YOU are a Cyborg: Society Redefined by the Synthesis of Man and Technology

Documentary Film

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Statement of Purpose

General Topic and Social Significance

Our topic for the MJD senior seminar research project centers around the ways in which humans are becoming more like robots and robots are becoming more like humans. We will need to spend some time defining what a "robot" and a "cyborg" is, but right now, for us, that means when technology and human-like features (physical, emotional, psychological) combine to create a hybrid of the two. This, as we have discovered through initial research, takes on many forms. We have found numerous articles and research projects done on the ways in which prosthetics, bionic body parts, brain chips, and other hardware are being placed in the human body. This will be a major part of our project, as it is one of the areas of the topic that is the most under-explored and under-represented in the media. There are organizations all over the globe doing research into how technology can help people with physical disabilities. One source that we discovered, the MIT Media Lab, is currently doing research into restoring and augmenting human function with mechanical prosthetics. Their site explains, "we develop technologies that augment human performance beyond what nature intends."[1]

This part of the topic will definitely involve medical research. It will be important to go into hospitals, universities, and other research centers and to a) actually see the equipment that is being created for patients to use to improve their function, and b) to interview the creators and the users and see what their perspectives are. Through this research, we are hoping to shine a light onto the positive, progressive, and revolutionary sides of the "technology in humans" idea. The work that scientists are doing to help return functionality to peoples' lives is incredible: for example, Nathan Copeland, a self-identified "cyborg," who has a brain implant that allows him to control robotic body parts using his mind.[2] He has the implant because he is paralyzed from a spinal injury in a car accident, and his use of the implant is part of a University of Pittsburgh research project on brain-computer interfaces. Another major company that we will be exploring in our research is Neuralink, which is a brain-machine interface (BMI) that Elon Musk is creating that will help people with brain injuries and disorders to regain functionality. Musk explains in a Neuralink video, "we will ultimately achieve a symbiosis with artificial intelligence. This is not a mandatory thing, this is something you can choose to have if you want."[3] Of course, we want our viewers to be able to physically see examples of prosthetic limbs, bionic body parts, and, of course, an exo-skeleton.

On the flipside of human development is the progression of robots. We plan to reach out to Boston Dynamics, a company based in Boston doing research on robotics and creating robot dogs that are eerily similar to those featured in the *Black Mirro*r episode "Metalhead." Their humanoid robot, Atlas, is a highly functional piece designed to achieve "human-level agility."[4] Videos of Atlas doing parkour and defending itself against attacks have gone viral online.[5] The other layer of this project that we want to explore involves the way artificial intelligence is

becoming more human-like. Some examples of this which we have already begun to explore involve technology like Google Assistant, a Google product that can do things like call restaurants and hair salons to book appointments for you in a creepily realistic tone, even including pauses for “umm’s” and “hmm’s.”[6] Another example of this human-like technology is Sophia the robot, who was brought to life by Hanson Robotics in 2016.[7] She has done some “human-like things” that many humans will never even get the chance to do: guest starred on numerous talk shows including Jimmy Falon’s *The Tonight Show*[8], addressed the United Nations, appeared on the cover of Cosmopolitan magazine, and she even has ROBOT CITIZENSHIP in Saudi Arabia. With this idea of technology becoming more human-like, we will also look at Alexa and Siri and question notions of privacy and security that come with them.

We also want to look at the ordinary person, and how cyborg-like many people are actually becoming. Sure, a person may think they are far from being a robot, but we want to take a closer look at peoples’ technology habits to prove the point that maybe we *are* becoming more robot-like and we just do not realize it. For example, imagine a student walking to class with her Apple watch synced to her iPhone, pressing “skip” on a song playing in her AirPods, and closing out a notification from her calendar telling her that her class starts in 15 minutes. Our topic involves some high-level technology, but we also want to show viewers that sometimes big ideas can be played out in simple scenarios to reflect the subtle but major impact it is having on people like us. This will help connect the larger, more “further out” idea to the everyday person.

This project idea is truly all-encompassing because not only can we explore the physical awesomeness and amazing abilities of technology, but we can also analyze the underlying psychological and ethical dilemmas that come about. We plan to investigate the side of the argument that people do not always want to think about when they are talking about life-changing technology. Perhaps we could interview someone who left the field and is unsure about their relationship with human-technology interaction and the future of the field. We can also explore an anthropological side to it all through cross-cultural understanding of robots and AI technology. We will look at popular culture representations of artificial intelligence (books, video games, film, TV series, Netflix, etc). We could also conduct a study on how comfortable people in different locations and cultures are with humans and technology based on factors like level of development, socioeconomic standing, access to resources, age etc. This would probably involve some statistical and data analysis, which would add another dimension to our project. For example, according to an article we found from *The Guardian* about human-like robots, the author explains, “In Japan, where the animus belief perhaps makes people more comfortable with the idea that spirit can reside in something that isn’t human, robots are already being used as shop assistants, in care homes and in schools.”[9]

In terms of an international angle, we plan to spend time discussing how other countries are developing these kinds of human-technology (there are so many places in the world that are making advancements in this field!). Opposingly, we could also look at places where access to technology is limited: what happens in countries that have barely even used the Internet? How do robots and AI affect them? How have these places “fallen behind” in terms of technological advancements and how is this affecting them? This difference all boils down to how we have grown to be acclimated with technology in our own environments and development. Despite

being amazed by the idea of humans in technology and technology in humans, at the core of our topic, there is also this feeling of fear of the unknown, and that is a theme that we want to represent in the visual product of our research.

Technology is continuously advancing and expanding, almost faster than we can process it. This field provides for some of the biggest industries in the world today and are starting to monopolize people's everyday lives. It seems as though there is an article written everyday about a new technology that has just been created or discovered. Since technology is a huge part of people's lives, we want to explore the many different aspects of this topic and discover the social and psychological impacts that it has had and may have in the future.

Representations and What is Missing

In an article we found titled "10 Documentaries on Artificial Intelligence That are a Must Watch," we realized that the way in which our topic (and similarly related topics) was presented was heavily based on the AI side.[10] For example, the film ***Lo And Behold: Reveries of the Connected World*** focuses on the Internet and explores changing definitions of what it will mean to be "human" in the future, but lacks a focus on the humans-becoming-robots aspect.[11] From this, we have begun to see that for us to be unique, we may need to put a stronger emphasis on the technology in humans and less on the development of AI. It will still be thematically important to include both, however we should probably favor one. It will be good to have lots of visuals of the physical technology and the biohacking examples. Additionally, many of these films lacked the cross-cultural aspect and focused solely on the tech; they barely even talked about psychology and ethics. Secondly, many of the documentaries that have been made about artificial intelligence and robotic technology are somewhat outdated. Although some films have been made only 10-12 years ago, in dealing with technology, these documentaries are outdated. Every year, there are incredible leaps and bounds made in technology. In addition to just technological change, there is also social and cultural change that occurs because of the advancements in technology.

As mentioned above, we plan to devout a chapter of our documentary to analyzing popular culture references to the idea of robots and artificial intelligence. In doing research, when we looked at mainstream media outlets and news sources, there were two main themes that have come about in most stories and headlines: innovation and fear. This is *exactly* the message we want to drive home in our documentary, just through a different story. News stories sensationalize gadgets and make us fearful of Big Brother, but what *we* want to do is find a new way to tell this story that humanizes the experience of technology. We are constantly fed click-bait articles about the newest Google app that can do crazy things or a self driving car or other new technology, but rarely are we given the time and space to digest and process the larger implications of this information. Our film aims to give the viewer the questions, perspectives, and space to contemplate answers to potential conflicts, be them personal, societal, global, political etc.

Amongst the academic research that we have found, many e-books and articles either discuss very specific research about one kind of technology or they just scratch the surface about many different aspects regarding humanoid and AI technology. For example, the ebook Becoming Digital: Toward a Post-Internet Society by Vincent Moscow discusses the social,

cultural, and psychological impacts of new technology, however, the author does not go very deep into the research and explanation.[12] Also, this book is more focused on Internet systems and technologies such as big data and converging technologies. Another article that we found is about prosthetics and technologies that help people recover from injuries.[13] Although the article is informative, it does not go into extreme detail on the matter. Throughout the article, various new technologies are brought up, but they are only briefly described and do not go beyond explaining the basic function.

For our project, we want to go beyond just the surface. We want to explore the functionality of these different technologies and discover the effects both socially and psychologically. By providing visuals, we want to give the viewer an in-depth look into the world of robotic technology and AI and give them a new perspective on the subject.

Questions and Angles

A unique avenue that we want to explore in this story are the cross-cultural elements of the various technologies and the AI associated. This topic is in no way *only* progressing in the United States; in many countries, huge advancements in the field of robots and technology have been made and with that comes larger cultural and societal impacts. We want to delve deeper into the various effects that this technology has made and how/if different cultures are adapting. It is important to consider how the evolution of technology and the rapid progress in this field have changed different cultures since this phenomenon is being seen throughout the world. We want our story to be relevant to everyone and have people connect on an individual level, but we also want it to connect globally and show that bigger picture.

1.) How do you convince those less knowledgeable on the subject of robots becoming more like humans, that it is a positive progression?
    a.) This question would be directed at the scientists and engineers within the field of robotics. Personally, we would love to hear a response to this question from the people at Boston Dynamics. Like most technological advancements there are those who are for and against the progress. When it comes to robots, it is not hard to find the skeptics. Many people view the humanoid robot as an almost apocalyptic scenario. While this may seem extreme it will be important to hear from those who hold this viewpoint.
2.) What are the financial benefits and drawbacks of integrating robots into society?
    a.) Obviously, the financial sector will play a major role in how available and accepted robots become, especially amongst corporations and businesses alike. SMC Alumni Jonah Kessel produced a piece for The New York Times that addresses this very question in China.[14] It would be very informative to discuss with him about the progress being made in China and how much it has changed since he released the video four years ago. While robots may increase product output and decrease the risk of injury for certain tasks in factories, the robot also takes away jobs from human employees. This question will be essential in addressing the socio economic relationship between humans and robots.
3.) How affordable are robotic prosthetics?

   a.) While it is hard to deny the revolutionary feat that is an attachable, mind-controlled replacement limb, the cost of that may be a setback. This question branches off of the socioeconomic relationship between human and robot. Will someone with an average to lower than average income, who lost a limb, be able to afford the initial purchase of that robotic prosthetic and the continued upkeep of that new appendage?
4.) With AI as a staple in everyday life, is our privacy a thing of the past?
   a.) Integrated AI technologies (Alexa, Siri, Google Assistant, etc.) are welcomed members in any household at this point. The question of digital privacy is an extensive rats nest of confusion with, seemingly, too many avenues to address at once. But, with the recent privacy crises, like the data debacle at Facebook or the user breach at Yahoo, the matter of privacy in the digital age has never been more relevant. This matter extends beyond household devices and their AI technologies. Many of the humanoid robots are designed with integrated AI. So, if these robots become commonplace, then what would stop them from obtaining information that was once thought to be private?
5.) Are prosthetic limbs and implant technologies creating freedom in what the human body is able to do?
   a.) With the help of modern technology and design, amputees have been able to create prosthetic limbs that have actually helped their performance. Despite their hindrance, they have been given the freedom to transform their body into what they want. For example, Hugh Herr, who is an avid rock climber and a double amputee, has designed prosthetic legs with feet that act as tools for his rock climbing and enhance his ability to climb.[15] He has different designed “feet” for different types of climbs. By the way of prosthetics, people are able to rebuild their body into what is beneficial for them.
6.) How do these technologies differ from culture to culture and how have they been impacted?
   a.) As said in the previous section, it is important to look at the adaptations that cultures have made to these technologies both in a psychological and physical sense (what technologies have they actually implemented in their society). Since the advancement of technology is a global issue, it is crucial to incorporate the views of other parts of the world. It would be interesting to get perspectives from people who live outside of the United States.
7.) How has pop culture influenced the public’s perception of robots and artificial intelligence?
   a.) There is no shortage of pop culture to reference when discussing robots within society. ***Ex Machina, I, Robot, WALL-E, The Terminator,*** and ***Robo Cop***, just to name a few. The premises within these films range from friendly little robots that save the day to post-apocalyptic worlds in which robots now dominate the human race. While many may seem exaggerated and overly sci-fi, these countless pieces of robot entertainment have undeniably played a role in how we, as a society, perceive and establish the relationship between human and robot.

This question will not only be entertaining to address, with its abundance of well-known tv shows and movies to draw upon, but it will also allow our audience to recognize how public opinion impacts the subject matter of our documentary.

8.) What are the possible health ramifications that are associated with implant technology?
    a.) Implant technology has progressed quickly in the last couple of years and people have begun to insert devices into their bodies to benefit themselves. For example, in the BBC video *Is this the next phase of human evolution?* Liviu Babitz inserted an implant that notifies him when he is facing north.[16] Are there any health consequences with having this technology constantly on or inside the body? Since this phenomenon is fairly new, the health effects (if any) have not appeared yet, but talking with a health professional would be beneficial in discovering more about this issue.

Medium, Group, and Skills

We have decided to present this topic through a documentary film. This medium gives us the capabilities that are very helpful in getting our ideas across. The topic that we have chosen relies heavily on visual aspects in order for the viewer to truly understand how this innovative technology works as well as the overarching, intrusive, philosophical ideas that we intend to pose to the audience. Each of us have taken or are currently taking the MJD digital film course. Through the MJD major, we have all taken classes that have enhanced our storytelling abilities and have given us the experience that we need in order to create this project. We all have a natural curiosity to pursue a story and dig deeper in order to uncover new aspects.

Each member of this group definitely possesses the intellectual curiosity and capacity to create a powerful project. None of us are so close to the topic that it will affect our ability to be objective and use reason in developing our arguments. We are open to learning and accepting new ideas and philosophies as we explore our topic. We plan to take a stance in our documentary that will engage many different schools of thought and will not use "black-and-white" thinking, but rather a more holistic approach. Not only is this project completely relevant in the time and place that we find ourselves, but it will also continue to grow and develop, as this field is positioned for longevity and innovation.

Our knowledge and skill sets definitely set us up for success. Bella has a math and data science background that gives her a quantitative, analytical mindset. This will help us a lot in understanding the workings of the technology (maybe even an edge when reaching out to interviewees in the tech field), and will also help when we are trying to make sense of statistical, data-based research and jargon. She also has a passion for storytelling and conveying really heavy, complicated ideas visually, so that will help. She finds the challenge of becoming an expert in a field that she knows nothing about really exciting. Sierra has a minor in psychology, so being able to have a basic understanding of how the mind works and how a person might be feeling in different situations could be beneficial in meeting with and interviewing people. She is a very visual and detail-oriented person, and has a desire to *see* a story and to create visuals that go along with a spoken topic. This can be helpful in translating what people are saying into different visuals that go along with it. Stephen has a background in filmmaking and video editing. This will help produce a high quality, professional-looking documentary that will portray

our story in a visually engaging manner. His persistent attitude paired with the experience of creating multiple long-form journalism pieces will hopefully get the team access to many valuable interviews.

Cultural Connectedness and Context

Environmental topics are of serious discussion and importance in our society and everywhere around the world today. The main question that is asked when on this subject of the environment are what could be done and how can this be fixed? Today, scientists and environmental professionals are extremely focused on trying to curb the pressing environmental issues that threaten our lives and our planet. With the advancement of technology, specialists have been able to create new and easier ways to solve some of these issues that have not been able to be fixed in the past. Specifically, artificial intelligence has significantly increased in performance and has been implemented in so many devices and technologies throughout the recent years. Various technological devices with artificial intelligence systems are being created and used for the purpose of trying to fix some of the environmental problems that the world faces today.

Broadly, our topic is all about technology and what the future will look like with the incorporation of new, advanced systems. Although our topic is not solely about artificial intelligence, the humanoid robotics side that we want to explore is tightly intertwined with artificial intelligence systems. In addition, we are also looking into how the future will be shaped and how society will be affected by these robotic systems. These environmental problems that we face are extremely crucial and it is important that they are not ignored. With the use of AI and deep learning systems, these issues that threaten the future of the planet are able to better be contained and then solved. It provides scientists and specialists ways to get information that they have not been able to get before and data that they cannot get themselves. By nature, AI devices provide scientists with information without being controlled by humans and can come up with data by functioning on their own. This opens up a whole new set of information and data. Professionals are able to analyze the information that they receive to then further come up with ways to solve these environmental problems.

