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Connections: the double interface and constructing the cyborg body

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Connections: the double interface and constructing the cyborg body is a result of my taking the spring 2009 class Anthropology of Cybercultures taught by Lucy Suchman at MIT. I accept the cyborg and its prostheses as a view of the posthuman, and seek to better understand the connections between the (dis)abled body and its adopted organs. How are these body extensions fitted to the user? As the connections become more ephemeral, how do we maintain an overview of the sites of connection and the (unintended) consequences that follow?

PROSTHESES, ORTHOTICS AND BODY EXTENSIONS

I readily consider my *personal technology* (my personal computer, my mobile phone, my glasses, my bicycle, et cetera) as an extension of myself. When working on ideas for new technologies at the MIT Media Lab, the first user that springs to mind is myself. I have come to consider it natural that technology serves as an extension to myself. At times I remain frustrated and pained by my command of my body extensions, their connection to my body being lossy, noisy and imperfect. Why do I constantly feel as though I must adapt my body to the technology provided if I am also developing it?

Human needs drive technological development. One could argue that local, personal technologies have an advantage in evolving, as single users are constantly invited to question their tools as they are in their environment. But once the tools are developed and deployed in a mass market, their personalisation is slightly lost. The body and technology adapt to each other. In 1929's *Civilisation and its Discontents* [2] Freud describes technology as a bodily supplement:

With every tool man is perfecting his own organs, whether motor or sensory, or is removing the limits to their functioning. Motor power places gigantic forces at his disposal, which like the muscles, he can employ in any direction; thanks to ships and aircraft neither water nor air can hinder his movements; by means of spectacles he corrects defects in the lens of his own eye; by means of the telescope he sees into the far distance; and by means of the microscope he

overcomes the limits of visibility set by the structure of his retina. In the photographic camera he has created an instrument which retains the fleeting visual impressions, just as a gramophone disc retains the equally fleeting auditory ones; both are at bottom materializations of the power he possesses of recollection, his memory. With the help of the telephone he can hear at distances which would be respected as unattainable even in a fairy tale. Writing was in its origin the voice of an absent person; and the dwelling-house was a substitute for the mother's womb, the first lodging, for which in all likelihood man still longs, an in which he was safe and felt at ease.

– Sigmund Freud *Civilisation and its Discontents* 1929

Here Freud takes a distinctly personalised view of technology, including mass technology that by itself does not serve one human, but employs many to serve many. Centuries after fire, hunting tools and dwellings, mass human needs can become a complicated aggregation of national sentiment and local desires.

As such, after the Second World War, technological development was mainly driven by militaristic inclinations of the Cold War. The large scale government-backed engineering effort as introduced in the Manhattan project continued and brought computers, cybernetics, advanced weapons, robotics, the internet and the space race. Game theory, surveillance and espionage became common place and researchers began to attempt to create artificial intelligence. Local needs for protection and power translated into expensive elite research institutions and think tanks.

Seeing technology as a constant extension of man's abilities nevertheless remained popular. Computers were originally seen as the replacement of human performers of mundane arithmetic tasks, and later computer hard drives were often likened with a human external memory. Software now helped with many other tasks, from precision engineering to combat simulation. Modern medicine supplemented man's immune system as modern food provided specific tailored sustenance.

During this time of engineering, Manfred Clynes and Nathan Kline wrote a paper proposing methods that would allow long-term manned space travel [1]. Coining the term cyborg, as a contraction of cybernetic organism, they proposed methods for *altering a man's bodily functions to meet the requirements of extraterrestrial environments* such as extending man's wakefulness, controlling metabolism and dealing with changes in gravitation and magnetic field. To them this was *more logical than providing an earthly environment for him in space*. Their cybernetic organism was not put into use to permit man's long term space travel, but the possibilities of augmenting man with the machines proved wildly popular, and cyborgs began figuring vastly in popular culture. Films like *2001: A Space Odyssey*, *Star wars*, *Blade runner* and *Neuromancer* were highly popular examples of artist's projections for the future of man and machine. They sketched a dystopian future where the integration of machine

into man would initiate mankind's decay. The seemingly uncontrollable march of technological development could have no other outcome.

