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Biomimetic Robots at War: The Ethical Ramifications of American Military-Industrial Complex

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In his farewell speech on January 17th 1961, President Eisenhower warned America about what he called the “military-industrial complex.” This complex was the union of highly innovative defense contractors (private companies that work on the advancement of weaponry) and the US armed forces. He stated that such a relationship would influence and corrupt the government as more sophisticated technologies are developed: "In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists, and will persist" (qtd. in Walker 1). The military-industrial complex arose during World War II but was not revealed until the end of Eisenhower’s administration. Eisenhower’s warning came after the development and subsequent dropping of the atomic bomb. Although the ramifications of using such a weapon were unknown, it was ruthlessly pushed forward by the military-industrial complex. The relationship between defense contractors and the government became increasingly intertwined as the arms race escalated and stakes were raised. Eisenhower’s message became a reality as the fear of communist rule prompted an increase in military development during the Cold War. Since the Cold War, national security has become a significant concern in the United States, and as the government becomes entrenched in military affairs, it is progressively difficult to regulate the size of the nation's military industry.

The military-industrial complex has generated a number of problems that remain relevant today, including the privatization of weapons and the secrecy surrounding national security and defense. The Department of Defense contracts out the creation of military weaponry to various private companies, thereby taking US national security out

of the public sphere and financing the private developments with communal funds.

Significant amounts of tax payer dollars are dedicated to private defense companies through the United States Department of Defense, yet those same tax payers are unaware of the management and distribution of their money. The Department of Defense released a statement through the American Forces Press Service about the requested budget for 2013 that demanded over five hundred billion dollars be spent on defense projects: "The Pentagon's budget top-line request is set at $525 billion for fiscal 2013 with an additional $88.4 billion for overseas contingency operations" (Garamone, par. 2). The Department of Defense utilizes civilian money to fund projects that are often kept from the public, producing a variety of weapons in addition to science and research that will help to create defense equipment in the future. By privatizing weapons development the government has, in effect, decreased public awareness and bureaucratized the entire defense system. Civilians can, however, trace defense spending to DARPA (Defense Advanced Research Projects Agency), a government agency that is responsible for weapons projects, and from there to certain defense contractors.

The majority of defense projects are primarily funded by DARPA and the US Navy. DARPA is a subset of the Department of Defense that employs defense contractors such as Boston Dynamics, Boeing, Stanford University, Carnegie Mellon University, Academi LLC (formerly Blackwater Worldwide) and others to perform research for government and military projects: "[DARPA is] deliberately low-profile, but hugely influential, Department of Defense arm. Here was a government agency– with a $3 million dollar budget, no less– that acted like a small company, that got innovative technology projects funded quickly and with a minimum of bureaucratic hassle"

(Belifore, Intro xxi). Both DARPA and other contractors are free to spend expedient amounts of money on weapons because stock holders and business owners profit from wars: “By allowing military, business, and political leaders, driven by mutual interests, to make decisions involving war, this group of elites will continually choose personal profits over the interests of the public” (Mastrogiovanni 1). Together, big businesses and the government decide which projects to fund. Not only does this undermine the entire concept of “power to the people” by detracting from, and occasionally obliterating, civilian power, it encourages frequent and unnecessary war. The military-industrial complex has created a “permanent war economy,” a situation in which America must constantly participate in wars in order to keep the economy afloat (Walker 41). The economy thrives when there is a war. It is practical for the government to fund projects that will make money and reduce the loss of lives. The reduction in death toll makes the cause seem moral, as if the overall cost of war on humanity will be decreased.

Essentially, the Department of Defense is encouraged to allocate money towards creative scientists for the development of America’s weaponry. This creates a situation in which scientists are only funded to create military technology, a problem Eisenhower recognized and commented upon: “A government contract becomes virtually a substitute for intellectual curiosity” (qtd. in Walker 11). Eisenhower explained how receiving a defense contract takes precedence over education and other intellectual endeavors. This is a crucial point because most defense research and development is carried out by universities. The government funds university research by providing grants for specific projects that are meaningful to the Department of Defense. In this way the government

garners the freshest and most innovative ideas by employing the greatest minds of the upcoming generation.