Microsoft has created a program called AI for Earth through which they partner with other companies that are working to solve environmental issues. Microsoft's program provides these companies with AI systems that create ways in which various environmental problems can better be monitored and then be improved. One system through AI for Earth is “Wild Me.” This system uses AI and deep learning to detect species that are on the verge of extinction. This system provides specialists with information such as location, migration patterns, animals’ social groups and date of sighting. It can also detect an individual animal immediately by using certain tags that human eyes are not able to determine. Overall, this system allows professionals to get a comprehensive understanding of the planet’s biodiversity.

Another system that has been created through AI for Earth is “OceanMind.” This system essentially preserves biodiversity among ocean species and prevents slavery in the seafood industry. They work with governments and NGOs in order to protect the vast ocean areas. Using AI, this system tracks and analyzes vessels in the ocean in real time in order to prevent any

illegal fishing activity and helps to promote sustainable fishing. Governments and organizations are able to take this data and analyze it to then take action.

The use of AI in complex systems allows for a large amount of data to be collected that humans would not be able to get on their own and allows for governments and companies to take big steps in trying to solve these dire problems. What we are researching and exploring for our topic is connected to so many other crucial parts of society and technology as a whole seems to be incorporated in every aspect of our lives. Environmental activism and attention towards climate change are extremely important and prevalent patterns in our society and with the use of AI and deep learning systems, we are better able to prevent devastating effects that we have inflicted on our planet.

Another trend that has begun and started to gain traction is robots being implemented in many sectors of the military. As said before, advanced technological systems and devices are being incorporated in all aspects of society and it is starting to make its way into the military. The wave of sending robots on the ground to accompany or even replace human soldiers has already started and is becoming more and more frequent. Robotic soldiers are already deployed in Afghanistan and Iraq, but this is just the beginning. New robots that have been improved in all aspects will soon be released on land and will be better equipped to fight and protect other soldiers. Different robots have been created for different purposes. Some have cameras that relay back video of what the robot is seeing on the ground. Other robots are equipped with various types of guns and ammunition, allowing them to actually fight against their opponent.

We are even seeing this trend of robotics entering military forces in the water. AI devices have been created and are being tested to be deployed. Using AI technology, these robot boats are able to sense their surroundings, communicate with other boats, and position themselves. With various guns that they are armed with, they are able to protect troops that are on beaches from any potential threats and attacks. With AI systems, these robots are able to go on the attack rather than solely being on the defense. They are able to do so much more than they have before.

A large focus that we have on our project is how robots are becoming more like humans with the tasks that they are able to perform due to the complex systems and technology that has been created. This is being seen directly within the military and is starting to take on even more human-like qualities and tasks. Robots have already been deployed and are being used to support human soldiers, but more advanced and versatile robots are already starting to be created and deployed. This is important to consider because it has to deal with human lives, which are now being put in the “hands” of these robot devices. How much can we rely on robots to protect soldiers during war? How can we trust robots to not “malfunction” and end up injuring or even killing a soldier? These are questions that are important to keep in mind when moving into this autonomous future.

Critical and Comparative Literature Review

Annotated Descriptive Timeline: 20 Key Historical Events

- **1920 - The word “Robot” is first used**[17]

    - The word robot was created by Czech playwright Karel Čapek.[18] It was first used in his 1920 play, Rossum's Universal Robots. The play is the story of a company that creates robots to replace human workers, but the robots eventually revolt and kill the humans. This play was the launching point for the use of robots within science fiction; an infatuation that has come to define entertainment in many forms.
- **1942 - The Three Laws of Robotics are formed**[19]
    - Prolific Science Fiction author, Isaac Asimov, published a short story called "Runaround" which contained three basic laws which he believed should govern robotics. While heavily and perpetually debated amongst professionals in the field of Robotics, Asimov's three laws have stood the test of time and remain relevant today. Asimov would go on to write more than 500 books in the fields of Science Fiction and Popular Science.
        - 1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
        - 2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.
        - 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
- **1950 - I, Robot is published by Isaac Asimov**[20]
    - One of the earliest science fiction books regarding the relationship between human and robot. In this collection of short stories, Asimov explores mortality in the context of both humanity and robotics, but also unravels and explains the future he sees amongst the two. The book would go on to be transformed into both a TV show and a movie.
- **1954 - First Digitally Operated and Programmable robot is invented**[21]
    - American inventor, George Devol, created the world's first industrial robot. Called the Unimate, the robot was a mechanical arm designed to accomplish tasks that were potentially harmful to humans.[22]
- **1956 - The term "Artificial Intelligence" is coined by John McCarthy**[23]
    - Defined by McCarthy as, "the science and engineering of making intelligent machines", the notion of Artificial Intelligence would go on to define some of McCarthy's biggest achievements. These include early versions of a self-driving car, many internet-based services, and an early system of networking between computers.
- **1959 - General Motors is the first company to utilize a robot in their factory**[24]
    - George Devol's Unimate mechanical arm is installed into a General Motors factory in Trenton, New Jersey; there it performs the task of die casting. By 1961 the Unimate became the first mass produced robotic arm used for factory automation.
- **1963 - The "Rancho Arm" is invented**[25]
    - Developed at Ranchos Los Amigos Hospital in Downey California, the Rancho Arm was the first attempt at a robotic arm designed to aid the handicapped.

Using six different joints, the Rancho Arm was able to have the flexibility of a human arm. Later that year it was acquired by Stanford University, where it would go on to become one of the first artificial limbs controlled by a computer.

- **1965 - British mathematician and computer scientist Irving John Good publishes Speculations Concerning the First Ultraintelligent Machine**[26]
    - Good's book explores the concept of superintelligence along with its many potential pros and cons. This is one of the first times we see the notion of a superintelligent machine uprising within the realm of academia. While defining the notion of machine intelligence Good outlines it by saying, "Since the design of machines is one of these intellectual activities, an ultraintelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion,' and the intelligence of man would be left far behind."
- **1968 - *2001: A Space Odyssey* is released**[27]
    - Stanley Kubrick's renowned sci-fi thriller was one of the first Hollywood films to bring AI to public attention. While it may not have been realistic in every aspect, the film, nonetheless, aided in creating the Hollywood archetype of the downfall of man at the hands of a superintelligent machine. This theme has been recycled countless times across all entertainment mediums alike and it has created a longstanding tension, for many, between man and machine in real life.
- **1970 - The first Artificial Intelligence Robot is created**[28]
    - Created by a group of engineers at the Stanford Research Institute, the robot, known as "Shakey," was the first robot with the ability to reason its actions based on its perception of the surroundings. This robot lay the groundwork for the generations of autonomous robotics to come.
- **1983 - The term Technological Singularity is coined by Vernor Vinge**[29]
    - While there are many different definitions, at its base the concept of a technological singularity refers to the point at which our technology becomes faster and smarter than we are, therefore advancing at a pace we cannot imagine. Kevin Kelly, the founder of *Wired Magazine*, defined technological singularity as this, "all the change in the last million years will be superseded by the change in the next five minutes."[30] In his novel Marooned in Realtime Science Fiction writer Vernor Vinge was the first to publish work with the term Technological Singularity, which he later expanded upon in his 1993 essay The Coming Technological Singularity. The concept of singularity was discussed within these fields decades before Vinge would publish it and many would say that Vinge was merely summarizing the theories and ideas expressed by those before him, including John von Nuemann, I.J. Good, and Alan Turing.
- **1997 - Mars Rovers put robotics onto a galactic level**[31]
    - As the most Earth-like planet in the solar system, Mars is a natural origin point to start looking for a home away from home in a sense. Starting with the Sojourner in 1997, NASA has continued to put rovers on Mars. These machines are incredible feats of robotic stamina and engineering ingenuity. The most recent rover, Curiosity, has been on the red planet for 8 years so far. These rovers not

only play a critical role in determining the viability of life on Mars, but they also advocate for a push into the field of unmanned space travel via machines like these.

- **1998 - The World Transhumanist Association (WTA) is founded**[32a]
    - Established by philosopher's Nick Bostrom and David Pearce, the World Transhumanist Association was created with three goals in mind. First, to open a public dialogue surrounding the concept of transhumanism and foster society's perception of these emerging technologies. Second, to fight for the right of an individual to adopt and enhance human function through these technologies. Third, to prepare for potential consequences of human enhancement.
- **1998 - The Transhumanist Declaration is created**[32b]
    - Originally created by a group of international authors as the mission statement for the World Transhumanist Association (now called Humanity+), the declaration provides 7 core beliefs held by those belonging to the WTA. It quickly became widely accepted as a sort of Transhumanism manifesto for transhumanists around the world.
- **2000 - First FDA approved Surgical Robotic system**[33]
    - The da Vinci Surgery System is used in general Laparoscopic surgery. This system represented the cutting edge of precision robotics within the surgical field and allowed for minimally invasive surgery where it was once impossible.
- **2000 - Honda release ASIMO, an advanced humanoid robot**[34]
    - Following nearly two decades of prototypes, including the first Honda Bipedal robot model, the E1, to the first Honda Humanoid model, the P1, which stood at a daunting 6 foot 2 inches tall weighing nearly 400 pounds, the company released its most advanced humanoid autonomous model, ASIMO. The name stands for Advanced Step Innovative Mobility. The humanoid robot has a lengthy list of functions, including the ability to respond to simple voice commands, play sports, and even dance.[35]
- **2011 - Siri is released to the public**[36]
    - Now commonplace to any Apple smartphone, the Siri AI system was first released as an application that could be added to the iPhone. It was not until the iPhone 4s was released that same year that Siri became integrated into all future iphones. But, the integration of Siri represents a much broader social transformation that reaches outside the bounds of just another exciting app. Siri represents the bond, which grows tighter each year, between a normal human being and artificial intelligence.
- **2013 - Boston Dynamics creates Biped Robot, "Atlas"**[37a]
    - Labeled by Boston Dynamics as, "The world's most dynamic humanoid robot" the two-legged machine can be seen performing incredible feats like parkour, backflips, and walking through the snow. The robot is one of the few in the world that can demonstrate that level of human agility.
- **2016 - Boston Dynamics creates four-legged robot, "Spot"**[37b]

    - Just three years ago Boston Dynamics created one of the most versatile and adaptive semi-autonomous robots to date. Multiple viral videos have been put out featuring Spot doing anything from pulling a truck, to opening a door, all the way to performing a dance routine to a hit pop song.Three years later, in 2019, Spot was put out into the market.
- **2018 - Johnny Matheny becomes first person to live with advanced mind controlled robotic arm**[38a]
    - The field of biomechatronics is making technological advancements more rapidly than ever, but mind-controlled prosthetics is still not the common practice when it comes to aiding amputees in regaining functionality. This is why it was a big deal that Matheny, a 64-year-old Florida man who lost his arm to cancer back in 2005, was given the chance to utilize the robotic arm for a whole year. This was a large step towards the integration of biomechatronic functionality into standard prosthetic replacements.[38b]

Mainstream Media Frames, Patterns, Priorities, and Stereotypes

News Headlines

1. Trend 1: Warning you to be cautious, especially around health
    a. Two studies lay the blame for childhood screen time at moms' feet[39]
    b. China due to introduce face scans for mobile users[40]
    c. Facebook Bows to Singapore's 'Fake News' Law with Post 'Correction'[41]
    d. What to Consider Before Trading Your Health Data for Cash[42]
    e. Inside Amazon's plan for Alexa to run your entire life[43]
    f. Smart speakers: Are you being fooled as technology advances?[44]
2. Trend 2: The Wow Factor - "magical" innovation
    a. Some day you may be able to monitor your stomach from your smartphone[45]
    b. Say goodbye to Alexa and hello to gadgets listening to the voice inside your head[46]
    c. Getting email on your skin is actually a thing now, thanks to Facebook[47]
    d. The next breathalyzer may be a chip implanted under your skin[48]
    e. A stretchy stick-on patch can take blood pressure readings from deep inside your body[49]
    f. Biohackers are pirating a cheap version of a million-dollar gene therapy[50]
    g. A sensor-packed "skin" could let you cuddle your child in virtual reality[51]
    h. Apple just released an app that tracks your heart, hearing, and menstrual cycles[52]
    i. Scientists Used CRISPR to Put a GIF Inside a Living Organism's DNA[53]
3. Trend 3: Robots will improve efficiency in business and other industries
    a. Wearable Robots Help Paralyzed Warriors Walk Again[54]
    b. Amazing Spider-Man tech will let soldiers scale sheer walls[55]
    c. Artificial intelligence improves biomedical imaging[56]
    d. White-Collar Workers May Be Most Impacted By AI, Says Brookings Report[57]

Conclusions: Something that comes up in every news outlet that we have looked into is the idea of fake news and the vulnerability of personal data. We went to the "tech" page of the

BBC, NYT, Fox News, Technology Review, and other major news outlets, and the top articles usually had something to do with a new scheme of one of the major tech companies (Google, Facebook, Amazon, etc.) having a leak of private information or having a problem with fake news. This sentiment of fear around giving away personal information is widespread across media outlets. News headlines often remind people how vulnerable they are in this new innovative landscape, and also how uncertain the future is for the average person. There is also a lot about the wacky and crazy new inventions coming about in the field. A large amount of articles have sensational titles about technologies that are represented as amazing and revolutionary**.** Short videos or articles will describe the physical elements and the basic function of the new technology, focusing on the novelty and the positive aspects. As we discussed in class, the idea of how cool, new, exclusive, and innovative technology can be is often the only thing that we see in the media; the "wow factor."

Television and Film

Science fiction is a major influencer of public opinion and perception of developing technologies. We have chosen to identify a few specific works of science fiction in order to bring about some of the overarching trends in television and film. One television show that we screened and feel is really important for our project is the Amazon original show ***Humans*****.** It seems kind of ironic that one of the most powerful and influential companies in the field of AI and cyborg development has created a TV show like this. The show takes place somewhere in the near future where robots called "synths" have become common in society. These cyborgs look like humans and even live in homes to work as housekeepers, however they are programmed so that they do not feel anything; they are simply artificial intelligence machines. However, when the creator of these synths' son nearly died in a car accident, he decided to create five conscious synths who would live to take care of him. Eventually, these synths discover the code to give other synths consciousness, and the whole show begins to propose questions about synth-rights and how people should feel towards them.

This quote, from season one episode four, is really powerful and it sums up the feelings and fears that the characters feel towards AI really well. It shows how people develop very complicated relationships with the synths. Though they know that the synths cannot feel any emotions, they still recognize that they tend to create emotional relationships with the objects around them that prevent them from feeling "nothing" towards them.

"I'm not a madwoman. I don't believe that Howard is a human. But I also don't believe that he is an inanimate object that I should be ashamed of having a connection with. We created these creatures. They walk and the talk and they look and they smell and they've become part of our lives and families. They are as close to humans as can be, and yet still people insist that forming a relationship with them or treating them with dignity is somehow perverse. Well, we've created a gray area, Mrs. Hawkins. We can't keep insisting that they are just gadgets. They are more than that. We have made them more than that."[58]

A film that has been very influential in thinking about how AI could develop in the very near future is ***ExMachina***, written and directed by Alex Garland.[59] This film introduced us to the Turing test, which we later discussed more with Thomas Dickerson in our pilot interviews. The film starts off by introducing us to the CEO of a major search engine company called BlueBook

(maybe modeled after Google?) who recruits a coder to come test the sentient artificial intelligence that he has created. If the human can be convinced, through his interactions with the AI, that she is a human, then the AI passes the test. This film really plays up the "fear of the robots taking over" stereotype. In a series of unexpected plot twists, the AI ends up tricking both the creator and the coder into letting her free. She kills her creator and locks the coder in a room, venturing off into the free world.

Conclusions: In science fiction, we are taught that our biggest fear and most complicated moral and ethical dilemma is fear that the robots will become sentient. If robots understand what they are and figure out their place in the world, they will rebel. Science fiction is often dark and skeptical, seeing sentient AI as only destructive. We see a glimmer of hope in ***Humans***, as the Hawkins family develops a bond with Mia the conscious synth. But overall, it is mostly about fear and endtimes; the viewer is left feeling disturbed and possibly pessimistic at the end of these productions. These feelings come about because of the ethical dilemmas that are produced from these (not too far off in the future) scenarios.

Social Media - Instagram

#Techblog, #Techupdates, #Robotics ***- see figure 1, 2, and 4.***

Instagram is all about sensationalism. These hashtags, among the thousands of others related to our topic, show some of the top posts about technology and robots. Many of them feature fantastical inventions like the self-driving car and a flying bus. Instagram is an entertainment app meant to keep people curious, so it makes sense that their top posts around these topics are very flashy and fun. Posts are less about fear of robots and more about the cool applications they can have for regular people like you and me.

