A Framework for the Evaluation of Militarized Genomic Technology

Isabel Canfield

Department of Philosophy, University of Notre Dame, South Bend, USA

Corresponding author: Isabel Canfield (icanfiel@nd.edu), Department of Philosophy, 100 Malloy Hall, Notre Dame, IN 46556 USA

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Isabel Canfield is a Ph.D. candidate in philosophy at the University of Notre Dame. Her interests include moral philosophy and action theory. She particularly likes thinking about collective agency and ethical questions that arise in medicine and war.

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As genomic technology rapidly advances, its further development for use in conflict is a focus for the United States military and other groups internationally. As we increasingly weaponize this technology, we ought to consider the ethical implications of its development and use. While there has been some scholarship on how to ethically implement genomic technology into the military, there has been little work focused on whether this technology can ever be weaponized responsibility in the first place. I aim to fill this gap in the literature by exploring the ethics of using this biotechnology in military contexts.

To this end, I develop a framework to adjudicate the militarization of genomic technology. I do this by proposing three principles that emerge through the examination of case studies. I test these principles by applying them to evaluate the use of irreversible genomic technology. I conclude that a genomic technology is suitable for use or development in military contexts if the technology is adequately responsive to the following three principles: 1) proportionality in combat, 2) beneficence for combatants receiving genomic technology, and 3) nonmaleficence for the broader non-combatant society. I end by exploring how future work could expand and refine the proposed framework.

Keywords: inflection point; ethics of technology; genomics; ELSI; military

1: Introduction

Genomic technology is rapidly advancing (McGuire et al., 2020). Genetically engineered babies were born in 2018, gene therapies have become widespread, and our understanding of the human genome is quickly developing. Unsurprisingly then, this advancing biotechnology is of interest to the United States military and militaries worldwide. However, the ethics of using emerging genomic technology in military contexts is not straightforward.

The use of genomic technology appears to be increasingly an area of focus for the US military (DARPA, 2018; DARPA, 2017). Yet, in many cases, the technology is still nascent. So, there is a unique opportunity to consider how to use, or not use, the

technology before it becomes too ingrained and widespread. We have a brief period before we reach the "inflection point," a concept described by Wendell Wallach:

> Inflection points are turning points in history followed by either positive or negative consequences. They provide windows of opportunity that allow us to assert a degree of control over the future we create. These windows can remain open for years, but in many situations they open and close quickly. Once a technology gets entrenched in the fabric of society, making a course correction becomes extremely difficult. And failing to act on the opportunities that do emerge, we surrender the future to forces largely beyond our control. (Wallach, 2015, 10).

While there is scholarship focusing on the ethical *implementation* of genomic technology in the military (Evans & Moreno, 2014; Mehlman & Yeheng, 2014; De Castro et al., 2016; Greene & Master, 2018; Shah, 2019), there has been little work focused on the ethics of using this technology in the first place. I aim to fill this gap.

To that end, I begin by arguing that there is a need to develop a framework to adjudicate the use of various kinds of genomic technology in the military. I propose employing a principlism framework of the type used widely in bioethics. Then, I offer three principles that could be a part of that framework. I claim that we can begin to evaluate whether a genomic technology is suitable for use or development in military contexts by employing the following three principles: 1) proportionality in combat, 2) beneficence for combatants receiving genomic technology, and 3) nonmaleficence for the broader non-combatant society. In the final section of the paper, I test these principles by using them to consider the ethics of the militarization of irreversible genome editing.

A Brief Landscape of Genomic Technology

Before continuing, it will be helpful to describe the various kinds of genomic technologies that I examine in this paper.[1] I mainly focus on human genome editing, also referred to as gene editing. This technology allows scientists to alter a person's genes to change how she functions (NIH, 2019). The most well-known and commonly used form of genome editing is CRISPR/Cas9. This system works by using the enzyme Cas9 to "cut" DNA where scientists specify using guide RNA. Then, a bioeDNA template is "pasted" in a process called "homology directed repair" (CRISPR Therapeutics, 2021).

There are two forms of genome editing: somatic and germline. Somatic gene therapies impact only the organism that is edited. A patient treated with this form of gene therapy may experience a change in his health or functioning, but he would not pass on that change to his children. By contrast, germline editing impacts stretch to the offspring of an organism. The potential impacts on future generations are difficult to anticipate fully, so germline editing is rare. There is consensus within the scientific community that this kind of gene editing is too risky to carry out right now (Bergman, 2019).[2]

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[1] While I mainly focus on human genome editing in this paper, all forms of genomic technology are subject to the framework I develop.