Robotics is a major component of American defense research and development because it is currently regarded as the most effective way to wage war in the future. Robotics have been one of the most rapidly growing portions of weaponry development due to break-throughs in engineering that allow for more complex systems. Autonomous robots have always been an aspiration in engineering, as they operate without the direct assistance of humans. Ideally, robots are capable of performing the same actions as humans do in war zones. For this reason, robotics is a major component of American defense research and development at this time. The military has devoted a significant amount of funding towords designing autonomous robots designed to carry out difficult or dangerous missions and reconnaissance that cannot be done by humans. These machines are intended to replace people on the battle field, a cause that appears morally appropriate as they would preserve the lives of our own soldiers.

The term “robot” was first used in 1921 in the play titled “Rossum’s Universal Robots” by Karel Capek, a Czech playwright, who wrote about a machine that has the ability to perform tasks similar to that of a human being including the act of killing (NASA). However, there were no functional autonomous robots until after World War II. The first of such devices came in the form of a manufacturing unit controlled by a computer code. The same principle of using computer code to command a robot was subsequently used to create a robotic arm (1969) and a robot that could perform a task in an environment with unknown variables (1979) (NASA). The advent of the military

industrial complex and the growth of the robotics are closely correlated as the military-industrial complex was responsible for creating many new fields of robotics.

One of those categories of robotics is known as biomimetic, a genre of robotics that relies and draws inspiration from nature for mechanical designs. The movement quality and evolutionary attributes developed in nature over billions of years is employed to create robots: “This new class of robots will be substantially more compliant and stable than current robots, and will take advantage of new developments in materials, fabrication technologies, sensors, and actuators” (Stanford University, par. 1). The theory of biomimicry was originally developed by Janine Benyus, a natural resources scientist, researcher, and writer, who sought to develop a way to apply the millions of years of evolution in nature to issues we face today: “Biomimicry (from bios, meaning life, and mimesis, meaning to imitate) is a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems” (Biomimicry Institute, par. 1). There are three principal components to biomimicry that involve using nature as a model, a measure, and a mentor, meaning that nature should be used as an example for human innovation.

Biomimetic robots can be based on a number of biological attributes. A robot can be built based on sensory abilities found in nature, movement quality, a special evolutionary strength (such as echolocation), or for human interaction. The first is known as neurorobotics, which creates devices that are founded in the principle of nervous system and function based on the fact that the “brain is embodied and the body is imbedded in the environment” (Armstrong 169). These types of robots are sensor oriented and are difficult to create because real-world environments are varied and

unpredictable. However, neurorobots are the most likely to be productive in the field because they must have "motor control and locomotion, learning and memory systems, value systems and action selection" (170). The second draws upon evolutionary movement, (mostly locomotion) skills, and traits that have been selected evolutionarily. Through evolution, locomotion skills have been honed based on terrain and natural obstacles. The benefit of building a robot based on such traits is that such robots can be specially designed for certain tasks and carry out those tasks with increased efficiency and ease. The last type of bio-inspired robot is one that is intended to interact with human beings and to replace or aid people in the field. These robots require one or more of the following attributes: visual and auditory recognition, somatosensory function, language, learning abilities, or "mind-reading" capabilities (188). This type of design is obviously of most interest to the military because it can be used to replace or accompany human beings in the field. It would allow the military to prevent loss of life without sacrificing a mission.

My interest in this biomimetics began with a series of videos released by Boston Dynamics, a progressive US defense contractor. These videos featured some of Boston Dynamics developments, a robotic dog and a robotic man. At first I was amazed at the engineering feat, a self correcting robot that is completely autonomous and able to complete its task with relative ease and steadiness. But something about the headless being that moved independently and appeared to think independently caused me to feel somewhat unsettled. The implication of such advanced technology is what truly caught my interest. What happens when autonomous robots go into battle against humans? Robots lack remorse and morals, two qualities that are innately human, important in any

human interaction, but especially in conflict. The technology I was seeing in the video had the potential to help people but because of the nature of the company developing it, the robot would be used to wage war. Biomimetic robotics, itself, without the impact of the military-industrial complex is simply science "Every species, even those that have gone extinct, is a success story, optimized by millions of years of natural selection. Why not learn from what evolution has wrought?" (Mueller par. 8).