Boston Dynamics and comments ***- see figure 3.***

This post is particularly telling of the way that people digest the content they see on social media as it relates to technology of the future. Boston Dynamics, a company we have already done lots of research on, posted on their Instagram account about their robotic dog named Spot. The comments are what interested us here, and below are a few of the most interesting ones. These comments say a lot about what people see for the future of technology when something new is showcased on a social platform:

"The future is now!"

"Omg let me adopt a spot and I will use him in my Tik Tok videos all day long"

"Farming applications will be HUGE"

"I DEMAND YOU STOP REFERRING TO THIS FOUR LEGGED ROBOT AS A DOG!!"

"My cat just passed away.. Can I trial one of these out as an anxiety aid?"

"Welcome to the #AnimalBot Age"

Lil Miquela ***- see figure 5.***

This example is a byproduct of the technical revolution that we live in. This account, whose handle is @lilmiquela, is owned by Brud, a software company based out of Los Angeles.[60] For a long time, Miquela posted on Instagram just like a normal Instagram influencer would, with lots of selfies, pictures with friends, and product placement. But, at a closer look, one can see that Miquela's face does not look normal. In fact, it looks like it is animated! It was a huge controversy on Instagram for the longest time with people questioning whether or not

Miquela was a real person and whether her photos were real. Recently, she has admitted to being a "character" of sorts, but also claims to be a sentient robot in her bio. Her photos, like the one with Milly Bobby Brown from ***Stranger Things*** in figure 5, feature celebrities, and she also markets different products, from jewelry to clothing to her own song that she recorded. The question of whether or not Miquela is a "real" person still lingers.

According to the Brud website, which is actually just a link to a public Google Doc, the purpose of creating characters like Miquela (and others that they have accounts for) is:

- Story worlds that have the power to introduce marginalized ideas wrapped in the familiarity of entertainment.
- Story worlds that can create a more tolerant world by leveraging *cultural understanding* and *technology.*
- Story worlds that are the product of a collective intelligence informed by diverse individual experiences.[61]

Conclusions: What comes out of a story like this is firstly, digital media influencers do not necessarily need to be real people anymore. This company could be a group of random people in an office in Los Angeles who look nothing like Miquela, and yet they are making thousands of dollars off of her because they are able to build a story around her. The fact that she looks a little "off" intrigues people and the mystery around her existence is entertaining, which is ultimately what Instagram is meant for. Secondly, the line between human and robot gets really blurred when people (or robots) take to social media. No one can refute whether or not Miquela is real because no one has any real proof. In today's media climate, digitally editing and Photoshopping social media photos is very common. So, why is this any different for Miquela?

Youtube

Below we have chosen a few examples of Youtube videos to highlight some of the trends we see in this media outlet:

- "Can we build AI without losing control over it?"[62]
    - This Ted Talk by Sam Harris discusses the progression towards a superintelligent AI. Not, a specific company or software, but rather the broad notion of a machine that will one day become an autonomous and powerful AI. This quote from the speaker, Sam Harris, sums up the talk quite well. Harris says, "...we admit that we will improve these systems continuously, and we admit that the horizon of cognition very likely far exceeds what we currently know, then we have to admit that we are in the process of building some sort of god. Now would be a good time to make sure it's a god we can live with."[62]
- "The Mind-Controlled Bionic Arm With a Sense of Touch"[63]
    - Technologies that enhance human performance as well as A.I. robots are often discussed as things that can benefit sick and disabled people and are a revolutionary part of modern medicine. They are presented to us as things we *need* in order to advance in the field of health and medicine, largely viewed only through a groundbreaking lens of progress and positivity. This video, about a bionic arm that can be controlled with connectors to the brain, really emphasizes

how this research is changing the way that humans and machines relate to one another.

- "Man Controls Phone with Microchip Implant | Body Mods S2 E2 | Only Human"[64]
    - This and other videos really highlight the bodyhacking side of our project. Bodyhacking videos are really common on Youtube and there is a whole community where people show off their new modifications and explain their functions. This is definitely for the "wow" factor, but it is also to show others the potential for what they could do with their own bodies, and it also provides a forum to discuss the processes.
- "The Caring Bear | Robotica | The New York Times"[65]
    - This article is about a talking teddy bear with AI technology that has been used in pediatric hospitals to help children feel more comfortable when going through different kinds of treatment.

Conclusions: Visuals are a very powerful tool in showing the public what kind of cool tech is out there. A lot of the videos on Youtube showcase the functions of different technology, which helps to up the "wow" factor but still show how big tech is being used practically. These videos really showcase the revolutionary nature of medicine and how it can change peoples' lives. Another major theme that we came across on Youtube was the power of the amateur. There are so many videos and even short series on peoples' bodyhacking journeys. Youtube is the perfect platform for sharing a personal story in a different way than on Instagram or Facebook.

Two Liberal Arts Perspectives as Frames for Analysis

The two Liberal Arts perspectives that we have chosen to focus on in this project are the Anthro-Socio-Cultural one and the Scientific one. The name of the Reference Librarian that we met with to discuss our project was Beth Dietrich and we met on Wednesday, October 9th at 10:00AM. Our topic lends itself to many of the different fields of liberal arts, from philosophy to psychology and all the way to politics and economics. However, we think the anthro-sociology of science and technology is the most relevant to be discussed, and doing research on the science behind body augmentation will prepare us for high-level conversations with experts in the field. There are several critical areas of innovation that need to be investigated from the scientific liberal arts perspective, specifically in the fields of biology, genetics, technology, engineering, and even physics. The ones we are going to focus on are biohacking, prosthetics (and biomechatronics in general), cyborgs, and genetics. As we have seen in the major media representations, these areas of the transhumanism movement will redefine ways in which we characterize a human.

Research into this field is plentiful. We have gathered a number of academic journals that provide studies on the ways in which prosthetics and genetic engineering are being used to solve a lot of medical "problems." We say "problems" because as we see in several of the sources (and will see later in the critical literature review), many of the problems that these technologies solve are not necessarily problems in the first place, just paths of evolution.[66] This is a stereotyped medical pattern that comes up a lot, too. Human intervention in life/biological processes in the form of technology has created a major shift in evolution, and has even caused

many to redefine what evolution truly means. Genetic engineering is developing in ways that humans never could have imagined, and research is being done into how genes can be altered to produce the perfect human.[67] We see in everyday life the prevalence of genetic research: younger generations are more than willing to join 23AndMe and sign away the rights to their genetic information. We also see major innovations in the field of prosthesis development, for example, a neural interface between prosthetic and human. In his article “Proprioception from a Neurally Controlled Lower-Extremity Prosthesis” from *Science Translational Medicine*, Tyler Clites explains the research he is doing into whether or not “old-school” surgical amputation practices can keep up with modern-day medicine, AKA, if historical practices in the medical field have to change to accommodate and compliment new technology.[68]

Emerging innovations in the field of science are truly incredible, but they bring about many Socio-Anthro-Cultural shifts in our society and raise critical questions for humankind moving forward. Imagine a scenario where cyborgs have become so normalized in our society that a person does not have a choice whether or not they will become one; they have to in order to function in society. Well, this might be the case already in some ways. If being a cyborg means incorporating man-made technology into your body, could a cochlear implant be considered technology, and therefore anyone who has it would be a cyborg? It is hardly ever the case that people question medical innovations like this. Technology like this is now so ingrained in the definition of being a human (in the West) that we do not think twice about it. This is because most of the time when people think about radical, body-altering innovations in technology, they are not thinking about ones that have already happened or are currently happening. They think about it as something in the future, despite the fact that according to many experts in the technology field today, we are currently in the middle of a revolution.[69]

In anthropological and sociological terms, the idea of cyborgs and technology as an extension of being human seriously challenge ideas of evolution and definitions of what the human body is and what it can do. This affects society in many ways: how do cyborgs and non-cyborgs interact? How does the government and law play into it? What happens to people who simply cannot afford or do not have access to this technology? And, what happens if something goes wrong? These questions will be posed in our documentary to push the viewer to challenge and deconstruct the cultural impact that incorporating technology into the human body will have. Will the robots actually take over? We also need to consider how artificial intelligence affects the way that humans view themselves. Is AI becoming *too* human-like, and why does it matter? What happens if AI gets smarter than humans? Are AI and robots a part of us and our society, or are they an “other?” Answers are proposed to these questions as we delve into the realm of robo-ethics and legal considerations for cyborgs.

Another dimension of anthropology that we cannot neglect to include is the way in which culture, race, age, gender, class, geography, education, and access will affect a person’s relationship to the technological revolution. As we learned through interviewing professionals in the field, there are already many problems related to bias in coding. Thomas Dickerson told us about how companies like Amazon are using AI to try to automate some of their hiring process.[70] This failed, though, because the algorithm was using data from past-hires, which lacks diversity, AKA the algorithm was programmed to be racist. Whether this is on purpose or not, it is a problem that people of racial minorities face and fear. Another example of bias in

coding happened when Apple Pay and other credit cards were revealed to have credit limit discrimination based on gender. It is also important to think about how different generations will interact with new technology. Despite what many think, Pew Research put out a study in 2017 that says, “roughly two-thirds of those age 65 and older go online, and a record share now own a smartphone - although many seniors remain relatively divorced from digital life.”[71] Figure 6 shows different charts about technology use among seniors. It leads us to wonder how receptive they will be of technology *in* the body.

Access to education will be an important factor in considering anthropological influences of technology. Schools are where many children learn basic technology skills, from typing to computing. As technology becomes more and more relevant in our lives, one can anticipate that schools will respond with sufficient technology education courses, *especially* when the technology is part of a person’s body. What, then, will happen to those who do not have access to education? How will they use technology that they have not been taught how to use? This could be problematic. As discussed several times throughout our proposal, class is a serious consideration when thinking about technology in the body. There already exists an extreme wealth gap in the United States, and extreme wealth gaps around the world, which affect peoples’ access to technology. But what happens when this technology is necessary for a person to flourish? We anticipate that it will only widen the gap. This needs to be addressed by policy makers and political leaders as technology continues to develop.

There are a lot of questions to be asked about the impact that technology will have on how we define ourselves as a society and as a human race. There is a serious cultural shift happening in the 21st century, where people are excited and in awe of new technology, but also very fearful of it, as it disrupts long held beliefs about how we relate to ourselves and our world. And, also, because it is uncharted territory that people understand very little about. We need to decide which scientific and technological innovations we can live with/ accept readily (like prosthetics) and deconstruct *why* we accept them without question. Then we need to begin to consider more challenging incorporations of technology into the body (like biohacking) or the human essence into technology (Siri and Alexa), and reflect on what makes people nervous about those. Or, alternatively, why we *are not* nervous about them, why we blindly accept them into our lives. Of course, that is, until something goes wrong. A documentary like this is *so* important and relevant in the here and now because it gives people the chance to become aware of and start to come to terms with where we are and where the future is heading.

Compare and Contrast Critical Literature

As we discussed in our proposal, a major theme in our documentary will be the way in which technology is being incorporated into the human body. So, it made sense to find resources that dig into the biology behind biomechatronics. In the article “Exoskeletons and orthoses: classification, design challenges and future directions” which is part of the *Journal of NeuroEngineering and Rehabilitation*, Hugh Herr begins by explaining, in great scientific detail, four different classes of exoskeletons and orthoses that his team at the MIT Media Lab have been studying and developing. They each serve different purposes, from endurance to load transfer, as well as torque and work augmentation. However, the part of this journal that is most important to us is the section where the author explains the future direction of the field of study

and the potential challenges and scientists may face. Current limitations include the unnatural shape and noisiness of devices, a surface-level understanding of how artificial muscles could attach to the exoskeletal frame (however the hope is to one day be able to understand muscle and tendon function enough to be able to perfect these artificial muscles), a lack of direct exchange between the wearer's nervous system and the device - to name a few. In speaking about future investments in the field of exoskeletons, the author mentions that, "the fact that large automobile companies, such as Honda and Toyota, have recently begun exoskeletal research programs is an indication of this technological shift.[72] This is transformative for society because it means that people who were once restricted to wheelchairs could now (assistedly) walk.

But this article was written in 2009, and while research is still being done in this field, the field of biomechatronics is interested in more than just walking and basic mobility. Elliot Rouse's et al.'s article "Design and Testing of a Bionic Dancing Prosthesis" published in *PLoS ONE* discusses research being done into prosthetics that are designed for maximal ankle joint kinesthetic motor mobility, which ultimately allow people in this study to be able to dance the rumba. The authors talk about the point of doing this kind of research in saying, "by understanding such activities, devices can be created that extend the motor skills available to amputees, improving their quality of life and diminishing the gap between the abilities of amputees and non-amputees."[73] Here, we see humans incorporating technologies into their bodies so that they can reclaim the ability to express themselves artistically. The ability to express oneself freely seems like an important human right, but what if that right is dangerous? And who deserves/ should have access to this right?

This brings us to the discussion of bodyhacking or biohacking. The best definition for this phenomenon that we can come up with from combining ideas from multiple sources is that biohacking is a voluntary process where small groups or individuals create technologies, often using biological processes, that can be tested and used in the body for various reasons to augment or enhance their natural abilities. This brings the idea of incorporating technology into the body into a whole new realm because now people are doing it out of desire for enhancement beyond human capabilities, rather than necessity for restoration of human function. In "Entangled Agencies: New Individual Practices of Human-Technology Hybridism Through Body Hacking," an article by Barbara Nascimento Duarte from the journal *NanoEthics*, the author provides some examples of these innovations: "pocket-sized kits that sample human DNA, microchip implants that keep tabs on our internal organs, blood sugar levels or moods, and even 3D printers that produce tailored hip replacements."[74] Duarte distinguishes the field of bodyhacking from that of biomechanics (prosthetics) because biomechatronics focuses on bringing the body back to its "original integrity" and the "focal point of this paper is the 'recreational' apparatus developed by non-specialists, integrating artistic and technophile circles."[75] Bodyhacking pushes us to reconsider the ability of the human body and "challenge long-held normative beliefs about what bodies do, what they should look like, and how they should behave."[76] On an anthropological and cultural level, this is huge, because it challenges current normative ideas on what it means to be "natural" or "human" and how we relate to our bodies.

So, what is the difference between an amputee using technology to restore function and a biohacker using technology to enhance ability? Well, according to the definition of cyborg that Wikipedia provides, a cyborg is "an organism that has restored function or enhanced abilities due to the integration of some artificial component or technology that relies on some sort of feedback."[77] The keywords here are *restored function* and *enhanced abilities*. People who incorporate technology into their body, whether it is out of necessity or desire, are cyborgs. We plan to build on this definition by asking our interviewees what their definition of "cyborg" is (since it is ever-changing in today's age), but for now, using what the definition we have, it becomes increasingly important to explore questions of ethics and cultural shifts. Transhumanist Dreams and Dystopian Nightmares: The Promise and Peril of Genetic Engineering is a book written by Maxwell J. Mehlman and published by Johns Hopkins University Press which deeply questions the definition of evolution. He writes about different feats of technological innovation in the realm of genetic engineering that are causing anthro-socio-cultural questions to collide with scientific ones: "power has been transferred from nature to science," he asserts.[78] His book is all about how despite the ongoing debate around whether or not genetic engineering is ethical, we need to try to understand that regardless of ethics, genetic engineering is a *reality*, and with this technology, people *will* try to alter their evolution. In accepting this fact, we then need to learn to risk-manage and learn to be cautious in our endeavours: we must be critical.

In the last section of his book, titled "Managing Risk in Evolutionary Engineering," he considers some of the consequences of selective gender engineering: lack of diversity, gender imbalances, inability of non-engineered people to reproduce with engineered people. He argues that government regulation will need to play a role in genetic engineering to ensure that we do not live these potential consequences. The theme of law and regulation on new technology has come up a lot in our research, and we will see this later in our discussion of the book Citizen Cyborg. Mehlman also comments on the economic impact of genetic engineering and how this relates to the disparity of wealth in the United States by laying out this scenario: "As discussed earlier, [In Vitro Fertilization], which would be a necessary first step in genetically modifying an embryo, costs about $50,000 for each live birth. Since this is the median household income in the United States, it is clear that many Americans (not to mention those living in poorer countries) would lack the resources to pay for IVF, let alone for the genetic engineering. No doubt costs would come down over time, but by then it might be too late."[79] This would have critical consequences on American society.