[2] While there is scientific consensus that germline editing is too dangerous to explore at this time, there is a documented instance of human germline editing. Dr. He Jiankui, a controversial Chinese scientist, announced in 2018 that he had genetically modified human embryos so that the resulting children would be unable to develop HIV. Dr. Jiankui did not submit to any formal ethics review and publicly announced his research only after the genetically modified children were born (Cyranoski & Ledford, 2018). There was outrage in

Beyond gene editing, a variety of actors are utilizing genetic, also called genomic, testing. In medicine, this technology has helped patients and families gather information on their propensity to develop various diseases, diagnose existing health conditions, and better prepare for reproductive and future care (ACMG Board of Directors, 2015). Outside of the medical context, genetic testing has become more broadly accessible through direct-to-consumer services such as 23andme (McGuire & Burke, 2008). Genetic testing is now used in various ways, from connecting individuals with previously unidentified relatives to helping police find suspects through investigative genetic genealogy (Su et al., 2011; Guerrini et al., 2021). There are various questions about the ethics of using and implementing genomic testing in a military context. However, as there is comprehensive work in the literature on this topic (Maxwell et al., 2020), I largely leave aside questions about genomic testing in this paper.

Finally, it is worth briefly touching on chimera research. A lot of the interest in this technology is in developing a way to grow human organs within animal hosts or through the combination of human and non-human animal DNA.[3] This is accomplished

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the scientific community, and beyond, after the public discovered Jiankui's research. In 2020, a Chinese court sentenced Jiankui to prison for "illegal medical practice," (Cyranoski, 2020). Although, as of 2023 Jiankui has been released from prison and serves as the director of the Institute of Genetic Medicine at Wuchang University of Technology (Goodyear, 2023).

[3] In January of 2022, the first successful transplant of a genetically modified pig heart was completed. The pig's genome was modified to include six human genes which were selected to make the heart more compatible with a human immune system (Rabin, 2022). Although the research participant died two months later, this transplant represented a major leap

by combining human stem cells and animal embryos in a process called "interspecies blastocyst complementation" (Koplin & Savulescu, 2019). While no US federal laws explicitly prohibit this form of research, there is a moratorium on National Institutes of Health (NIH) research funding. Although public perception on the acceptability of this sort of research is shifting in favor of increasing support (Crane et al., 2020), there are good reasons to proceed with caution. The ethical implications of creating beings or even non-conscious entities designed from joint human and non-human DNA are staggering. New questions have emerged about what entities count as human beings and what we owe to beings with any human DNA -- even if these beings are not human (Kwisda, White & Hübner, 2020). I mostly leave aside considerations of the ethics of chimera technology, as these questions have been widely discussed, and these questions about the ethical implementation of chimera research and use do not drastically change in military contexts.[4]

2: The Need for a Principlism Framework

As I have already indicated, there is a need to discuss the ethics of utilizing new and emerging genomic technology in the military context. In part three, I will propose principles to help us further this discussion. In developing these principles, I work to

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forward for this technology, (Rabin, 2022). Subsequently, more genetically modified orangs have been transplanted and this technology is quickly developing (Christensen, 2024).

[4] Future scholarship could consider whether the well-discussed risks of engaging in chimera research are outweighed by special considerations in the military context. Much of what I say in this paper, although not explicitly focused on this topic, would be helpful in that conversation.

create a framework of the sort proposed by Tom L. Beauchamp and James F. Childress in *Principles of Biomedical Ethics.* Their approach has been widely adopted in the interdisciplinary field of bioethics and, more broadly, in general medical practice.

Beauchamp and Childress (1979) propose four principles: respect for autonomy, nonmaleficence, beneficence, and justice. They argue that these four basic principles should "function as guidelines for professional ethics" in medicine, given that these are the principles best suited to serve "as an analytical framework that express the general values underlying rules in the common morality" within the medical profession (Beauchamp & Childress, 12). The common morality is a "set of norms that all morally serious people share" (Beauchamp & Childress, 3). Importantly, these norms are all equally basic. Beauchamp and Childress credit W.D. Ross in understanding how their principles ought to function in helping moral actors to identify and act on *prima facie* and *actual* obligations (Beauchamp & Childress, 15).[5]

The purpose of a principlism framework is not to give definitive answers to moral questions. Instead, it is intended to assist us in "identifying and reflecting on moral problems" within a particular discipline (ibid).[6] While some of Beauchamp and

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[5] Turning to Ross, he explains that a *prima facie* duty is distinct from a "proper or actual duty" (Ross, 2002, 19-20). An act that is *prima facie* right is not as such an act that we necessarily have an obligation to fulfill; rather, it is an act that we have some moral reason to undertake, (ibid). In thinking of competing *prima facie* duties, we are thinking of competing moral reasons for action, (Ross, 28-31). In deciding how to act, what we are deciding is what moral reasons are strongest, (Ross, 33).

[6] In fact, Beauchamp and Childress state that their framework may appear thin "because *prima facie* principles do not contain sufficient content to address the nuances of many moral

Childress's framework is applicable to the use of genomic technology in military contexts, the utilization of this technology within the military raises largely distinct questions from those that occur within the scope of, typically, therapeutic medical practice. Given the inability to perfectly apply the bioethics principles to questions about the militarization of genomic technology, I utilize the structure outlined by Beauchamp and Childress, and by extension Ross, to propose a unique framework.