Biomimetics has the potential to help civilians, but because of the influence of the military-industrial complex and the correlation between military development and economic gain, military biomimetic robotics has become detrimental to science and to the world. While biomimicry proposes that we draw from nature to solve world issues, military biomimetic robotics lends itself to causing problems and inflicting harm. The main concern is the effect such innovations will have on people both on the offensive and the defensive sides of armed situations. The ethics of the applications of biomimetics can be examined through a comparison of pre-existing biomimetic projects and through an investigation of fictive texts that explore the use and consequence of military robots.

Bio-Inspired Technology and National Security provides a rational and legitimate method for evaluating the ethical value of the application of biomimetic robotics: "A useful beginning to any question of morality might then be to look at the three grand traditions of ethical theory for assistance: virtue theory, deontology, and utilitarianism" (295). Virtue theory concerns the person taking the action, while deontology involves the nature of said action, and utilitarianism examines the consequences of the action. The authors also propose these questions: "Would developing and implementing this technology corrupt our character or somehow make us dysfunctional human beings?

Would it constitute a rights violation or somehow lead to disrespect to human dignity and autonomy?" (296). If the technology adheres to these principles and does not infringe upon individual rights then the technology is ethical. If the consequences of biomimetic inventions are morally justified and have regard for humanity, then they may be considered ethical as that technology that adheres to these principles does not violate any human rights.

The morals surrounding the implementation of biomimetics are clearly defined when projects are compared directly to one another. Through examining different projects, it is possible to analyze moral effects. The following are two examples of biomimetic projects that are presently established. The first concerns the replication of the water wicking capability of the thorny devil. Thorny devils are able to extract water from the earth on which they stand and have hidden capillaries that channel water into their mouths. This research is currently conducted by Andrew Parker, an evolutionary biologist of University of Sydney, Australia, a university which is not affiliated with the US Government. Parker and his team are attempting to duplicate the system the thorny devil uses in order to create a water collection device that can draw water from a simple patch of damp sand (Muller). The advantages of this technology is that it would give people the ability to collect and purify water in regions where water sources such as springs and rivers do not exist. As water deficits are currently a major problem, this would be highly beneficial to people in arid areas with limited access to water. This application of biomimetics is able to aid people and therefore it can safely be said that it does more good than harm. This technology is not intended to harm human beings, it is designed to help people.

Conversely, Boston Dynamics "Sand Flea," based on (as the name suggests) a sand flea, is a small robot able to jump on to the roof of a two story building almost soundlessly; it is desired for military reconnaissance and intended to assist defense missions. In this instance, the robot is not doing anything to directly help a person in need and is simply being used to spy on an enemy (Boston Dynamics). The ethical value of such a device is unclear as it allows the United States to protect itself but can also be utilized like wire tapping, undermining an individual's right to privacy. As Boston Dynamics is a military defense contractor, they fall under the influence of the military-industrial complex. Because this technology is developed by a defense contractor, it is intended to gain advantage over an adversary rather than aiding people in need.

The use of military robots is not the only ethically questionable portion of biomimetic technology. In the near future, our technology will become advanced enough to operate without specific direction from a person or computer. Essentially, robots will be able to utilize logic to complete tasks without the help of a person. This development would require the robots themselves to make morally sound decisions on their own. Although there are current experiments investigating the creation of robot brains using neurons from mice and stimulating brain activity through electrical current, there is no way to determine how robots with such brains will react outside a lab (Lin 139). Therefore, it should be assumed that they will not react or behave in the same way living organisms would in any given situation. Military robots, particularly, cannot be treated as living organisms because they are programed for a specific mission and their primary, perhaps only, intention is to carry out that mission (Armstrong 170). Robots

fundamentally lack the ability to accurately act as living organisms do, regardless of how advanced their technology is.