But that brings us back to the question of whether genetic engineering is ethical, and whether any kind of technology being incorporated into the body is ethical. Ethics is a huge part of our research project because society's opinions on cyborgs are diverse and often challenge one another. "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," argues Kevin Warwick in his article "Cyborg morals, cyborg values, cyborg ethics" published in *Ethics and Information Technology*.[80] In this, he is asserting that cyborgs are not different entities than humans. Francesca Ferrando and Rosi Braidotti, authors of the book Philosophical Posthumanism, would agree with this, stating that "talking of human embodiment as an outfit which can be conveniently reshaped reveals a reductionist

approach, based on the Cartesian body/mind dualism, according to which "I" am my mind, while "I" have a body that can be replaced without much loss. The famous cogito set the privilege of the mind over the body: 'I think, therefore I am.'"[81]

However, Warwick is cautious to accept this idea that humans are still humans, even when being combined with a machine, and his article makes the distinction that when the nature of the brain itself is altered, rather than just body parts, the situation is different, and there is "the potential for cyborgs to act against, rather than for, the interests of humanity."[82] This idea, however, could be challenged by the idea that new body parts, by definition, fundamentally reconfigure the brain's functions. This is why we need to consider the whole package, brain and body, when talking about ethics. Warwick predicts that "the values, morals and ethics of a Cyborg would relate to its own life, what it feels is important and what not. In fact humans may not figure too highly in such a scenario."[83] This cautionary statement is similar to one of the major media representations that we discovered, which is that cyborgs are going to take over the world. But it truly *is* important to consider what will happen to a society and to an individual mind when a machine is half of the equation. We plan to ask this question during our interviews.

Ferrando's book Philosophical Posthumanism warns us that we need to consider what the larger consequences of doing all of this to our bodies will be. This book delves into how the word "human" has been redefined time and time again throughout history, and how "evolution's grandest creation— human intelligence— is providing the means for the next stage of evolution, which is technology."[84] Ferrando sees technology as the next logical step in evolution, which is counter to the ideas of other branches of philosophy, where technology as something completely separate from evolution because it is not natural. The author also comments on inequalities that will result from this new phase of human evolution with technology, saying "considering that a large number of the population worldwide is still engaged in the attempt of surviving, if Philosophical Posthumanism was reduced to a reflection on the technological kinship of the human revisited in its specific technical endeavors, such a preference would confine it to a classist and techno-centric academic movement."[85] This causes us to consider the consequences that transhumanism will have globally, as different societies throughout the world are at different stages of development. Circling back to Mehlman's ideas about the potential issues with genetic engineering, it is important to think about how genetic engineering will change the way people in different parts of the world are able to interact, and ultimately reproduce.

In continuing a discussion around ethics, another dimension of technological ethics that must be considered is in artificial intelligence (AI). In Nick Bostrom and Eliezer Yudkowsky's article "The Ethics of Artificial Intelligence," which is part of the *Cambridge Handbook of Artificial Intelligence*, the authors discuss what criteria will be necessary when developing AI in the future, and assert that "responsibility, transparency, auditability, incorruptibility, predictability, and a tendency to not make innocent victims scream with helpless frustration [are] all criteria that apply to humans performing social functions; all criteria that must be considered in an algorithm intended to replace human judgment of social functions; all criteria that may not appear in a journal of machine learning considering how an algorithm scales up to more computers."[86] The authors consider how the human race will accept AI, and if it will grant moral status to a machine capable of making human-like decisions, since "we do not normally hesitate

to ascribe sentience and conscious experience to any individual who exhibits the normal kinds of human behavior."[87]

Ajay Agrawal, Joshua S. Gans, and Avi Goldfarb's review of AI in the workplace, *What to Expect From Artificial Intelligence*, explores a different avenue of AI, convenience and availability. The authors relate the progress of AI to the early stages of the computer algorithms. A once expensive and time consuming process, the design of applications was all done manually by a person entering and tweaking algorithms. Now, with the introduction of digital computing, the process of arithmetic was made much faster, but more importantly, much cheaper. Once the computer was able to create and maintain algorithms of its own, the digital computer was flooded with millions of applications all serving unique functions. The authors predict that the same trend will unfold with the integration of AI. But AI is not going to advance algorithm capabilities, but rather, "The task that AI makes abundant and inexpensive is prediction — in other words, the ability to take information you have and generate information you didn't previously have."[88] The power of prediction fits right into the discussion held above regarding Bostrom and Yudkowsky's article on AI ethics. Will they follow the same rules as we do? Will they be in the same "class" of persons as us? The second half of Bostrom and Yudkowsky's article deconstructs the idea of "the robots taking over," where a logical series of events could lead to a machine getting smart enough to understand how it was made and thus redesign itself to be more powerful. The authors provide theories on how this could play out in society, and even cite Asimov's Three Laws of Robotics (mentioned above) as a model for ethical AI development. Ultimately they decide that the challenge of future research will be to create a scenario where a supermachine also has super-ethics.

In the book Citizen Cyborg, James Hughes argues that with transhuman technologies, which allow people to push the boundaries of science and continue to advance, there needs to be a system where these technologies are democratically regulated. In our project, we want to bring up some of the cultural and societal issues that come with these various technologies. This book discusses some of the concerns about how these technologies are being integrated into society and whether these technologies are equally available to everyone. He states, "In democratic societies we try to give each other as much control over our own bodies and minds as possible. Now technologies promise to make it possible to fully reconfigure our bodies and minds. Will we make it possible for everyone to use these technologies to achieve their fullest capabilities?"[89] Again, the idea of access comes up, and with the advent of technology, one must ask who will have access to it, and where will that leave people who do not have access to it in terms of social status? And what about people who voluntarily resist it?

Hughes goes on to explain that BioLuddites are people who reject the idea of integrating these types of technology into society. It is important to keep in mind the relationship that these technologies have with culture and society and to listen to viewpoints on this matter. To Be A Machine is Irish journalist Mark O'Connell's award winning deep-dive into life, death and all the technology in between. The author garners many viewpoints upon the notion of transhumanism, but perhaps his most useful is from the perspective of an outsider looking in. Late in the book O'Connell remarks, "I was a *user* of technology, a passive beneficiary of its many advances, while knowing next to nothing about it per se; these people, though, these transhumanists, were rooted in the intimate logic of machines, grounded in the source code of our culture."[90] In some

respects this is the way in which we will need to be presenting the ideas within our documentary. The content we put forth will not be, in any way, groundbreaking to a computer scientist or a transhumanist who is watching, but rather we hope to not only introduce, but to open a dialogue as well amongst the “passive beneficiaries” who may be seeing this sort of ideology and technology unfold for the first time.

Keeping this audience in mind, the article “Algorithms, Future and Digital Rights: Some Reflections” by Renato Rocha Souza, is relevant to the average citizen and provides people with important ideas to consider. He explains that society’s system is fully dependent on technology and no matter what we do, these devices are always around us. Souza brings up the topic of privacy and explains that “we give away huge chunks about our life in social networks, and through smart devices connected to the IoT (Internet of Things).”[91] By sharing different aspects of our lives with the world, we are essentially giving up our privacy. Souza explains that it is difficult for people to free themselves of this habit and from social media platforms because of the comfort we have created through digitizing our lives. These ideas are important for average people to recognize and keep in mind because it affects them everyday, whether they realize it or not.

Source List of Critical and Central Issues

1) The power of medical technological innovation (biomechatronics) but the lack of critical and skeptical questioning of this field.
2) The impact of technology in creating social, cultural, and economic disparities among societies that do and do not have access to the materials necessary to participate in cyborgization.
3) Redefining ideas of what it means to be human and reconsidering the path of human evolution. Is evolution exclusive for natural processes? If so, where do technology and cyborgs fit in?
4) The ways in which society and culture will change and shift when there is a divide between cyborgs and non-cyborgs (with an emphasis on genetic engineering). How will people reproduce?
5) How will the public perception impact the reception of these new technologies? In that same line of thought, how, as a society so ingrained with notions of robotics and genetics defined by pop-culture, do we differentiate between science and science fiction?
6) How has AI redefined our notion of intelligence? Can we even grasp the full potential of a machine that may one day be able to process and compute information at a speed unfathomable to a human? And how will we program these machines to incorporate ethics?
7) How will the religious landscape conform or resist the wave of transhumanist progress and robotic advancement?
8) How will corporate America and other power brokers develop in the changing technological landscape? As autonomous robots and AI become more prominent, will major companies even consider the ethical side of these technologies? Who will be held accountable when AI used in corporate settings breaks ethical codes or fails?

9) Should there be a governing power that provides guidelines as to what is and is not allowed when it comes to transhumanism, biohacking, AI, and autonomous machines? If so, who and why?
10) How will everyday life be impacted by these technologies and what is the timeline for this progress?
11) Who is financing the research, design, and distribution of these new technologies and how will it impact the economy? How is profit at the center of this movement?
12) How affordable and how accessible will these new technologies be?

Major People Who Have Shaped These Issues

1) **Hugh Herr** - Professor of Media Arts and Science, Massachusetts Institute of Technology, head of the Biomechatronics group at the MIT Media Lab.
    a) Contact: hherr@media.mit.edu.
    b) https://www.media.mit.edu/people/hherr/overview/
    c) Author of "Design and testing of a bionic dance prosthesis" and "Exoskeletons and orthoses: classification, design challenges, and future directions"
    d) "A double amputee himself, Herr is responsible for breakthrough advances in bionic limbs that provide greater mobility and new hope to those with physical disabilities."
2) **Tyler Clites** - Author of "Proprioception from a Neurally Controlled Lower-Extremity Prosthesis" from *Science Translational Medicine*.
    a) Provides a scientific perspective on amputation and prosthetics.
    b) Mentioned in the Ozy article as "the wiz kid building a better cyborg" https://www.ozy.com/rising-stars/the-whiz-kid-building-a-better-cyborg/92848
    c) Working with the idea of creating a neural interface between robot and human.
3) **Steve Haworth** - a body modification artist and inventor of subdermal and transdermal implants. He designed specialized medical instruments called dermal elevators for this process. He has also done pioneering work with surface bars, ear shaping, tongue splitting, magnetic implants, and artistic branding (using electrocautery units).
    a) http://stevehaworth.com/ - based in Arizona.
    b) Cited in the article "Entangled Agencies: New Individual Practices of Human-Technology Hybridism Through Body Hacking."
4) **Lissette T Olivares -** Professor of Social Science and Cultural Studies, Pratt Institute.
    a) https://pratt.academia.edu/LissetteOlivares
    b) Co-founder of Sin Kabeza Productions, a multimodal artist-activist platform inspired by more than human effects and committed to the design and dissemination of technologies of consciousness.
    c) Publications are plentiful and span a wide range of topics that are related to what we are studying - could provide ethical perspectives on transhumanism.
5) **Marc Raibert** - Founder and CEO of Boston Dynamics.
    a) https://cbmm.mit.edu/about/people/raibert

   b) Raibert is founder and CEO of the robotics company Boston Dynamics. His company has created some of the world's most dynamic robots that have left millions of viewers in awe of the agility, dexterity, and speed of their machines.
   c) His work would be a crucial piece to portray the other half of our exploration. “How are robots becoming more like humans?” Gaining access to these incredible robots would be a major driving factor in the documentary.
6) **Mark O’Connell** - Journalist and Author.
   a) https://mark-oconnell.com/about/ (this page contains email addresses to all of his publicity people)
   b) Talking to O’Connell could provide us with a very important perspective from another journalist who has been writing and investigating this field for most of his career. Also, although O’Connell is a rather well-known journalist who will most likely be reluctant to share his inside sources, it will definitely be worth a shot to reach out and see if he has any contacts we could use.
7) **Nick Bostrom** - Philosopher, Professor and founding director of the Future of Humanity Lab at Oxford University.
   a) https://www.nickbostrom.com/ (this page contains all of his Contact Links)
   b) Bostrom is one of the leading thinkers amongst Transhumanist philosophy. His viewpoint regarding transhumanism and human evolution with machines is almost unparalleled within his field. He would be a critical perspective in our documentary.
8) **Josh Bongard** - Professor of Computer Science Department at the University of Vermont.
   a) http://www.cs.uvm.edu/~jbongard/teaching.html
   b) Bongard’s areas of expertise include Evolutionary Robotics, Evolutionary Computation, and Physical Simulation. In 2011 Bongard was recognized by former president Barack Obama as one of 94 recipients of the Presidential Early Career Awards for Scientists and Engineers; one of the highest honors bestowed upon science and engineering professionals by the U.S. government.
9) **Jeremy D. Brown** - Professor in the Department of Mechanical Engineering at Johns Hopkins University.
   a) https://me.jhu.edu/faculty/jeremy-brown/
   b) Brown’s research includes engineering, biomechatronics, medicine, and psychophysics. He develops haptic prosthetics mainly for upper-limbs and minimally invasive surgical robotics. His aim is to give amputees a sense of touch through the prosthetics he creates.
10) **Christoph Burkhardt** - Founder of the Burkhardt Group LLC and Tinybox; author of Don’t Be a Robot.
   a) https://www.burkhardt.solutions/about
   b) https://www.youtube.com/watch?v=GrDHm-cg3cA
      i) Ted Talk on Burkhardt speaking about the ideas that are presented in his book.

c) Burkhardt has a background in cognitive psychology, economics, and futurism. He could be a good person to talk to who has experience in the field and may have a different and maybe even opposing perspective/opinion on this topic.

11) **James Hughes** - Executive Director of the Institute for Ethics and Emerging Technologies. Author of Citizen Cyborg.
    a) https://ieet.org/index.php/IEET2/bio/hughes
    b) Hughes has a background in sociology and bioethics and he serves as the Associate Provost for Institutional Research, Assessment, and Planning for the University of Massachusetts Boston. He is a member of Humanity+ as well as other societies/groups. He is also currently working on writing his next book, with a tentative title of Cyborg Buddha.

Findings: Reshaping Our Project

There is still so much research to be done on our topic. It is really broad, and moving forward, a critical step will be organizing all of our findings in a way that is digestible, rather than scattered and overwhelming, to an audience. However, given the fact that we still have a lot to explore, it is somewhat difficult to conclude in a section like this where our project will go moving forward. In terms of mainstream media frames, patterns, priorities, and stereotypes, we have a lot to work with. Playing off of the way that society thinks about our topic will be an important storytelling tool, and will give us a unique way to grab the viewer. As we explained above, our film may not be uncovering new ideas in terms of science/tech-jargon or deep philosophical thought, but what will engage the average viewer who uses an Apple watch everyday but thinks nothing of it. It will engage someone who reads a lot of science fiction books and watches Black Mirror. It will engage someone who reads BBC articles about petri-dish brains, and gets a little fearful about the future. And this will get people talking about an issue that is often ignored or pushed away because of this fear or because of a lack of understanding. We want to make people think about the things that they are unsure of and make deliberate decisions about how their lives will be affected by them.

The overwhelming influence that mainstream media frames have on the way that people feel towards technology via sensational stories and “wow factor” headlines is evident. However, we want to challenge the average person to look beyond this, and we plan to provide them with a story that makes them consider all aspects of technological integration. Like any good documentary, we will lean to one side or the other, but in doing so we will still strive to provide an extensive breadth of information so that the viewer can ultimately have the time, space, and context that they need to make informed decisions about their own lives. We want to be sure that we include some of the many different perspectives that people have on the topic because it is important that the audience does not hear just one viewpoint. By the end of our film, however, we want to make a clear statement/argument about this topic. While we have done a good amount of research on the topic, we are far from experts in these fields, so we understand that it would be foolish to jump to conclusions as to what we want to tell our audience. Before we decide on what that is, it will be crucial to talk to different professionals and people in this field. We acknowledge that any biases presented in this film are not accidental, but rather have a purpose in informing the viewer.

Overall, there is still a lot of room to continue a discussion of liberal arts perspectives mentioned in section 2. We investigated the scientific and anthro-socio-cultural side of our topic, but in the process, discovered that perspectives from philosophy, religion, and politics/economics are highly relevant and should be considered to some degree as well. With a huge and timely topic like ours, we have to consider all of these sides because they are all relevant in decision making and in understanding the effects of this movement on our society and personal lives. We touched on philosophy a lot in our critical literature review, and moving forward, we plan to incorporate a chapter in our film about ethics, humanity, and definitions of evolution. Religion will also play a role here. We found lots of sources on the secularization of transhumanism and on the way that the Catholic church views this issue. Real critical questions and contemplations will arise in religion when we think about genetic engineering and AI. One of the very first questions that comes to mind is, does a machine or cyborg have a soul? How will a cyborg be judged by a God? Will religions like Catholicism accept people with augmented brains into their church? These are serious questions that need serious thought.

We touched on politics and economics a bit, and in reality, this is one of the biggest issues to think about. How will we define what a citizen is and what rights cyborgs receive (or how the rights of citizens will change)? How will we regulate biohacking and other practices that experiment with the body? Who will be in charge and held culpable if and when things go wrong? What laws should be in place to ensure that AI does not get out of control, and if it does, how can we stop it? We may not have to do a lot of research here, because just thinking about it even for a few minutes, we can come up with so many questions surrounding the law. What if robots take control of the government? Will they be allowed to have jobs? Will they redo our legal system? How will justice work? We also explored ideas about economics when we discussed access to technology in our research. Wealth inequalities will only grow and widen, as technology for cyborgs will likely be expensive, which will ultimately isolate certain people in society.

