations will begin collecting data to charge different insurance fees whether or not users behave (Park). For some activist groups like Stop the Cyborgs, these potential security issues have been enough for them to protest cyborgs and even wearable tech like Google Glass (Pitts 156). The "design of the body could become a motive for power struggles" and commodification of limbs, parts, and even children could lead to dehumanization and devaluing of the species (Latham 411). An already recognizable trend in marketing toward "aestheticization and commodification of ethnic difference" could become the roots for new struggles in social equality (Latham 411). Naysayers also point to the traditional fear of the generation gap. Letting newer tech surpass users and outdate them would be "losing the competitive edge" and could drive consumers into a frenzy of modification (Pitts 151). More money could mean better mods, and a new class would develop. If the cyborg community does not catch potentially dystopian elements in advance, then the advanced technology would only escalate these issues of competition and control. Cyberpunk dystopian fiction tends to operate under the "corporatized realm of technomania" and the "subjection of all individuals to pre-existing systems of control and power" (Latham 413). In essence, sci fi lit is filled with dystopian scenarios, cautionary tales about the consequences of a passive populace in new cyber culture era. In order for the cyborg culture to succeed and not be swept away by the negative aspects of commercialism and capitalism, every member needs to take an active role in shaping the future.

*Religion & Ethics*

There are also religious and ethical implications to consider. For many faiths, the human body is considered a sacred temple. Creating a society that is based in "repairing" what gods have designed could greatly alienate entire cultures ("Entangled Agencies" 2). Clynes and Kline noted this outcome, saying the hardest challenge cyborgs would face would be the "spiritual challenge to take part in their own evolution" (Kline 338). Moreover, changing the human body has the potential to create new class systems and force social exclusion (Park). When athletes with prosthetics begin out-running competitors, "techno-doping" as it has been termed, will lead to unfair advantages. Destruction of gender is another possibility, because researchers feel that mechanizing a body will make approximation of traditional roles harder (Latham 425). In sum, it is debatable whether the movement can overcome and surpass the "inherently repressive gendered stereotypes on racialized people and their sexuality" that originations from biases precedents, and science fiction interpretations (Latham 410). Will new modifications make society less gendered, less racist, and more socially minded? Those who oppose body modification fear dystopian consequences of enhancing humans in their current state of racism and sexism.

## CONCLUSION

The cyborg is not an extremely radical scientific idea. However recent advances in cybernetics and DIY biolabs have for the first time, transitioned the idea of integrated machine-man systems from fiction to reality. The works of biohackers and body modifiers have made cyborgs possible, if still a fringe-phenomena. Despite the medical, ethical, and societal controversies surrounding the movement, its growing assimilation into art, fashion and other technological fields is bringing biohackers and body modifiers slowly into the limelight. It is very unlikely that this new wave of technology and industry is avertable, and even cynics recognize the human body's potential as a new frontier of exploration. Although currently the biggest advances are being made by pioneering individuals, as Isaac Asimov said, "the history of science is full of revolutionary advances that required small insights that anyone might have had, but that, in fact, only one person did." Society should not view technology as working against humanity, but rather as an integral part and extension of ourselves. How we choose to integrate, and how we chose to shape our next phase of evolution, as a species, are the exciting questions we are now faced with.

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