Twenty years after the cyborg was offered to space, it was also adopted by the feminist theorist Donna Haraway. Haraway argued that we are all already cyborgs, using technology on a daily basis to function. Our bodies are hybrid of man and machine, as we wear glasses, use pacemakers and drive cars. She uses the cyborg as an inclusive term for the man and his technology as described by Freud. Once she establishes this cyborgian entity, she uses it to depart from classic MacKinnon feminism (who seeks to outlaw pornography as hate speech towards women) to a new, post gender world where there is no defining female identity to be hated. No one has a stable identity in the cyborg world where organs might be added and removed at will.

The cyborg is resolutely committed to partiality, irony, intimacy, and perversity. It is oppositional, utopian, and completely without innocence. No longer structured by the polarity of public and private, the cyborg defines a technological polls based partly on a revolution of social relations in the oikos, the household. Nature and culture are reworked; the one can no longer be the resource for appropriation or incorporation by the other. The relationships for forming wholes from parts, including those of polarity and hierarchical domination, are at issue in the cyborg world. Unlike the hopes of Frankenstein's monster, the cyborg does not expect its father to save it through a restoration of the garden; that is, through the fabrication of a heterosexual mate, through its completion in a finished whole, a city and cosmos. The cyborg does not dream of community on the model of the organic family, this time without the oedipal project. The cyborg would not recognize the Garden of Eden; it is not made of mud and cannot dream of returning to dust. Perhaps that is why I want to see if cyborgs can subvert the apocalypse of returning to nuclear dust in the manic compulsion to name the Enemy. Cyborgs are not reverent; they do not re-member the cosmos. They are wary of holism, but needy for connection- they seem to have a natural feel for united front politics, but without the vanguard party. The main trouble with cyborgs, of course, is that they are the illegitimate offspring of militarism and patriarchal capitalism, not to mention state socialism. But illegitimate offspring are often exceedingly unfaithful to their origins. Their fathers, after all, are inessential.

– Donna Haraway - *A Cyborg Manifesto: Science, Technology and Socialist Feminism in the Late Twentieth Century* 1991 [4]

The cyborg that Haraway constructs is a rejection of the boundaries between humans (male or female), machines and animals. It is also a rejection of the origin and basis of man as described in Genesis and gendered Oedipal narratives

in favour of man as shaped by affinity and environment. Man is not dependent on some perfect template it should strive for. The development of technology is, to Haraway, the production of material artefacts of cultural evolution. Technology becomes a true extension of the human body, man being rendered disabled without it. Unlike the melancholy surrounding the futuristic science fiction renderings of the inevitable victory of machine over man, Haraway's cyborg is proximate, if not current, and also full of exuberance and possibility. Although born from the dismal polluted and bastardised mix of patriarchalism, techno-fetishism, imperialism, capitalism and militarism, Haraway's cyborg offers a helpful image to reposition around. Thinking by means of this cyborg allows the consideration of other and more participatory futures of technoscientific worlds.

The examples given in theoretical texts on cyborg theory still often use the reader's empathy with the blind, the deaf or the amputated [7]. The disabled body that remains without its cyborgian technology is an evocative image of helplessness. The draw to the disabled body however is especially the reader's fascination with the endless configurations of the possible cyborg solutions. Who is Steve Mann, walking in many mediated spaces at once with his wearable technology, and who is Steve Mann stumbling through airport security stripped of his machines [3]? Is it fair that he has a machine aided advantage and should we expect him to strip himself of his auxiliary organs at will? The prosthesis and its place in a cyborgian entity becomes a fetishised object, a prosthesis as not merely a cover-up but a coveted improvement. Freud also writes on the prospect of the prosthetic future, where organs can be donned and shed as the body evolves. He remains hesitant of the Godlike future man, but patient for future developments of technology. This quote was later echoed by many theorists writing on the promise of prostheses.

Man has, as it were, become a kind of prosthetic God. When he puts on all his auxiliary organs he is truly magnificent; but those organs have not grown on to him and they still give him much trouble at times. Nevertheless, he is entitled to console himself with the thought that this development will not come to an end precisely with the year 1930 A.D. Future ages will bring with them new and probably unimaginably great advances in the field of civilisation and will increase man's likeness to God still more. But in the interests of our investigations, we will not forget that present-day man does not feel happy in his Godlike character.