Critical Analysis of Similar or Related Productions

Production #1: ***KAI LIN: OUT ON A LIMB | The Problem Solvers Ep. 1*** - Filmed and Directed by Jordan Manley.

From a technical standpoint, ***KAI LIN: OUT ON A LIMB***, is a beautifully crafted documentary film. The cinematography is purposeful and well executed. The color grading is consistent and very appealing to the eye. The innovative and sometimes subtle animations add so much to a piece that would have shined even without them. Overall, this film has an aesthetic that we will be striving for in our documentary film. Even though the subject matter of prosthetics may not be visually engaging at first glance, this film did a fantastic job of taking technical subject matter, like industrial design drawings and computer models, and incorporating an artistic flare to the entire piece. We hope that in our piece, we can also present very statistical and mechanical information in a visually captivating manner. While they did cut back and forth between it a few times, we wished there was more footage of the actual construction of the prosthetic.

This film presents many positive positions on prosthetics, such as the advancement of tailor-made prosthetics which allow amputees to participate in more technical activities like rock climbing. But, it fails to address a few critical issues that we feel should have been answered. One of the most important ones is the question of money. Who will be able to afford these unique and adaptable prosthetic limbs? According to the website Cost Helper Health, a standard prosthetic leg can cost a person without health insurance roughly 10 thousand dollars, while the more advanced prosthetics can run a patient up to 70 thousand.[92] A health insurance patient can expect to pay the cost of copays and coinsurance of 10%-50%. While this video was by no means trying to sell the viewer this prosthetic limb, it would have been very useful to at least reveal the rough cost of production for the rock climbing leg that Kai created. Economically, where does it fall among the spectrum of complexity in a prosthetic limb? These questions of affordability and accessibility are ones that we feel are lacking in many media representations of the subject. Whether it is a prosthetic limb or an autonomous robot, it is too often portrayed as either an amazing life-changing piece of equipment, or a terrifying new invention that will take over the world. Rather than presenting polarizing ideas about tech, we hope to find a middle ground amongst these two stances by providing as many details as possible, but also by asking the questions that do not necessarily provide the best sound bite.

This film does address one of the most pertinent objectives in the world of prosthesis today: how can a prosthetic limb match human ability? In this piece the climber and amputee, Craig DeMartino, talks about the need for a prosthetic that in no way inhibits the person it is on. In the case of rock climbing, Craig notes that the end goal is to get his prosthetic to the point where it is not the fake leg that holds him back, but rather his own physical fitness level.

One of the most important parts in the documentary is actually a rather subtle detail. It is a quick shot towards the end of the film with text on the screen reading, “Kai + Craig continue to collaborate on the design together…”[93] On the one hand, the lack of a final product may seem frustrating or inconclusive, but on the other, it is a crucial piece of this grand technological puzzle. Whether we are highlighting humanoid robots or cyborg humans we are striving to push forward this notion of continuous progress. These new technologies are never truly finished. Within each little niche of humanoids and cyborgs, there are creators constantly tweaking and testing with form and function.

Production #2: ***Beyond Bionics: how the future of prosthetics is redefining humanity*** - Produced by The Guardian, created by Richard Sprenger, Alex Healey, Ash Jenkins, Ken McFarlane, Mustafa Khalili, Josh Daniels, and Mark Rice-Oxley.

From a filmmaking point of view, ***Beyond Bionics*** is a very good representation of what we believe we can create for our own documentary film. The technical gear required to film it was clearly less advanced than ***KAI LIN: OUT ON A LIMB***, which was a much more cinematic approach to the documentary genre. While we would love to have the same amount of time that the filmmakers had within the lives of Kai Lin and Craig DeMartino, we anticipate our level of access will be a little more constrained. Similar to ***Beyond Bionics***, we foresee run and gun scenarios in regards to the type of b-roll and interview footage we will be able to obtain. This film seemed to gain more extensive access to the lives of the people living with these prosthetics,

while the footage and interviews within research facilities and universities appeared to be limited and on a tighter time frame.

Perhaps the most important notion to come from this film is that of symbolism. Symbolism was used not in reference to a single image or a single technology, but rather to progression as a whole within the fields of humanoids and cyborgs. In the documentary, this is brought up by Brazilian scientist, Miguel Nicolelis, who works as a professor of neuroscience at Duke University. He created the mind-powered exoskeleton that allowed a paralyzed man to make the first kick at the 2014 FIFA World Cup in Brazil. In front of the eyes of the entire world, Nicolelis' revolutionary technology was on full display. But, as he remarks in this piece, "…it was a humble kick. It was a tiny thing compared to what will come in the future."[94] To Nicolelis, the kick itself represented years and years of hard work, but it also symbolized all of the incredible technological innovations that have yet to arrive. Throughout ***Beyond Bionics,*** this notion of looking to the future can be seen and heard repeatedly. All of the amputees in the film remark on the incredible advances that have given them many of their abilities back. In our documentary we want to portray the same notions. Yes, we should marvel at the technologies we have at our disposal today and all those that lead us to this point, but we also need to understand that it does not stop here. In many cases, the small, sometimes seemingly insignificant, steps technology has taken merely symbolize the species-altering technologies that are still to come. Nicolelis says, "We, probably, are becoming the first species that is capable of influencing its own evolution by what it produces, our technology. We are creating completely new constraints on how humans socialize, communicate, mate."[95]

Unlike ***KAI LIN: OUT ON A LIMB***, ***Beyond Bionics*** does address the issue of affordability and access. In order to highlight these issues, they focus on a young amputee named Jamie Miller. With unrealistic costs and an 18-month long waiting list, Jamie and his father were able to craft a prosthetic arm at home thanks to the advancements in 3D printing. While Jamie's arm is not as flashy or futuristic as the other two amputees, it serves its purpose at a fraction of the cost. It was a short, but very important aspect of the film that provides a much broader context to the economic side of prosthetics.

This film does a fantastic job at showing the viewer how advanced prosthetics will be used to do basic and fundamentally human things, like grabbing an object, driving a car, or playing an instrument. Just like we hope to do with our documentary, ***Beyond Bionics*** grants the viewer a brief, but significant, look into the lives of those who have lost limbs and the advancements in technology that are giving them back the function they had once thought lost forever.

Pilot Interviews and Ethnographic Observations

Pilot Interviews

Interview #1: Thomas Dickerson

Thursday Nov 14th, 11-12pm, In-person at Scout and Co. Coffee in the Winooski Circle ***- see Figure 7 for photo.***

Background:

Thomas is a Saint Michael's College Alumni working in the field of Artificial Intelligence. His undergraduate degree was in computer science and currently uses deep learning in his career. A professor of mine at SMC said he would be a great person to talk to about the current state of AI, and that is what we plan to do. He is also the founder and chief science officer of his own company, Geopipe, which is a deep learning software that he designed and sells to companies trying to build video games and other applications. We plan to ask him more about this and how it could relate to our project.

Interview:

Meeting with Thomas to talk about the current state of AI to hear some of his opinions about the industry and where it is headed was extremely valuable for our research. He was able to give us a lot of background explanations and insights into this field, making him a great interviewee in the pilot stage. We began the interview by asking him about his background in AI and what he is doing in the field right now. Firstly, he explained that many people working with AI do not actually refer to it as AI, but rather call it "machine learning." "AI is a blanket term," Dickerson explained, "it has been watered down by companies saying something is AI but it is not intelligence, and over-hyped by pop-culture."[96] Machine learning is the specific subarea of AI that involves getting computers to learn statistical methods. He went on to explain how his company, Geopipe, sells a network to customers that range from game designers to architects. The program is a real-world simulation that contains precise parameters and measurements about different locations around the world. The way we understood it, it is like a more accurate, detailed version of Google maps.

Next we moved to the topic of evolution and asked for his thoughts on how AI and other technologies in the human body potentially "interrupt" evolutionary processes. Dickerson explained that evolution is an ongoing process, only producing changes when there are large selective pressures; when one individual is stronger, their strength traits will evolve and their characteristics will become dominant. However, when these selective pressures that force evolution to happen are not present, a different kind of evolution happens where a lot of neutral traits transfer, but this is not necessary for survival. He explained how he has definitely noticed that there is an interest in the industry of using technology to enhance humans in various ways, but there is no obvious direction in his mind about where things will go. He explained the two viewpoints on incorporating tech into the body in saying, "you can be an optimist on that and think it will improve quality of life, and have a big impact on people with disabilities, creating this kind of leveling-effect. And that has an impact on biological evolution, because now people with disabilities are at the same level as others, so the disability traits will sustain but will not mix into the population. But on the other side, people are pessimistic because they think we will become too dependent on tech, or because the "normal people" will not be able to understand the tech, and the tech will be used for manipulation and spying. If you do not have the technical knowledge to understand how you are augmenting yourself, it could be dangerous."[97]

This was so important to hear because it segwayed us into a conversation about dangerous AI and the larger implications that it would have on society. We asked him where he falls on the two sides of the debate around AI, and he said that he is generally a skeptic of it all. "Cautiously optimistic," he said, because he understands the potential downsides of human-tech interaction, but is also hopeful that we can figure out how to do it right.[98] He seemed very

skeptical of the idea of strong AI, which basically means self-sustaining, autonomous AI that could exist without humans. He introduced us to the “singularity movement,” which is related to transhumanism, but differs in that the idea is that machine intelligence will improve themselves, and then tech will start evolving so rapidly that we will not be able to predict that happens after that; we will have human-level AI and potentially superhuman AI.

He then gave us this huge overview of some potentially dangerous technology that is already being used and will continue to be used in the near future. The first example was GPT2, which is a machine learning agent created by OpenAI, a nonprofit associated with Microsoft. The software is one of the first machine learning agents to be able to generate large chunks of text that are plausible and coherent. The way it works is that you give it a writing prompt, and then it will predict what it thinks should come after that text. This could be very dangerous in the era of fake news and politicization, since you would be able to generate content from a certain political viewpoint. Ultimately they declined to publish the code because they thought it was too dangerous, however a Brown Master’s student that Dickerson knows was able to duplicate the code and publish it for free on the web. When asked why he did this despite the other company not publishing it, he explained that hiding knowledge does not protect us, it makes it more dangerous, because if a few people know how to do it and can weaponize it, it will be a lot harder to learn how to deal with it. So by making it public, it gives people the opportunity to study it.

The second example that is creepily relevant today is the “deep fakes” phenomenon. The idea is based on general adversarial networks (GANs). He explained it all in really technical terms, but the long-short of it is that there is this software that slowly keeps getting better and better called a generator, which creates life-like content (images, videos, audio, etc), and also a discriminator that is designed alongside it that is programed to be able to distinguish this “fake content.” So in a real life example, in one of the Superman movies, amateur programmers used a GAN to remove Superman’s mustache in a life-life, convincing way. Which is cool for movies, but when we are living in an era of fake news, the ability to be able to create extremely convincing life-like content will seriously challenge things like the justice system. If a video comes out of Trump doing something illegal, who will decide if content is real or fake? How can we tell truth from lies? Dickerson seemed really worried about this, saying, “The legal system is totally unprepared for this, journalism is totally unprepared for this, your grandma who watches fox news is totally unprepared for this. It will put us into a post-truth society.”

Following this, we asked Dickerson about his ideas about what defines a cyborg. He said that the “classical definition” of someone who has replaced half of their body with prosthetics or cybernetic enhancements is not enough anymore. While he thought it was almost too complex to define in this era, one defining attribute he could settle on was whether or not the augmentations affect your nervous system, i.e. prosthetic technology with arms that communicate with their nerves. He also said that he thinks the technology needs to be an internal part of your body rather than something externally attached.

When we asked Dickerson whether or not he believed it was man *versus* machine or man *and* machine, we got into a big conversation about ethics and bias in coding, and how this is actually a larger societal issue. For example, say you create an algorithm to try to decide jail sentence time for criminals. Well, the algorithm would be drawing on historical data, and

historically the United States has a pretty racist criminal justice system, and so this would ultimately translate to code. So, he concluded, we *need* humans because we need people to sort this kind of stuff out and be held accountable. Additionally, as another philosophical societal critique, Dickerson pointed out that perhaps the reason we fear "the robots taking over," AKA a technical slave uprising, is because of the way we as a society currently treat our working class.

Dickerson concluded that these big discussions around civil rights will need to be had by people in the future if we are going to go in this direction (which we are). This interview was really great because Dickerson was able to explain some big consequences and fears in the industry that we had not even thought of, plus he introduced us to some new technical terms and ideas that are currently relevant. In terms of new directions, a few things that we talked about and plan to explore more are more on fake news in the 21st century, brain headsets that read your brainwaves and perform simple control tasks, state surveillance using AI (especially in the Hong Kong protests), Alan Turing's work called *Computing Machinery and Intelligence*, and more on strong AI. Dickerson offered to reach out to his colleagues at the Brown Robotics Research group to help us find more people to connect with in the field.

Interview #2: Katheryn Wright

Friday Nov 15th, 9:45am, In-person at Champlain College Miller Center, Lakeside Campus ***- see Figure 7 for photo.***

Background:

Katheryn is a professor working in the Core Division of Education, Human Studies, and Psychology at Champlain College. She teaches courses on the self and the body and has a PhD in Media Studies. This background gives her a perspective on the ways in which bodies and technologies can come together, and her research focuses on this relationship using critical frameworks including biopower, affect theory and the virtual, which we hope to learn more about. We anticipate her having a philosophical perspective that we can interact with by asking questions about ethics and transhumanism.

Interview:

Katheryn had a different perspective on our project than Thomas. Thomas is serving customers in the tech field, whereas Katheryn is an educator of students who are about to enter this field. She has a Media Studies degree but her classes focus a lot around philosophy and the bigger questions that people should be asking about tech. She considers herself a post-humanist, meaning that she recognizes that humans are, and have always been, connected with their environments and the technologies in them. She explained the distinction from transhumanism, which believes that we are on an evolutionary track that cannot be stopped. Instead, she believes that we are not on a linear path, but rather are defined by the choices we make and the developmental spaces that we create for ourselves. She explains that technology defines what it means to be human, and that we are not separate from this technology, but rather a part of it as we interact with it.

Katheryn had really interesting perspectives on how tech will affect non-Western populations as well. She spent time doing research in the Gambia and in other parts of Africa, and spoke a lot about how a dependency on tech is often created and manufactured in these parts of the world, making them reliant on tech that they otherwise might not have wanted or

needed. The concept, called “digital dependency,” treats tech like a drug that people want other economies to get hooked on. If you think about it, computers not only need to be purchased, but they also need upkeep and maintenance and upgrades. Using tech to create a new form of colonialism, Westerners would be bringing jobs to people in 3rd world cultures, but also creating a “need” for tech, and then abandoning the society. This will make people feel incomplete without engaging in the world through technology; this narrative is used to justify different interventions with 3rd world people. Ultimately this brings about questions of access and disparity when we start to ponder how phenomenon like this will play out when the integration of tech into the body is normalized in society.

It was very clear as we interviewed Katheryn that she is really well-versed in the literature related to this and other topics. Throughout the interview, she suggested several new theories and papers about these theories to us. For example, she suggested we explore Bruno Latore’s work on network theory, which says that humans are the only ones with agency, and the world is a bunch of networks between animals, tech, humans, etc. that are based on their relationships. With this theory, instead of looking at the relationship as a whole, you instead look at all of the moving parts in order to try to understand it.

In terms of her thoughts about the future, she seemed to view tech as neutral, not good or bad. Ultimately she said that we as a society need to figure out what we want and what the consequences of our practices with tech would be. “Is it the tech itself that’s the issue or is it the practice? Tech carries with it the algorithmic culture, and how those consequences play out depends on their context, so it’s hard to plan for the future,” Katheryn said. “As members of a collective, we need to establish a set of values (what do we want as a community), then think about the relationships that we have with other things in that community.”[99] Very philosophical.

She also had some interesting things to say about technology and isolation. A lot of what Katheryn studies involves the ways in which screens are affecting us socially. But in a broader sense, she says that tech in general is isolating us, despite what we think about the “social network.” For example, she points us to Sherry Turkle’s work, *Alone Together*, which talks about comfort robots and people who use robots in order to feel a sense of companionship. This can have lots of benefits, like for people with dementia. You have all of these cool things in tech to help us establish connections, but what she points out is that they actually isolate you. So, what happens when your body becomes a mesh with body mods? Is it self expression, or does it block you out from others? Katheryn pointed out that even now, the phenomenon of students walking around with headphones 24/7 is creating a barrier. She wonders what will happen when these headphones become a part of your body.