Each person is equipped to make decisions though a process known as "orient-observe-decide-act" (OODA). Our human desire to survive and evolve is the basis for this method of reasoning. This process can be replicated in robots in a drastically sped-up version. There are a number of differences between robots and humans that allow humans to make ethical decisions. Humans are interested in surviving and evolving as a species and therefore rely on value-based principles for decision making that will perpetuate the human race. Robots, however, have only the information programed into them to determine the right course of action and cannot register situations in context. This is conveyed in combat situations. Robots have the ability to make rapid decisions but often lack the ability to differentiate between combatants and non-combatants: ". . . technologies . . . accelerate the observe-orient-decide-act (OODA) loop for moral decision making, boost the chances of unintended consequences . . ." (Armstrong 299). Robots lack feeling and morals, two qualities that are innately human, essential in any human interaction but particualrly in conflict. Although a robot may be able to recognize and react to a human expression with the "proper" response, there are many nuances in the way humans think. Moreover, every person will react to a situation differently based on their personal experiences which are too variable to impress on a robot.

The fact that military robots would be programmed to defend themselves means that they would not be able to differentiate between armed combatants and a civilian As *Robot Ethics* states: "The main ethical problem arises because no autonomous robots or artificial intelligent systems have the necessary sensing properties to allow for

discrimination between combatants and innocents" (Lin 116). If robots are pitted against humans in warfare, it is likely that the robots will have an advantage because they are unable to feel pain or remorse.

The introduction of robots will reinvent the dynamics of war. Merciless machines will be matched against a human enemy. With the addition of robots to the military arsenal, America will be able to destroy various groups of people with little to no detriment to itself. This will make it easier to convince the public that war is not overly intolerable or exorbitant; after all, America would not be losing any of its own. Consequently, the government agencies in charge of highly advanced weaponry hold the world at gun point without any fear for themselves or their country. The military industrial complex empowers American defense personnel, and grants the authority to command groups at will, and to kill people all around the world without concern for themselves. This perpetuates the American habit of engaging in war, profiting from it, and then developing an increasingly volatile arsenal. Ample funding exists for the creation of weaponry but not for humanitarian aid or even for robotic technology designed for the sole purpose of aiding victims of catastrophes such as natural disasters. We turn to nature as a model for military weapons but not for the purpose of solving philanthropic issues. Robots could be used to deliver food, water, and medication to people in areas that are typically inaccessible, but will instead be used to eliminate our enemies.

Science fiction has been instrumental in conceptualizing and furthering real-world science and invention. Although these may not be the actual consequences of implementing robotics, fiction often offers important insights that reveal certain truths

about our reality. As a result it is prudent to examine works of science fiction that relate to the use of robots not for a veritable indication of the future but for possible problems and solutions that arise as a result of developments in biomimetic robotics. The following texts, “Fondly Fahrenheit”, “RoboCop”, and *I, Robot* are fictional examples of potential outcomes of using biomimetic technology and method of coping with problematic situations.

Alfred Bester’s short story “Fondly Fahrenheit,” though clearly fictional, demonstrates how remorseless robots are detrimental to the well-being of humans. The tale revolves around a man named James Vandaleur and his android robot. The android is Vandaleur’s primary source of income. The robot works in a factory and its earnings are sent directly to Vandaleur. All androids are supposed to be imbued with the conception that they can never harm a human being or valuable property, a program that protects the interests of civilians in the immediate vicinity of the robot. However, Vandaleur’s android has a systemic flaw that overrides its command never to injure human beings whenever it is in an environment with high temperatures. Once the android is exposed to heat, it is inclined to kill the people who surround it. This story illustrates the danger of utilizing robots that lack “ethical” programming.Vandaleur emotional connection to his robot undermines his ability to control it. The android can create as much damage as it pleases and Vandaleur will protect it. He is constantly relocating and changing his identity to prevent his android from being dismantled by police. Vandaleur’s attachment to the android and the android’s lack of compassion and morality demonstrate the potential problems that arise from the use of biomimetic technology. This text reflects the effect that robots could have not only on innocent bystanders but also on their handlers.