– Sigmund Freud *Civilisation and its Discontents* 1929

The prosthesis remain ill-fitted, and the human is not yet used to their presence and effects. Freud's clipped celebration redirects to his own prosthesis which covered his palate, pitted by oral cancer. The prosthesis caused him great pain but he was dependent on it for survival. Decades later man and machine are still in a similarly awkward ritual, where common prosthetic technology is not

yet entirely adapted to an individual body. Instead, mass produced prosthetic arms have an average pinkish tone, an average length with an average socket fitted with an adaptable squishy silicone sleeve. Perhaps the reason is that mass produced technology takes an average user into account, cursorily acknowledging non-average usage, is that by considering the average user, one can offset the engineering costs otherwise involved in custom designing each prosthetic piece. This solution, although practically driven by monetary concerns, is counter to Haraway's sketch of the cyborg, where the implosions of man machine are driven by cultural evolution.

As expected, the disabled body does not remain an image for the fitting of a prosthetic. All bodies are disabled in comparison to Steve Mann's cyborg setup. It is not that the prosthetic is considered as technology, but technology is considered as as prosthetic to the body in need of futuristic functionality. The word prosthetic has become a very popular metaphor for describing the posthuman, man depending on new technology in daily life [10]. Technology becomes a cognitive prosthesis, cameras and hard drives extending our memory, phones extending our voice and virtual bodies extending our identity. Prostheses are no longer replacing a missing or dysfunctional piece of the body, but extending it to previously absent possibilities. The status of prosthetic has become so epic that some theorists doubt our ability to ever fulfil our hopes for it [7]. Theorist Sarah S. Jain even writes about the prosthetic imagination, analysing the extreme harnessing of the prosthetic trope as a gleaming improvement instead of a constant interaction with the body it is connected to [5]. She calls the usage of prosthetic *a tempting theoretical gadget with which to examine the porous places of bodies and tools*. According to Jain, the prosthetic trope is useful in the display of deficiencies and the need to develop technology for them, and this weighing is necessary to justify the pained and polluting development of technology. But the trope's inherent irony has been partially lost and it and shows no responsibility towards its origins.

How then can people like me and my colleagues incorporate this vision of a feminist cyborg into our design practice? With what interface can we connect and disconnect technologies from the body? In 2007, Lucy Suchman wrote:

Feminist rereadings of the cyborg replace the binaries male-female, human-machine, and subject-object with the possibility of an open horizon of specific, historically and culturally constituted, sociomaterial relations. Crucially, these relations are still power differentiated but in ways that can be recovered, as distributions located in specific configurations. Although the cyborg since Haraway suggests generative new forms of analysis, however, to realize that promise requires shifting out from its popular figuring as a singular, albeit hybrid, entity. The latter inherits a problem that characterizes any strategy centered on a heroic (even monstrous or marginalized) figure; that is, it obscures the presence of distributed sociomaterialities in more quotidian sites of everyday life. Along with the dramatic

possibilities of the feminist cyborg, we need to recover the ways in which more familiar bodies and subjectivities are being formed through contemporary interweavings of nature and artifice, for better and worse. Put another way, now the cyborg figure has done its work of alerting us to the political effects, shifting boundaries, and transformative possibilities in human-machine mixings, it is time to get on with investigation of particular configurations and their consequences. How then might we locate conditions for action and possibilities for intervention in the specificities of more mundane sociomaterial assemblages?

– Lucy Suchman *Human-Machine Reconfigurations* 2007 [11]

Here Suchman sketches a platform for future design practice. What are the configurations with which we are now interacting with machines and how are these connections effecting the goal of the configuration? To me a major part of this question is what is the connection between us and the machines? Is the connection a clear one, does it allow the machine to be an extension of our bodies? Are there unintended consequences resulting from the connection, is it leaking, infecting? In what times and spaces do these connections take place?