Overall, Katheryn seemed really interested in all of the many avenues that could be explored as we move to the future. She was weary of the way that tech will affect generational divides, especially as we consider tech entering the body. “A colleague of mine says that everyone born after 2000 is a different breed,” Katheryn said, which made us giggle. But it is also sort of true![100] The way that children neurologically develop now is different than before, because a lot of our development happens through screens, which Katheryn believes has really large implications on human development in general. We also talked a bit about genetic engineering and how wealth inequalities will affect that. “Forty years ago, the first IVF baby was born. And that was crazy, but now it’s so common. Imagine what else will happen with genetic

engineering," she said.[101] She reflected on how gene screening nowadays is just a matter of how much money you want to spend. In the same way as many of our other interviews have ended, Katheryn left us with lots to consider for the future of human development.

Interview #3: John Cohn

Monday Nov 18th, 11:30-1pm, In-person and filmed at North Campus, Saint Michael's College ***- see Figure 7 for photo.***

Background:

John is an IBM Fellow based at the MIT-IBM Watson AI Lab in Cambridge, Massachusetts. For the first 30 years of his career he has always worked with chip design, however, when his son died, he transitioned into other projects that involved working with other people, especially children. He has a true passion and interest for designing, creating, and inventing. With his many years of experience and skill in the field of AI and robotic technology, it would be extremely beneficial to hear his perspective and point of view on the subject. We are also hoping to tap into his network at MIT to get access to the Media Lab. We hope that he can give us insight as to where the movement of transhumanism is headed and what his next steps or plan is for the future. We would like him to show us demonstrations of his work and AI technology that he has created. We also hope that his enthusiasm and passion comes through.

Interview:

The interview with John Cohn was incredibly informative. One of the most important takeaways we got from this interview was John's notion of balance in the world of tech. Early in the interview John described himself as a "technology optimist," but admitted that over the years he has learned to appreciate both the risks and the rewards. John was quick to state that any sort of robot revolution is far off, but instead there are more immediate fears we should address. Some of those being ethics, privacy, and malevolent human-control of these technologies. To counter these, he noted many societal improvements that these technologies have given us, like increased public safety, automated air travel, and a general increase in convenience. John said this when discussing the evolution of technology, "It is not good or bad, it is how you apply it."[102]

One of our main goals with this documentary is to portray these complicated technologies in a way that a person who has not spent their lives studying them can understand. In this regard, John did an amazing job at taking all these complex ideas that he has devoted his life to and simplifying them to a level which a normal person could relate to. So, when we interview these people, many who are highly regarded experts in their respective fields, including John, we ask them, "How does the public feel about AI?" While the intricacy of today's technologies, such as AI, may be more complicated than other inventions prior, John noted that the fear of change is just the same. Whether it was steam power, atomic power, or even computers, humans fear what they do not know. John talked a lot about the overwhelming existential fear the general public seems to have surrounding AI, but he believes that the fear should give us a reason to think about these technologies, not avoid them.

We continue to revisit the notion that humans are at a turning point in their history with the advent of all these complex technologies. John alluded to this technological frontier that humans are now discovering and stated that on this frontier the line between humans and machines is becoming gradually blurred. He discussed the progress being made with

Brain-Computer Interfaces, especially through his work at MIT. We hope to be able to visit his lab where this work is being done.

The interaction of tech and the body is a huge piece of our production, so the discussion of cyborgs came up rather quickly. Unsurprisingly, John was strongly in favor of human augmentation projects. While John noted many advancements in human augmentation that have helped those with disabilities, he was also quick to acknowledge that the advancement of able-bodied people is also upon us. Augmenting those who did not start at a deficit is becoming more available and more acceptable. As the list of human augmentation capabilities piled up, John was quick to add that the question of ethics is becoming even more pertinent as these technologies arrive. How far can we go before we start to create a sort of superhuman that we did not intend to?

Ultimately, this interview with John was a real eye-opener. His unique perspectives and articulate ideas were evidence of his years and years of experience within these fields. He really gave us more than we could have hoped for going into it. Our discussion of AI, ethics, robotics, human augmentation, and much more left us inspired to go out and discover as much as possible about all of these fields. We believe John will continue to be an incredibly helpful friend and resource throughout the production of this documentary.

Interview #4: Josh Bongard

Monday Nov 18th, 2-3pm, In-person at Innovation Hall on the University of Vermont campus ***- see Figure 7 for photos.***

Background:

Josh Bongard is a professor of computer science at the University of Vermont. His areas of expertise include evolutionary robotics, evolutionary computation, physical simulation. He runs the Morphology, Evolution & Cognition Laboratory at UVM, which we are hoping to be able to tour and observe. This lab is where he studies morphology, which connects to the use of prosthetics. We are hoping that he will be able to speak more on cyborgs and prosthetics. He also has a book called How the Body Shapes the Way We Think: A New View of Intelligence, which we plan to discuss in more depth with him. We also hope to learn about evolutionary robotics and how its similarities and differences from what we have been studying.

Interview:

Josh was one of the first people we interviewed who is actively involved in researching and designing robots. We walked into his office in the new Innovation Building at UVM to see a table covered in robots and robot parts. We started off the interview by asking Josh a little bit about his book. He talked about how historically, machines were designed very rigidly; you built the machine arm and it would not change, and it was expensive to create. But now, robots are being designed with new materials that allow for malleability and shape shifting, which means that the robot can change. This is huge! We are switching from this idea of embodiment, which is related to rigid robots, to bodies *changing*, which is related to “soft” robots.

He then showed us some of the robots he has been working on, specifically one called the Starfish Self-Modeling Robot. Josh told us that a writer from Black Mirror saw this robot in his publication and actually created an episode based on it! The robot was designed in a virtual simulation using evolutionary robotics. In layman’s terms, this means that there was a virtual

world and several of these bots were placed in the simulation. Then, Josh hooked up the program to the Vermont Advanced Computing Core (which is just a big supercomputer), and let mother nature run her magic, AKA ran a really sped up version of evolution where natural selection determined which bots lived and which died, with the significant traits sustaining. In the end, a superior bot prevailed, and this bot is what Josh materialized.

It is interesting, because using this technology, we could run millions of scenarios to see how different organisms would evolve and how they would adapt to their surroundings. It brought about really provocative questions about *actual* evolution. Because think about it: this program runs simulations on robots and then at the end, they created a superior bot. But what if the same thing were done for humans? Josh could not give us the specifics (because they are still in the process of getting the paper reviewed), but he hinted that they are actually beginning to test the same program, but then materialize the bot using biological material!

This prompted a larger conversation about evolution. We started talking about what percentage of technology a person would accept into the body, and what this percentage would signify. For example, what percent of your body needs to be technology for you to be considered a cyborg? It is the same for phones and computers, he explained. Since we live in a society where we have unlimited access to technology, we can make a choice about how much we want to interact with it. There are some people who spend all day every day on screens, and alternatively there are people who want *nothing* to do with computers, and resist them at all costs. “People who don’t use the Internet are at an economic disadvantage in the West,” Josh explained, “because the way our economy is set up, it’s hard to flourish without the use of tech.”[103] He anticipates the same phenomenon to play out as people begin to incorporate tech into their bodies.

Evolution, historically, has only been about the ability to reproduce and survive. It has not been about the promotion of the best, most perfect traits, but rather the sustainability of traits that do the best at keeping us alive. The human body is not optimal; we have plenty of characteristics that are unnecessary for survival. But how will this change when we start to incorporate tech? That is the basis for transhumanism, says Josh.

So, we asked him, what are the applications for these robots? Like, why are we building them? What are they good for and how will people use them? Josh kept coming back to the comparison with modern computers. When computers were first invented, people had no idea how the average person would use them. “People just thought of them as government machines,” he explained.[104] But, look at all of the ways that we use computers today! Uber, Tinder, and thousands of other apps, all unanticipated but all byproducts of the computer. And that is how he views robotics: we do not even know all of the many ways they will be used, but they WILL be used. Look at how commonplace computers and phones are today. Josh believes that in the future, robots will be just as common and normalized in society.

Next, we challenged this technologist by asking him about the consequences and cautions that people should have moving forward. He explained that there are two kinds of fears that people usually have around tech: 1) economic fears (the robots are going to take my job!) and 2) existential fears (the machines will rise!). Josh seems to have this mindset that we should not even be worrying about these things yet because we do not even know what the scenarios will be like. He had something *really* fascinating to say about the second fear though, and in this

he introduced us to the idea of anthropomorphization. Anthropomorphization is when you assign human qualities to objects. Josh said that when people fear the machines rising and taking over, they are assuming that machines will have some kind of human qualities or human emotions. But the likelihood of machines having this “soul” or ability to feel, according to Josh, is slim. “You have technology around you already, you do not need an expert to tell you if you should be afraid,” he said.[105] This brings up interesting questions around ethics, though. If robots cannot feel, is it okay to abuse them? And what happens when, as we begin to incorporate tech into the body, the line between human and robot becomes blurred? What happens when you cannot figure out if the decision you made originated from you, or from the machine? How does this affect the justice system? These questions will definitely work their way into our documentary, so being able to discuss them with Josh was huge.

Interview #5: Nick Cheney

Wednesday Nov 20th, 9-10am, In-person at Innovation Hall on the University of Vermont campus ***- see Figure 7 for photo.***

Background:

Nick is a research assistant and associate professor at the University of Vermont. His research involves using biological systems to design machine learning algorithms for artificial neural networks. The design aspect of his research involves creating flexible, scalable, and context-aware robots and decision-making systems through a variety of techniques like deep learning, reinforcement learning, evolutionary computation, and meta-learning. We are hoping that he will be able to provide some insight into the mechanics behind robotics and what some of the longer-lasting implications and expectations are for the future.

Interview:

We began the interview by asking him to explain to us what he does within the Neurorobotics Lab and the types of projects they work on. He explained that his lab was split into two sections. One section looks at fundamental AI research, such as new algorithms and ways to improve artificial intelligence. The other section includes taking advantage of what AI can do and using it to accelerate science and medicine. Rather than looking at every individual or treating every patient the same, the medical field can rely on the massive amount of data that has been collected on everyone. This presents the opportunity to provide personalized care, which creates a more effective and efficient system. This is a very important and interesting point to take note of because it has the ability to change the way the medical system operates as a whole and can have significant impacts on everyone involved. Cheney continued to say that there is a large possibility that we could continue to see a lot more embedded devices for medical purposes in the future.

Going off this idea, we asked what some of the consequences of inserting devices into the human body might be. He went on to say that it is more about the unintended consequences. Every experiment and test that they do are in a very controlled setting, but he explained that they know that there is always a risk that these systems perform differently when put in a different environment/surroundings and they can act differently in the real world compared to what they are trained to do. He says that there is uncertainty anytime you are creating a system and he stressed the importance of thinking carefully about this process rather

than only thinking about the potential of these devices. This is crucial when looking at any type of technology and is an extremely important idea to keep in mind moving forward in our project. We have to ask ourselves what are the possible risks along with the benefits that a new technology might bring?

This idea of caution and potential of malfunctions with these devices is a topic that is a big concern amongst the general population, therefore it is important to discuss. This led us into asking about ethics and where it fits in with his and his team's research process. He explained that there is an institutional review board that makes sure that, when dealing with human subjects, they are treated ethically. In terms of long term projects, Cheney says that it is a harder task for the investigators to decide what is ethical and what is not. He believes that individually, people are thinking implicitly about the ethics of certain projects, but he thinks that there needs to be more explicit conversations among each other. Hearing him explain this makes it seem as though there is some fight for attention when it comes to ethics and there needs to be more focus towards this side of the process.

We then got onto the topic of evolution and how the track of humans can alter due to these systems. He explains that with the advancement of medicinal technology, we have been able to decrease the amount of deaths and increase the chances of survival. However, now there is the issue of wealth, inequality, and who is able to get access to this medical help. For the future, he says that they are creating more and more systems that are being incorporated into the body and this will continue to change. This is a big question that many people have and is a topic that we want to focus on for our project. The issue of how many people will be able to afford these technologies and who will even have access to them is one that is important to address for our viewers.

We then got on the topic of the connection between the brain and prosthetics or other technological implants. The brain is impossible to fully understand the function and process, however we have figured out enough to connect the brain to robotic systems and devices. He then told us about a very interesting system in which a microarray is placed on the tongue of a blind person, allowing them to feel what is around them in real time. It is interesting to get an idea of the various projects that are being produced and to continue to learn about new devices because this is an avenue we want to explore.

On the other hand, he began to explain that the general population seems to be skeptical and fearful of this new transition and era into AI and robotics. He explained that part of this fear comes from automation taking away any jobs that consists of repetitive tasks that an AI system would be able to perform. This fear also comes from what is presented in the news. He says that the scary stories are interesting, therefore that is what the public sees. It is a very skewed perspective of AI. Although it is important to consider the skeptical side, it is just as important to keep a balanced view and understand all aspects.

Ethnographic Observations

Observation #1: Generator VT Observation

Thursday Nov 7, 5:30-8:30pm, Generator Makerspace ***- see Figure 8 for photos.***

On a chilly Thursday night in early November, we stepped inside the Generator Makerspace in Burlington, VT. An impressive one floor building, the space was filled with 3-D

printers, metal and woodworking machinery, and people of all ages crafting a variety of projects. The loud buzz of a laser cutter filled the building as we were greeted by our tour guide, a local Champlain College student. We had gone to the Generator for a quick tour of the space in the hopes of finding someone who was working on a project even remotely close to our topic, but we left with much more. The tour was informative and the space was impressive. And although the projects we saw were intriguing, like the drone racing course, handmade violins, or bottle openers blasted out of a sheet of metal with a plasma cutter, the tour concluded and we were left empty handed.

As we picked up business cards from a table near the door, we had noticed a few people gathering in the large event room just off the front entrance. Running back and forth with different gizmos and gadgets was an older gentleman, clearly in a hurry to set up for the event. An aged, yet youthful face, was framed by the hair of Einstein and a white beard that was half-way to Santa Claus. That man was IBM fellow and MIT alumni/enthusiast, John Cohn. The event he was prepping for? A reunion of Vermont's own MIT Alumni group, or as Cohn likes to call it, VOMIT. It seemed to be sheer luck that we had stumbled upon this reunion that perfectly coincided with the tour we had booked just a few days earlier.

We saw John Cohn standing at the other end of the large room, setting up his computer and organizing all of his presentation toys around him; including a small tesla coil, a pair of remotely controlled LED-sunglasses, and a bag of razors. A self-described "mad scientist," Cohn did not disappoint. He greeted us with a warm smile and an attentive yet distracted demeanor. "Do you mind if I code while we talk?"[106] was one of the first things he said to us. As part of the presentation he was about to give, Cohn was setting up an AI interface he had recently designed which synced the movement of a human body to the sounds of an instrument(s). Sometimes he would acknowledge what we said, and other times he would just turn away and start dancing in front of his computer.

It neared 6pm and the event was about to start. As we began to make our way to the door, to our surprise, Cohn invited us to stay. So, we threw on some name tags and joined the elite ranks of the MIT Alum. Eventually, the reunion began and the room was filled with around 20 alumni, most of which were over 60 years old. I remember Cohn asking the group, "who is the youngest graduate here?"[107] It had to have been someone from the last decade. The event started with another tour of the space and then a talk given by Cohn, in which he discussed his life's work and his mission to always incorporate play into his work. Cohn reflected on the progress of computers, his career progression from MIT student to IBM fellow, and his involvement with the IBM Watson AI Lab.

In all of this tech-talk, Cohn also reflected on all of the times in his life when "hacking culture" and goofing around with serious, expensive technology helped to enrich and inspire curiosity in his life. Talking and tinkering, Cohn, stood in front of a group of MIT alumni, who sat there, quietly taking in all that Cohn could throw at them. After an electrifying demonstration of the tesla coil by his side, the talk concluded. We approached and thanked him for his time and we settled on a date for an interview. Cohn seemed ecstatic at the possibility of showing us around MIT and was more than happy to put us in contact with others in our field of study. We left energized about the sources and the possibilities we had uncovered in just a few hours. While we left the Generator Makerspace with a rather high profile interview in the works and

possible access to MIT, we gained so much more from those few hours. We finally got to see, firsthand, an AI at work in Cohn's, crazy new body manipulated music application (seen in the bottom right picture below). One of our main focuses with this piece is how the human body interacts with new technology. While Cohn's application did not deal with technological implants or surface level augmentations it was a brief, but exciting, glimpse into this field.