Vandaleur's attachment differentiates him from his android and is evidence of his humanity, contrasting with the unfeeling actions of the robot.

"RoboCop," directed by Paul Verhoeven, is a film about the usage of robots in law enforcement. Set in crime ridden Detroit, the film follows Murphy who is a conventional police officer until he is shot and transformed into RoboCop by a company known as OCP (Omni Consumer Products). Once he has been revived, his limbs replaced by robotic parts, his memory is wiped and he is given directives by his creators to protect the city of Detroit. OCP is interested in preserving the safety of Detroit because they plan on building a new office building in the city. They are therefore concerned with developing a police force that is able to secure the zone surrounding their new building. In this endeavor, OCP displays attributes of the military-industrial complex, as they clearly are not a government agency yet are able to develop and dispatch robotic police officers which is traditionally a governmental right. This is made abundantly clear when Richard Jones, a senior executive, shouts "We practically *are* the military" when his associate questions his ability to obtain military grade firearms. In order to transform Detroit into a safe area where an OCP office can reside, there are two types of robotic cops originally presented to the OCP director. The first, led by Jones, is know as the ED-209 enforcement droid. This model is dismissed, however, once it shoots and brutally kills one of the junior executives. The actions of ED-209 illustrates many of the concerns surrounding the ethics of using military robots. The droid does not understand that the junior executive is not an actual threat and ends up killing him due to the fact that it does not comprehend that the executive is participating in a demonstration exercise. OCP opts to replace it with RoboCop, the creation of Bob Morton, a middle ranking executive.

RoboCop is trustworthy and ethical because it was created using Murphy's brain and parts of his body and therefore has a moral barometer of a human being. However, this is not possible with current technology and there is no way to marry a human brain with a robotic body. This film shows some of the ramifications of using robots without an ethical governor as well as demonstrating the conflicts that accompany the military-industrial complex.

Isaac Asimov's *I, Robot* is a popular science fiction novel that centers around the recollections of a Dr. Susan Calvin, "robopsychologist." Calvin recounts the problems she and her team experienced with robot in the form of short story-like anecdotes. Asimov determines the three cardinal rules similar to the ones in Bester's short story that robots must comply with: they must never harm a human being, they must obey human orders, and they must preserve themselves so long as the two previous rules remain intact. These laws guarantee that robots will act in obedience to, protect human beings, and will always act ethically so long as the human ordering them acts ethically. In the novel, these rules create a method of ensuring morality of the robots that are an integral part of society.

One of Dr. Calvin's accounts includes a robot in which these rules have been modified. In this particular robot the strength of the first rule is decreased; therefore the robot's desire for self preservation is stronger than its inclination to protect a human from harm. The problem with this robot is that it would allow a person to come to harm through not acting to stop whatever situation is putting that person in danger, which is equivalent to first-degree murder with a fourth-degree murder charge to whoever created the robot. Without the benefit of the first law, the use of robots are no longer ethical

because they do not hold the interests of human beings above all else. This illustrates the absolute importance of the first law. Asimov emphasizes the ramification of using uninhibited robots, a problem that is directly connected to using biomimetic robots in the military. If Asimov's laws of robotics were applied to military robots, then it would be possible to eliminate the deaths of non-combatants, and would prevent the use of robots against human beings in general. The only manner in which robots could be used in the military under these rule is for reconnaissance and surveillance, which would not satisfy the Department of Defense's desire for the use of robots in the military. Although Asimov's laws are exceptional in terms of maintaining robot ethics, they are not practical because of the large influence of the military-industrial complex, which would encourage the rejection of such laws because they limit the volatility of robotic weapons.