COMPANION CONNECTIONS

In the 2001 Stanley Kubrick/Steven Spielberg film *AI: Artificial Intelligence*, a future world is portrayed where robots figure widely as a companion to humans. The field of Artificial Intelligence has now cumulated in a young boy robot which is capable of loving and can provide companionship to humans in a world devastated by global warming. Even though there are leaps and bounds in the improvement of robotics, the humans in the film are still entirely free of technology. There is no piercing of the flesh or mixing of man and machine. Instead the humans give the robots, or mechas as they are called in the film, verbal commands and requests. Man and machine are still entirely separated.

Growing out of classic artificial intelligence, Rodney Brooks from the MIT AI lab went against the reductionist approach that put logic as the forefront of AI research and instead proposed *situated robotics*. Situated robotics holds the position that instead of cognition being a process in pure logic, it is an emergent property of action, and therefore embodiment is necessary to create artificial cognition. With this point of departure, Brooks and his students created Cog, a robotic head, torso and arms modelled after a human, and used it to explore embodiment and the interplay between sensors and motor actuation. After Cog, PhD student Cynthia Breazeal created Kismet, a robot capable of displaying emotion and more naturally interacting with humans. This was as part of the larger umbrella project of Sociable Machines, aiming at creating more companion like robots.

Cythia Breazeal now has her own research group at MIT, the Personal Robotics group. They continue to explore possibilities of human robot interaction by means of voice recognition, visual tracking, emotion recognition, the building of mind models of humans (to know what they know) and emotional display on the robots. Their robots now range from the teddy bear sized Tofu, a simple, stationary, bird-like robot that blinks and moves by means of a repurposed game controller, to Nexi, a MDS (mobile, dextrous and social) robot that wheels around, has facial expressions and talks to people.

The Personal Robotics Group is part of the corporately sponsored Media Lab, and one of the group's sponsors is the German automobile manufacturing company Audi. Robotics researcher Mikey Siegel is working on embodying the car, giving the car a personality that can be used to convince the driver to be safer and alert him to problems in the car. Siegel is developing a head that can submerge into the dash board and extend to interact with the driver. When submerged, the top is flush with the dashboard. During a presentation on his work in process, I was able to discuss some of the design choices he made while developing.

My first question to Siegel was why he settled on the very literal head on the dash as the car-driver interface. How did he decide that this was the most effective way to give the car companion like features? What research did he do that resulted in this interface? The answer was a little candid, as Siegel explained that he was the only person put on this 8 month project and by the end of it he needed to have a tested, working prototype. Audi was not particularly interested in doing an anthropological study and discouraged Siegel's attempts to do a user study with Cliff Nass. Due to the legacy of the group he was coming from and his acquired skills as one of its students, Siegel settled on a contained prototype. He was not particularly invested in the project and did not see it going beyond the prototyping stage.

The companion connection here seeks empathy from the user. The user builds up a social relationship with the machine because the machines attempt to speak the same language as humans speak to other humans. There are so many delicate experimental sensors required to begin to attempt to speak the same social language as humans that hardly any of the Social Machine or Personal Robotics creatures have made it out of the lab. The first large scale user study was conducted with Autom, a robot to help encourage users to lose weight. Autom as developed after the researchers found that users would find robotic heads versus animated on screen characters more credible and informative [6]. However, the situations in which such a one-track character is helpful are very limited. Chatterbots never proved that successful for similar reasons. The companion connection and the *AI: Artificial Intelligence* prophecy seem unlikely.

The imaginary prosthetic and the real prosthetic are not completely disjoint, they can often be found together. Vivian Sobchack is a theorist studying technology and how it is being incorporated into our lives, and she also has a prosthetic leg. Hugh Herr is a prosthetics researcher and bilateral amputee who was co-organiser of H2.0, a conference organised at the MIT Media Lab in 2007 with the tagline *a symposium focused on ushering in a new era in human adaptability where technology will merge with our bodies and our minds to forever change our concept of human capability*.

Vivian Sobchack spares no details in explaining the connection of her prosthetic leg to her flesh body. Between her and her hard leg there is a silicone suction socket. The connection consists of a individually cast silicone liner and a laminated socket connected with a shuttle-lock mechanism. On what she calls ‘good days’, her hard leg feels like her [9]. But the her that she is connecting to has changed due to her prosthesis— she has lost weight due to the exercise she does to maintain her own technobody. In her new ‘lean, mean, machine’ body, she feels sexier, and she considers her new body as a good trade for her lost leg. Yet, Sobchack does not consider herself a cyborg. She constantly reminds the reader that Haraway’s *Cyborg Manifesto* was also greatly ironic, and that her *lived-body* remains more important than her *hard-body*.