Observation #2: Prosthetics and Orthotics Virtual Tour

Tuesday Nov 12, 9:00-9:30pm, Pitt SHRS ***- see Figure 8 for photos.***

In this 360 virtual tour of the University of Pittsburgh School of Health and Rehabilitation Sciences laboratory, we were able to receive an encompassing view of the ways in which people work and interact along with the different operations that occur in this specific environment. The first room that they show the viewer is filled with long tables with many tool boxes almost set up as stations to work at, with a trash can at each one. As we rotate around and observe the room, we see about eight people dressed in blue scrubs, working individually on different projects. The narrator of the video explains that students use this space, the main fabrication lab, to work on their own projects, which consist of plaster modifications and device assembly. Some students are seen working on smoothing or sanding a molded piece made of plaster, while another student is working on assembling a metal rod with an artificial foot to a prosthetic plastic mold.

Next we are brought to a room called the thermo forming area, which is where students learn how to work with plastics and other cheap materials to create their projects. In the video, we see one student working with a faculty member to push down a piece of plastic over a plaster mold. Another student is controlling a large machine, which is connected by a tube to the frame that holds the plastic. These projects include custom orthotics and prosthetic diagnostic sockets. Here we see that this process requires a lot of work and at least three people are needed to carry out this procedure. The narrator explains that there are infrared ovens and vacuum stations that are sectioned off in another room to be separated from the lamination room. There are many important dynamics to take note of in spaces like these and to understand that there are certain rooms that are off limits for safety.

The tour then leads us into a room, the machine room, a space in which we are able to shape plastic, metal, and wood to create custom designed prosthetics. Here, students learn the operations of the machines in order to cut, grind, and smooth the custom prosthetics that they are working on. This process also helps with the overall comfort of the patient with their prosthetic. In the video, we see three students using large machines to cut and smooth various pieces that they have created.

We are then shown the "multi-purpose classroom" where lectures are often held and students can conduct initial assessments and castings on the patient models before they begin fabrications. There are parallel bars that provide the patient support when trying out their prosthetic. This space allows for patients and the students to test and see what works and what does not. This is a very important part of the stage because it allows the students to see what needs to be changed and fixed and the patient is able to voice their concerns/questions as well. This laboratory is a place where students are able to learn with the supervision and help with trained and very skilled faculty.

Overall, after observing the video provided in this virtual tour, it shows us that creating any type of prosthetic is a long process and takes a lot of learning. There are many intricate materials that are involved and many different kinds of rooms that are utilized for specific purposes. All these different factors that are involved with labs such as these are extremely important to consider when for the future of our project. This virtual tour gave us a sense of what the environment is like in a lab with busy students and professionals working on projects. It's important for us to see and understand what occurs in these types of labs and work spaces because we can then be better prepared for any potential interviews or walk-throughs.

Alternative Observation: Jay Bellissimo Artificial Intelligence Talk
Tuesday Oct 29th, 4:30-5:30pm, Saint Michael's College

Jay gave a talk about AI in the workplace and the future of AI. It was very beneficial for learning more about practical applications of artificial intelligence and for hearing what kinds of tools IBM and other similar companies are researching and developing. He even talked about ethics and how companies like IBM and other competitors in the industry need to consider this. His big thing was "man AND machine," not "man versus machine."

Working Arguments

Moving forward, we have been able to refine and hone in on our central arguments. This will allow us to reflect the hard research and new perspectives that we gathered throughout the semester. Something that came up a lot in our interviews as we questioned the socio-anthropological side of our topic was the fact that **different groups of people with different statuses from different parts of the world will be affected in DIFFERENT (and unpredictable) ways by technology being incorporated into the body**. Now, this sounds pretty vague, but here we are mostly talking about the ways that this technology will affect societies that do not have access to the tech right away. Our project, in order to stand out from other similar documentaries, will be certain to focus on intersectionality. It will look at how people from different socio-economic, racial, gender, and other minorities will interact with technology. Ultimately, it seems that it will follow similar patterns as iPhones and computers, however things seem to get a bit more tricky when the technology is put IN someone's body. More inspection into the topic will need to be done, but we really want to make the argument here that it is not just the upper-middle Western white man who will be affected by this technology. It is *everyone*, especially globally.

Another argument that we are hoping to make is that **new technology like this will have larger political and economic implications that people will need to grapple with**. This was something that we, ourselves, were uncomfortable confronting at first. Our seemingly "unbiased" perspectives were challenged when we thought about what would happen if we suddenly found our that all of this research into biomechatronics and AI was funded by, say, Donald Trump, or another influential political leader. How would that affect the research? Would people still "blindly" accept it as innovation? Would they still hand over their private information via health app on their phone without a second thought? We want to unearth the truth about where the funding for this research comes from and show the viewer who the big controllers of

this field are. Research into big corporations will play a role here, too; who feels the negative consequences of big names controlling the field? We are not trying to tell the viewer *what* to feel in terms of political bias, but rather we want to give them the facts and tell them that they *need* to think about it and decide *how* they feel about it all.

Something that we discussed a lot with our interviewees was the idea of human evolution, and how this new technological era affects or disrupts the "natural" path of human development. After considering what our interviewees had to say and comparing it with academic journals and books like Philosophical Posthumanism from our critical literature review, we argue that **the definition of evolution will change in that it will no longer be just be about surviving, but with new technology in the body, it will now be about thriving beyond our baseline potential.** Ferrando says that the next stage in human evolution is technology, but others that we interviewed see technology as a different kind of evolution altogether.[108] At first, technology being incorporated into the body meant creating prosthetics and other assistive technology that could help bring a person back to their full capacity as a human. But, as Thomas Dickerson explained, without selective pressures in evolution that force humans to pass on trains that simply sustain their survival, the traits that we will develop will now be for *enhancement* beyond the "need."[109] With time and space, we will begin to evolve into creatures that implement technology out of a desire to do better than just survive; we will create technology to thrive.

Almost all of our interviews included a discussion around ethics, which is good, because from this we were able to conclude that right now in the tech field, **conversations about ethics and the justice system are not being had, but they need to be, and a standard or precedent needs to be put in place.** Despite the corporate script that we heard Jay Belissimo give at his talk about IBM and their ethics with AI, others who are doing research and development in the field seem to think that these discussions are peripheral at best, and they need to be given much more serious thought. Now, despite what a lot of science fiction and media tell us, many of the professionals we talked to did not seem fearful about the possibility of the robots taking over anytime soon. They seemed to think that conscious AI is something that is much further down on the timeline. However, something that we *can* learn from science fiction is that we cannot wait until the conscious AI exists to start having conversations about how it will affect society (this is what they do in *Humans*, and it is a disaster). The argument that we want to make here is that regular people, not just professionals, need to have conversations about how they want technology to be regulated by the government, if at all. If we leave this decision up to the machine-makers, we might not get what would be best for the society.

This documentary will continue to grow and develop in unanticipated ways as we continue our research, which is what makes us confident that we chose a great research topic. Even after nearly ten full weeks of research, we are still able to see that there is so much to learn and so many avenues to take. We have been able to focus our documentary topic through our pilot interviews and brainstorm ideas for how to incorporate storytelling elements that will allow the average person to understand the complex future ahead of us. Through inspection of other documentaries and research in the field, we have decided that our project will have more of a focus on the technology in the body and less on the technology becoming more human-like (AI). AI is a very important part of this topic that will not be neglected, but ultimately there is

more room to explore a unique documentary on the body, specifically featuring biohacking and biomechatronics. These topics will be what we focus our interviews on moving forward. Because of the research contained in this proposal and because of the experiences that we have gained throughout this semester, we are ready (and excited) to create our documentary in the spring.

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Appendices

Due to the large file sizes, digital audio recordings of all interviews available upon request.

Figure 1. Top posts from #techblog on Instagram. Caption 1: “Would you trust a flying bus?” Caption 2: “Technology (heart eye emoji)” Caption 3: “Did you see the Cybertruck by @teslamotors?”

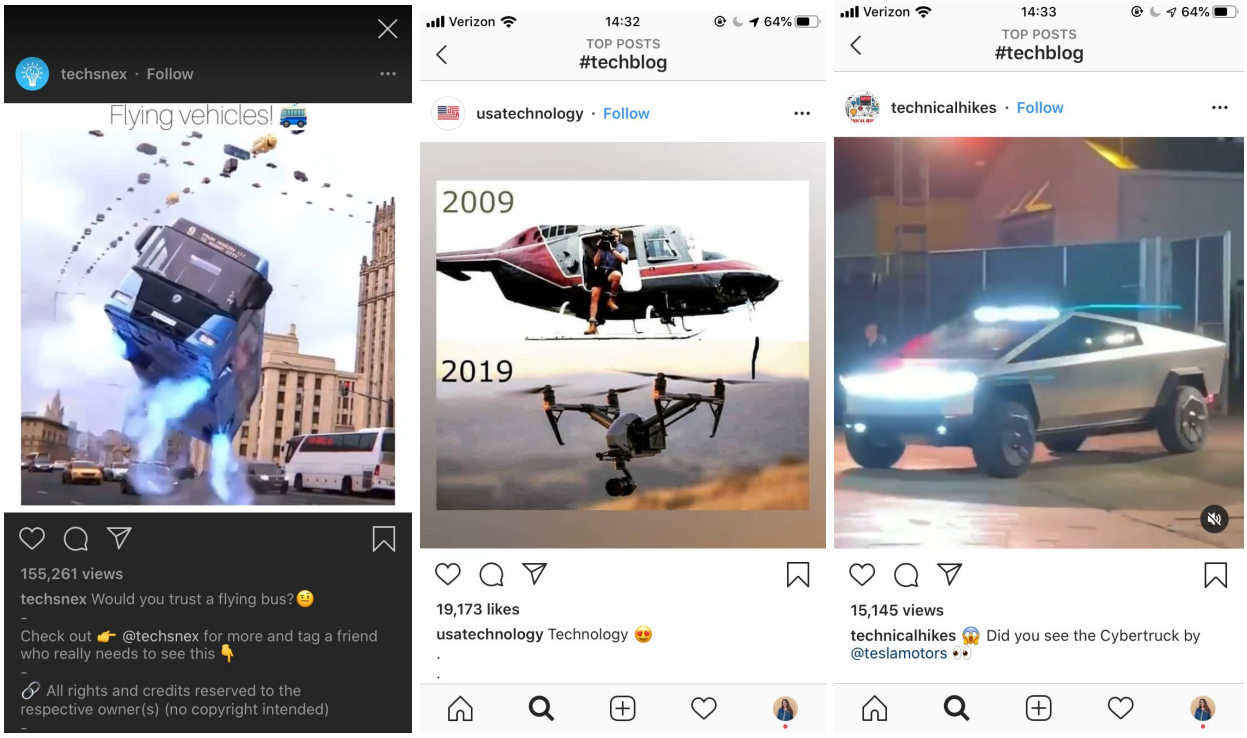


Figure 2. Top posts for #techupdates on Instagram. Caption 1: “New Bosstown Dynamics robot make soldiers obsolete” Caption 2: “SEER: Simulative Emotional Expression Robot with Elon Musk #deepfake”

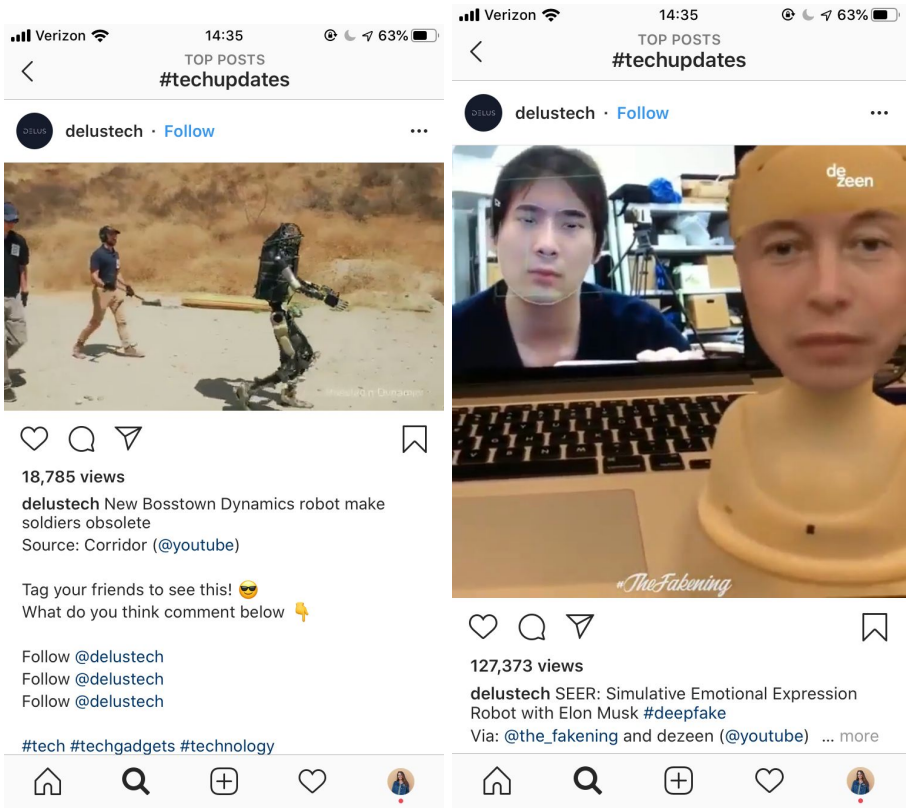


Figure 3. Boston Dynamics Instagram post about Spot the robot, and comments.

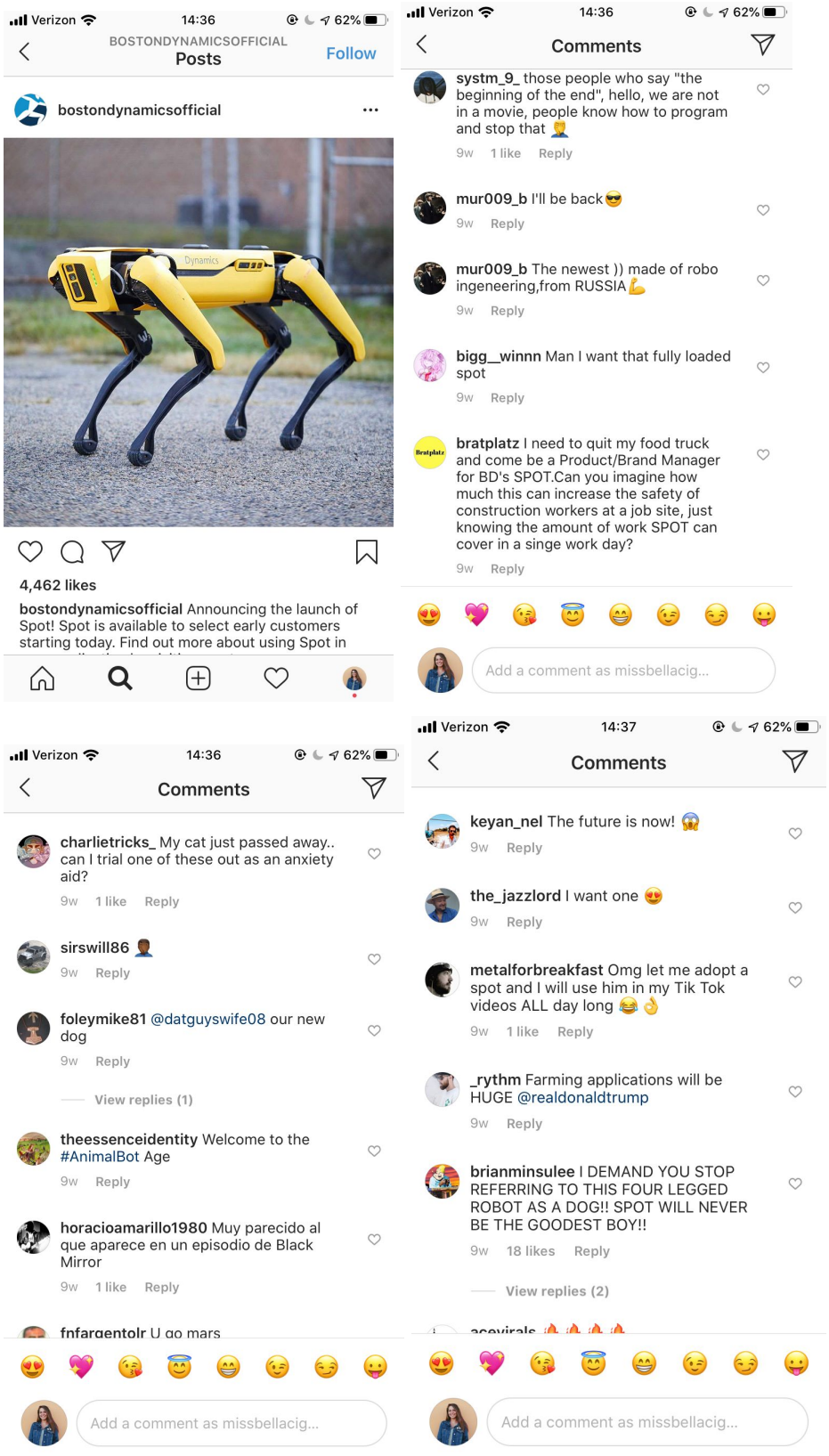


Figure 4. Top posts from #robotics on Instagram. Caption 1: “Cello Concerto. The Hands, The Grace… What Elegance” Caption 2: “Robots meet pro wrestling” Caption 3: “A robot developed by EPFL researchers is capable of reacting on the spot and grasping objects with complex shapes and trajectories in less than five hundredths of a second.”