Such rules of robotics are no longer just theoretical, they have come under consideration due to the rapid growth of military technology. In recent months there has been much discussion concerning unmanned ariel vehicles or drones, robotic vehicles that are operated remotely by pilots in the United States. The development and implementation of drones began under the Bush administration following the 9/11 attacks. They were originally aimed at Al Queda leaders but the scope of drone targets expanded to include groups of militants such as the militaries of Pakistan and Yemen. Additionally, the government has "carried out "signature strikes" against groups of suspected, unknown militants" (Shane par. 19). "Signature strike" targets are typically groups of young men carrying weapons in extremist areas. These attacks are a highly controversial way to use drones because the targets are not a confirmed threat and the remote pilots have no way to tell if their targets are indeed a threat.

This application of drones has spurred the development of a set of guidelines that would aid pilots and control targeted killing. Drafts for a formal rule book are currently underway since the press attention drones received this past summer. Although the United States defense operatives "insist that the process is meticulous and lawful, the president and top aides believe it [the use of drones] should be institutionalized" (Shane par. 7). The secrecy surrounding drone procedures is a product of the military-industrial complex and institutionalizing drone policies would be a significant deviation from the standard practice of masking such information.

This discussion has also initiated research on how to create an "'ethical governor'" (Troop par. 2) for remotely controlled robotic devices and robotic soldiers. The primary issue surrounding drones is that they can be considered un-ethical because the pilots themselves have no sense of danger and therefore kill non-discriminately and inconsiderately. Although researchers say that "current technology is nowhere near the level of complexity that would be needed for a military robotic system to make life-and-death ethical judgments" (par. 3), research on algorithms that could regulate morality are underway at Georgia Institute of Technology. As the U.S. drone fleet has grown from fifty to nearly seven thousand since 2001, it is important that such research has commenced. The National Defense Authorization Act of 2001 stated "that one-third of all attack aircraft should be unmanned by 2010 and one-third of all ground combat vehicles driverless by 2015" (par. 14) inciting a large change in the United States military and concern among scientists in the field. Although a handful of these scientist believe it is possible to create a robot that complies with internationally agreed upon rules of combat, insist that robots cannot and never will be able to be ethical.

This discussion becomes increasingly poignant as biomimetic robots become involved not only our battle fields, but in our daily lives: "As robots advance into our homes, workplaces, schools, hospitals, battlefields, and society at large, it would serve us to be well informed of the ethical and social issues and prepare for a more mechanized world" (Lin, Intro x). Regardless of our individual opinions on the implementation of robotics, they have become an integral part of both the military and society. It is necessary for every American to possess some knowledge about our nation's foreign policy, and with it the future of "modern" warfare. The world has already experienced a technological and arms boom in the past century, an occurrence that will only be expanded upon in this century. The ethics surrounding twenty-first century warfare become increasingly important as such technologies will drastically change war strategies, and it is vital that we evaluate the implications of using robots in warfare and to analyze the consequences that accompany the military's application of biomimetic technology. The effects of the military-industrial complex have become evident and continue to overshadow the manner in which weapons are used and has done very little to discourage America's interest in waging war.

Because Eisenhower's warning was not recognized and acted upon, it is now impossible to disentangle defense contractors from the US defense system as the military industrial complex is now integral to the way this country functions. The response to Eisenhower's warning about the military-industrial complex was much the same as the original reaction to military robotics. Both were developed, implemented, and had taken hold well before they were made public. Because of the political climate surrounding the Cold War, Eisenhower's address was not heeded until many years after he left office: "It

would take another decade and a national fissure over the Vietnam War before Eisenhower's words of caution would begin to penetrate the national psyche" (WGBH par. 6). Similarly, the ethics surrounding military robots were not commonly examined for nearly two decades because of the national security issues surrounding 9/11 and America's invasion of the Middle East and have only come to the forefront recently as citizens becomes aware of drone usage. Hopefully, our country will be able to address the ramifications of utilizing military robots before they become irrevocably rooted in the defense system and create unreconcilable damage.

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