Insofar as the leg remains an object external to me, a hermeneutic problem to be solved, a piece of technology to use, I cannot live it and be enabled by it to accomplish intentional projects that involve it but don’t concern it. So, of course, I want it to become totally transparent. The desired transparency here, however, involves *my* incorporation of the prosthetic – and not the prosthetic’s incorporation of me (although, seen by others to whom a prosthetic is strange, I may well seem its extension rather than the other way around). This is to say that although my new and enabling leg is made of titanium and fiberglass, I do not perceive myself as a hard body – even after a good workout at the gym, when my union with the weight machines (not the leg) momentarily reifies that metaphor. Nor do I think that because my leg may very well outlast me into the next millennium, it confers upon me invincibility or immortality. Prosthetically enabled, I am, nonetheless, not a cyborg. Unlike Baudrillard, I have not forgotten the limitation and finitude and naked capacities of my flesh – nor, more importantly, do I desire to escape them. They are, after all, what ground the concrete gravity and value of my life, and the very possibility of my partial transcendence of them through various perceptual technologies – be they my bifocals, my leg or my computer. That is, my *lived-body* – not my prosthetic leg which stands inert in a corner by the bed before I put it on in the morning – provides me the *material premises* and,

therefore, the *logical grounds* for the intelligibility of those moral categories that emerge from a bodily sense of gravity and finitude.

– Vivian Sobchack *Beating the Meat/Surviving the Text, or How to Get Out of this Century Alive* 1995

Not everyone shares Sobchack's sentiment though. Double amputee, fashion model and collegiate athlete Aimee Mullins encourages everyone to come to her with ideas for new prosthetic legs – animation foam, glass, space material – she wants to be at the forefront of technology. I was fortunate enough to be able to sit in on a class taught by Hugh Herr where Aimee Mullins would be giving a guest lecture, and was able to not only ask some questions but also listen to some of the interactions between Mullins and Herr.

Mullins first outlined some of the adventures of her younger life as a double amputee, interactions with other children and later with her track trainer. Unlike Sobchack, Mullins was always a bilateral amputee and has no recollection of 'good' legs. She studied at Georgetown and was on the able-bodied women's track team, where she ran with a new kind of legs, carbon graphite 'C-legs' which spring forward with her every step. During her first race during her first track meet she popped out of one of the sockets, a traumatising event she now remembers fondly because of how her coach convinced her to just put her leg back on and get back out there for her next race. Mullins continued to show all of the different legs that had been made for her over the years – barbie legs, sprinter legs, shock absorber legs, and for in the Matthew Barney film she was in acrylic jellyfish legs, furry cheetah legs, and for the fashion show she was in carved wood Alexander McQueen legs – during which she gave two major accounts of people wanting what she had, coveting her switchable legs.

Before Mullins walked the Alexander McQueen runway show, she was sitting backstage getting ready and used to the carved ash wood legs that had been designed for her. According to Mullins, in big runway shows it is custom for the biggest model to get the most exciting new piece of fashion to wear during the show. While she was sitting backstage, Naomi Campbell walked up to her and told her to 'take off those wooden boots, I'm wearing those'. And it took the showing of the connection between leg and leg to get Campbell to back off. Mullins describes Campbell as jealous in this situation, jealous because Mullins has something Campbell will never have.

Some years later, at a Chanel party in New York City (Aimee Mullins is quite a fancy lady) Mullins came wearing her new 'pretty legs', or legs she could use to wear four inch heels. With the leg at the heel, Mullins ended up at 6'1, much taller than the average woman at the party. She had an interaction with an acquaintance at the party who came up to her, astonished that Mullins was so tall. 'She kept repeating, 'you're so tall! that's just not fair', over and over. She coveted what I had. What I had and she could not. I could have the perfect leg.'

During both accounts Mullins continuously stressed the desirability of her limbs.