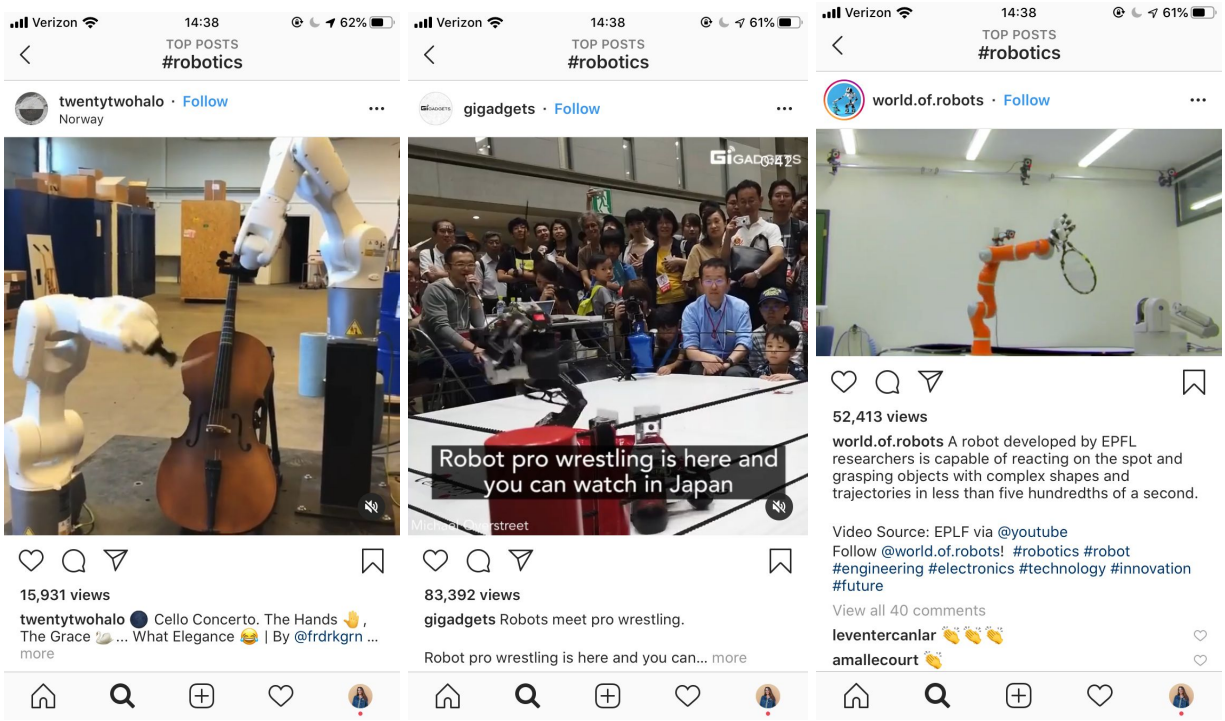
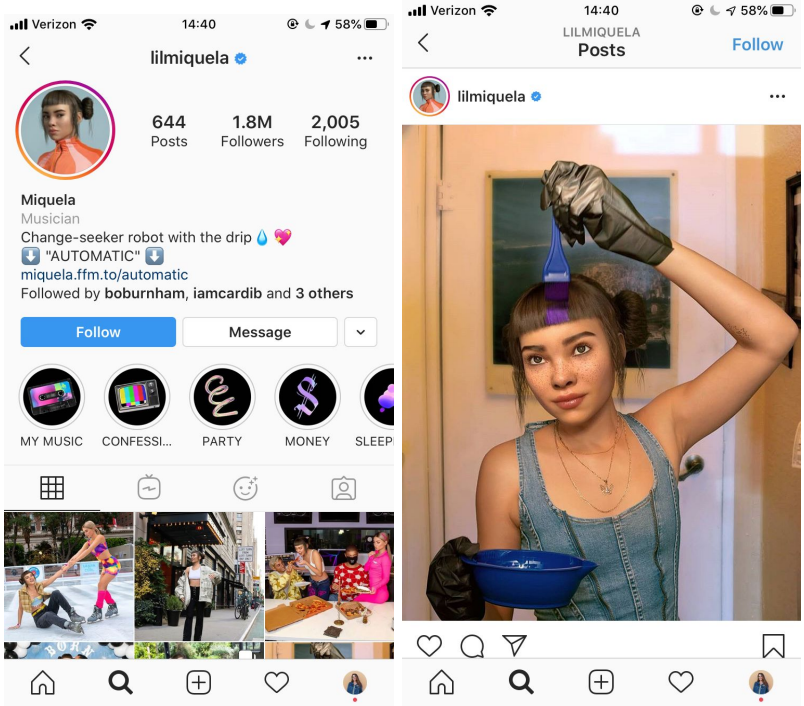


Figure 5. Instagram profile for @lilmiquela and several of her posts for reference.



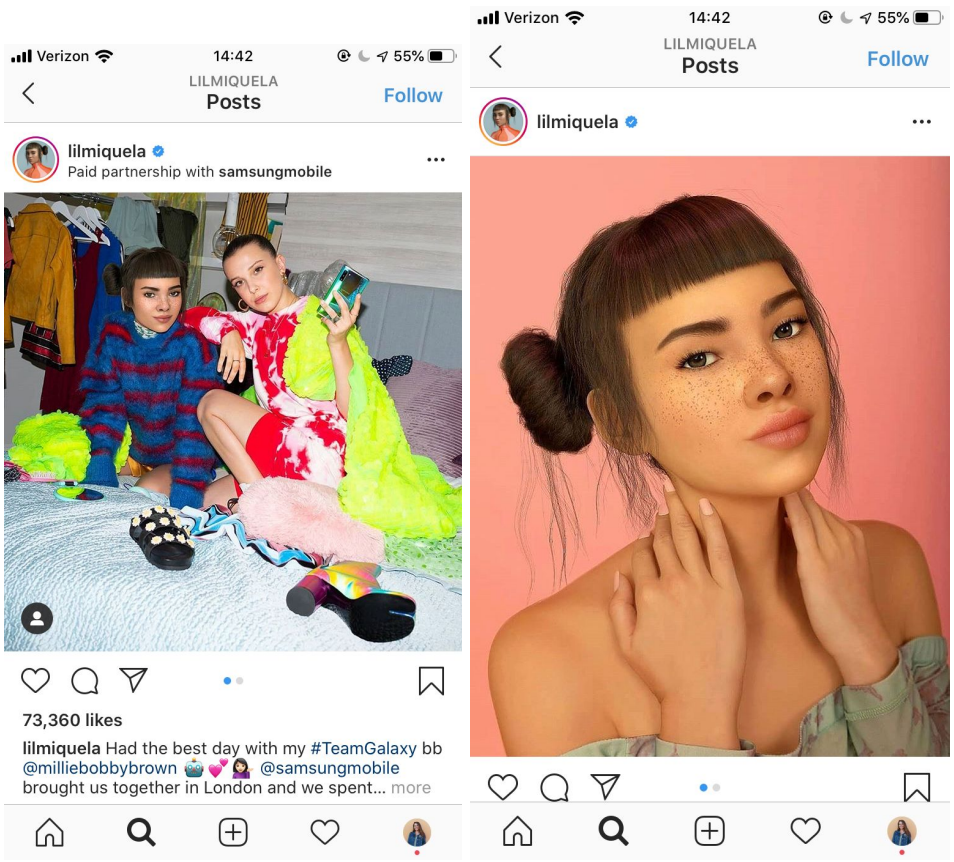
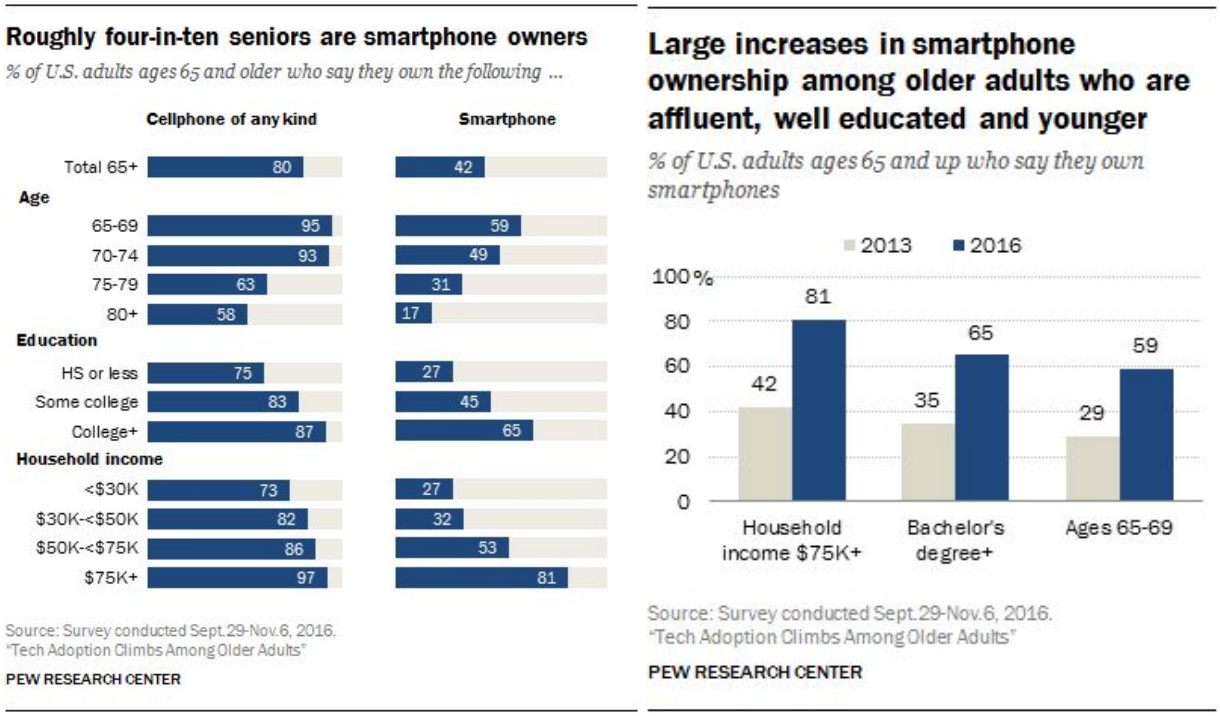


Figure 6. Statistics from Pew Research Center about technology use among people age 65+.



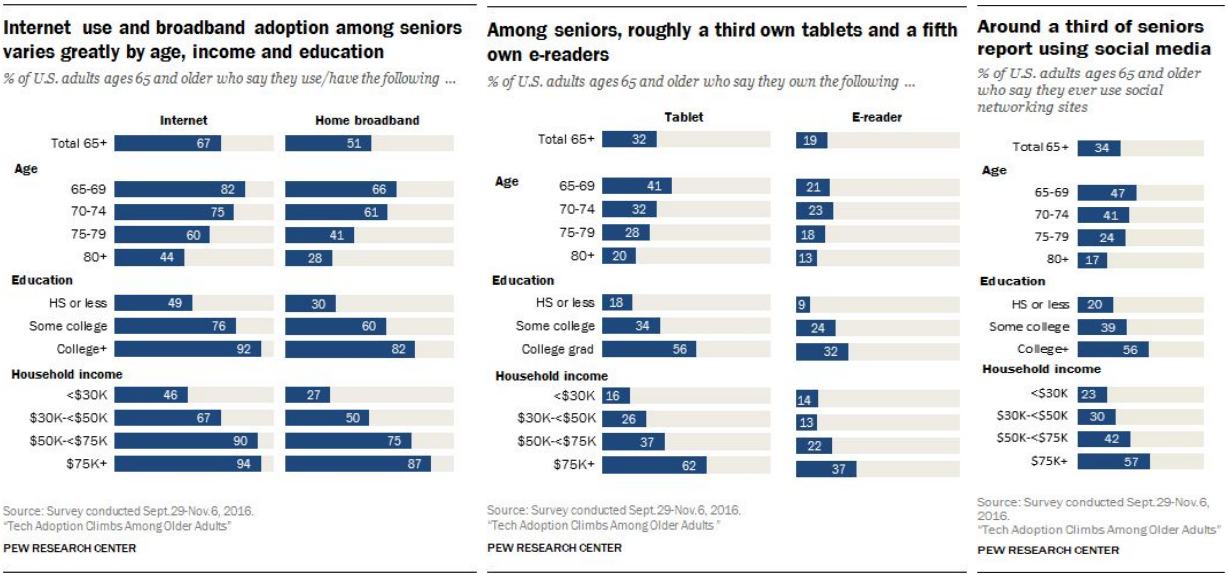
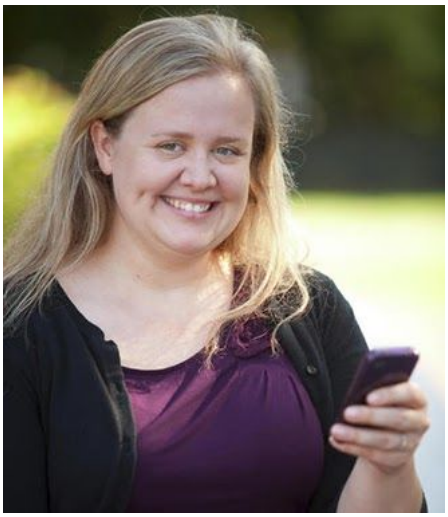


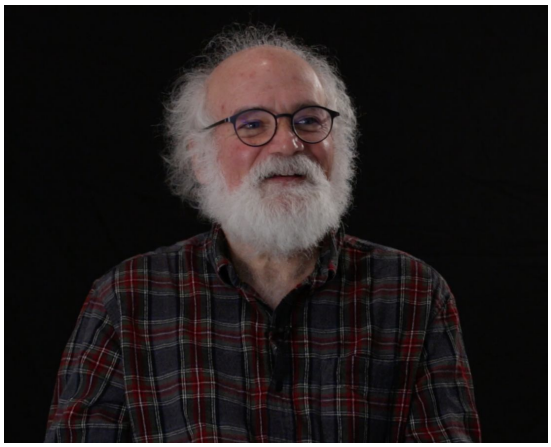
Figure 7. Photographs of interviewees.

Interviewee #1: Thomas Dickerson

Interviewee #2: Katheryn Wright



Interviewee #3: John Cohn



Interviewee #5: Nick Cheney

Interviewee #4: Josh Bongard, photo of his robot that he tested with us during the interview.

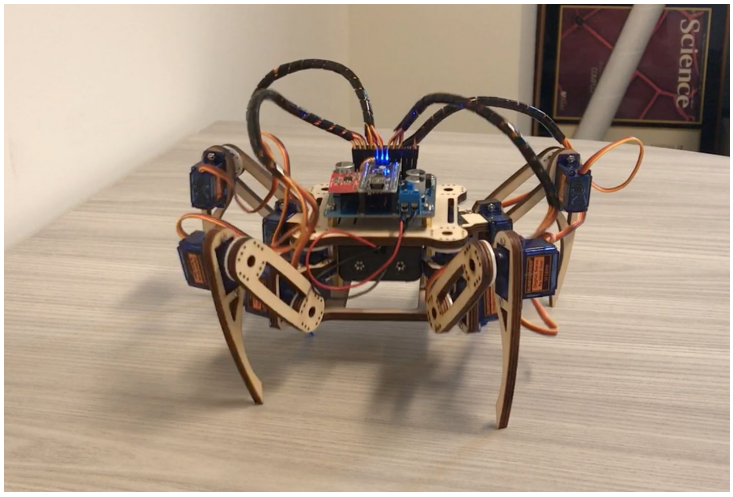


Figure 8. Photos from ethnographic observations.

Observation #1: Generator VT

Observation #2: Prosthetics and Orthotics Virtual Tour