She also often mentioned Oscar Pistorious, the paralympic athlete whose legs were banned from competing in the Olympics because of the unfair advantage they gave over normal legs. But Mullins and Herr indeed agreed that Pistorious was more advantaged than his able bodied competition, but they did not agree that that should rule him out. Tiger Woods has had laser eye surgery to improve his eyesight to better than 20/20, and that does not disqualify him from golf. Mullins and Herr considered that the IAAF felt threatened by the possibility of Pistorious winning and therefore did not want him running in the Olympics. Herr served as an expert witness in the case of Oscar Pistorious but agreed with the IAAF's notion that Pistorious was advantaged – he after all could engineer whatever legs he wanted, unlike the other athletes who had to stick with what they already had. According to Herr, his own ankles are 30 percent more efficient than regular human ankles. Like Sobchack, Herr and Mullins claim to be better off with their prostheses. They have no desire to be 'able-bodied'. According to them, they are already more 'able-bodied' than those with natural legs.

What struck me as odd in Mullin's discussion of all her legs was that although she could change them with the whimsy of a new pair of shoes, she did not ever want to expose herself without her legs. In the Matthew Barney film, she outright refused to do any scenes without some sort of prosthetic, even if it was not functional. Their 'more able-bodied' selves are dependent on the inclusion of a set of legs, or in Herr's case ankles, and as I asked on, I found that it is not the inclusion of the specific set of legs, but the freedom to switch between any legs you wanted. Herr and Mullins do have the super power to give themselves any legs they want.

Most amputees do not have the same luxury Herr and Mullins have with custom made legs and ankles. The silicone sleeve in Mullin's first sprinter legs are much more luxurious than many standard fit prosthetics. Due to their star status in prosthesis and engineering, Mullins and Herr make whatever they want, but that does not mean it is accessible to anyone else. For the less privileged, the physical connection between prosthetic and body remains irksome and problematic.

The prosthetic is not the only physical connection. Computers, precision machining tools, non invasive surgical tools and simulation environments all provide a connection to a machine to communicate across a boundary elsewhere. The interface between the human and the command centre of the software is not as often considered as the connection between the newly harnessed tools and their site of operation. With the designed constraints chosen for these tools, the more natural their first interface is, the more easily they can operate at the second. The second interface might be inside the machine, with another part of the machine and man working together to operate there. The physical/virtual distinction no longer provides a mapping.

VIRTUAL CONNECTIONS

In 1908 J. Stuart Blackton made a film called *The Thieving Hand*, where a beggar is fit with a prosthetic arm that has memories of its own. True to its previous thieving owner, the arm starts to steal from people on the street, and through a sequence of events the arm finds its previous owner back in jail. The theme of machines retaining virtual memories of their owners is reiterated many times in fiction in the 100 years that have passed since.

In the popular first filming of the Japanese Manga Ghost in the Shell, a ‘ghost’ is found to be haunting certain governmental sector networks and taking control of machines and cyborgs. The ghost hacks its way through cyberspace until it reaches servers under different legislative control. There the ghost requests political asylum from the government, which is difficult to decide on considering the ghost’s lack of embodiment.

Ray Kurzweil, like Marvin Minsky, believes that all of human cognition can be broken down into smaller parts which finally can be saved digitally to later be retrieved and loaded into a new body. The cyborgian body is unnecessary according to the accounts of transhumanists who believe that flesh, disease, suffering and ultimately death are all temporary inconveniences that will soon be overcome by technology. According to transhumanists, we are already slowly replacing our memory and some of our cognitive processes with technology, and this trend is going to continue until we fully replace ourselves.

Meanwhile, more practically, the virtual presence now consists of sets of information uploaded onto the internet in the form of photographs, text, and semantic information about how the information uploaded has been made to interact with previously uploaded information. That means blogs posts, Facebook pages, contact lists, the contents of microblogging services and the endless profiles for all the different social networks. These bits of data are pieces of the non-virtual world that are being curated, imported and collaged by many users to form their online identity, one not only free of gender but also free of embodiment. The connection between the online and offline is easily hidden and can easily be completely fractured. Summed up in a famous New Yorker cartoon of two dogs browsing cat profiles: "On the internet, no one knows you're a dog."

A second virtual presence exists in the gaming worlds, where one need not stick to only one identity. The gaming identity can be kept completely separately from both other virtual identities and the offline identity. The connections are again only made at the discretion of the creator. Simultaneously, updates not directly requested at a computer are difficult to obtain in real time in offline life. The connection not only is tenuous, but it is asymmetric. The upload remains easier than the download but for the transhumanists and the rest.

CHEMICAL CONNECTIONS

Human enhancement by means of chemicals and bioengineering is a lopsided debate framed by technological development. In competition, doping is always strictly forbidden but also always secretly used. In medicine, any agent that somehow eases life is acceptable. Then there are vitamins, supplements, cosmetics and other chemicals of well being that are constantly used with little question for their validity and necessity. Finally there is a category of illicit substances that should not be used by humans under any condition. The boundaries between these categories are not always clear, as medicine moves to supplement, and supplement moves to drug. But the connections that bioengineered chemicals make with the body are in any case microscopically small and invisible to the humans that use them. Some of their effects and side effects are noticed by the human, but many more go unseen.

Recently I was an *IMPATIENT* in Natalie Jeremijenko's xDesign clinic, seeking advice and clarifications on the side effects of my chemical connections. Natalie took me and some five thousand dollars worth of water damagable equipment out onto the East River in New York City, after having properly fitted me with a wireless transmitter that the film crew would be using for recording the session for an independent television series. The experience was about as disorienting and bewildering as the set-up would suggest. Without too much backing information, Natalie told me that hormones from the urine of the inhabitants of New York were being released with the sewage into the water systems and there greatly effecting plant and wildlife. The hormones were disrupting the endocrine systems of many species, conflicting with the organism's own hormonal communication. There were ways for me to find out more. Then I was back on land.

The danger of an invisible connection is precisely that the lack of knowledge about it may lead to ignorance or misinformation. It is hard to look up the consequences of chemical connections without landing in the world of highly specialised science or hand-wringing despairing environmentalism. Many of the unintended side effects of chemical connections happen on the long term and span generations of users, and are not considered by their designers. The chemical connection remains a tricky one that I believe will need many decades to play out.

SOCIAL CONNECTIONS

One of the strongest connections man makes with machines is an imagined one. Humans form strong relationships with their cars, their computers and their phones [8]. Sometimes the machines get names, sometimes presents, but they are universally attributed with temperament and will. What is it about those personal yet mass produced technologies that is so appealing to the formation of relationships with man? Why do people like the sound of Harley Davidsons?

Particular brands?

Artist and technologist Kelly Dobson tries to address the need for machine communication by augmenting everyday objects with other modes of communication. She has made a blender that blends something depending on how you growl at it, and a large watermelon like machine that listens to and breaths with the person holding it. By giving the user a constant mode of communication with the machine, Dobson tries to help give the user a space in which to reflect and reconsider their placement in space.

Creating a social connection outside of the art realm is far more often occupied with the branding of a product. The brands appeal to the users for reasons beyond the actual functionality of the project due to the careful strategy of their deployers. But some objects acquire social connections due to their existence as an embodiment of achievement: the fifty thousand dollar watch as a banker's first Christmas bonus, a rickety car as a reminder of college days and perhaps an ankle as a reminder of an existence as a tenured professor with a lab researching ankles. The social connection is relevant to the future with the non-reductionist cyborg, but has no place in a future where all hardware is interchangeable and shared.

CONCLUSION

In this paper I unpack the cyborg and the prosthesis as they are now used in social theory and examine the connections of the modern day cyborg to her auxiliary organs. The companion connection shows an entity entirely separated from the human, an auxiliary organ only in its serving nature. The robotic companion proves a dauntingly large task not coming out of the research lab any time soon. For the physical connection, I considered the connection between an actual prosthesis and the flesh and explored two views of considering the prosthesis as part of the body, and considering the prosthesis as separate. The virtual connection is invisible, but no less painless. The download may be lagging from the upload in terms of importing from the body and onto the body, but the online presence continues to group. The chemical connection is poorly understood and complicated to examine, as its elements are invisible and its side effects unknown. Finally the social connection allows man to form long term attachments with machines, attachments with an emotion of a kind otherwise absent in technological research.

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