The framework I propose below will help us identify and weigh relevant moral considerations for the militarization of genomic technology. It is important to note that there are substantive questions about what principles belong within this new framework. While many of the principles I propose below are inspired by and related to those proposed in bioethics, the work of developing this unique framework is dependent on figuring out which principles are useful from bioethics, which new principles need to be articulated, and how the principles ought to be utilized in this new area. This is the work that will follow in the next section of the paper. It is this discussion that I hope will help us raise and consider moral questions about how to responsibly utilize genomic technology.

3: Three Potential Principles

I develop three proposed principles by considering case studies in emerging biotechnology and military history that raise ethical challenges. As a result, these principles are well suited for use in responding to related issues. Yet, as new forms of

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circumstances" (15). A similar challenge faces any account, including this one, that adopts this sort of framework.

technology develop, these principles may fall short. In these cases, I hope that the framework will, at the very least, provide a starting point in framing questions about whether to employ and develop genomic technologies in the military.

3.1 Principle One: The Principle of Proportionality in Combat

The principle of proportionality is a concept that appears in most contemporary versions of just war theory.[7] Most basically, we use it to help determine if the harms that are caused by an act are offset by potential benefits (McIntyre, 2019). The principle is understood as applicable in jus in bello or in the ethics that govern conduct in war. It is often discussed as the principle that explains why militaries ought to limit the amount of force they utilize (Walzer, 2006, 129). Given this description of the principle of proportionality, we can adapt it for use in the militarized genomic technology context. The first principle can be understood to require that the harms that result from using any genomic technology in combat ought to be offset by the benefits of using this technology.

To understand the importance of the first principle, it will help to think through a specific case study. So, let's begin by considering a new biotechnology that aims to protect soldiers from many nerve agents or, more specifically, the class of chemical compounds called organophosphates (Kaiser, 2020). Researchers are still developing this technology, and it has, so far, only been tested with mice. The therapy works

[7] We can trace this principle back to Aquinas. While Aquinas does not discuss the phenomenon directly by name, he discusses the concept in question in 64, article 7 of the second part of his *Summa theologiae* (*ST* II-II.64.7). There Aquinas argues that moderate force is morally permissible if the act is rightly proportionate vis-à-vis its goal.

because organophosphates are nerve agents that block enzymes that help to regulate muscles. The therapy protects the body by helping the liver produce enzymes that stay in the bloodstream and then break down the organophosphates (ibid). Existing chemical drugs that achieve similar results cannot offer protection for more than eight hours. Yet, researchers have found that the protection offered by this gene therapy can last up to five months (Betapudi et al., 2020).[8] Using a gene therapy to protect against chemical weapons raises several ethical questions.

To understand these ethical concerns, it will help to outline the threat of chemical weapons. The first use of poison gas was by British troops during the first world war, at the Battle of Loos. British soldiers used Chlorine gas unsuccessfully. The gas blew back onto them after a change in the wind (Imperial War Museums, 2021). While a change in weapon distribution later allowed chemical weapons to be used more successfully by various international actors (National Army Museum, 2021), new biotechnology may further lessen the risks of chemical warfare in the future. Although the Geneva Protocol of 1925 officially banned chemical and biological weapons in war (United Nations, 1925), chemical weapons were deployed in Syria as recently as 2013, and in front of United Nations officials (Warrick, 2021). As a result of this, and other modern uses of nerve agents, the threat posed by these weapons is still pervasive.

One way to limit the destructive nature of new militarized technology is to argue that the technology only ought to be used in a defensive, and never an offensive, manner. Then, as the protective gene therapy is defensive, the use of this new

[8] It may be possible for the gene therapy to last longer. However, proof of concept studies were terminated after five months.

technology appears to be straightforwardly an acceptable form of militarization. However, the distinction between defensive and offensive technology falls apart when scrutinized more closely (Levy, 1984).

The use of this protective gene therapy may make it easier to deploy and utilize chemical weapons in the future. It is much easier to use a technology offensively when the possibility of that technology harming you is mitigated. To understand this phenomenon, we can look to Don Howard's discussion of the Iron Dome, a missile defense system in Israel:

> Some observers think that the real goal of the overall program is to provide a comprehensive defensive shield against Iranian ballistic missiles so as to insulate Israel against retaliation if, for example, Israel chose to launch a pre-emptive strike against Iranian nuclear weapons facilities. If so, then what appears a defensive capability becomes an offensive one by making possible offensive actions that would otherwise lead to unacceptable risk to one's own nation (2022, 20)

As a result, allowing the use of a protective gene therapy that mitigates the risks of using nerve agents could lead to more chemical warfare, an outcome we should want to avoid.[9]

By using the offensive/defensive distinction, we might hope to use this standard to help limit the amount of unjustifiable harm that could result from introducing a new

[9] As this conclusion is compatible with both traditionalist and revisionist just war theory, I do not argue explicitly in this paper that we should want to avoid the widescale use of chemical weapons.

destructive technology. This is a good goal. Although the defensive/ offensive distinction won't help us. Instead, we may be able to limit unjustifiable harms of new technologies by considering other principles that feature in just war theory. Looking beyond the principles that are typically considered when we think about justified conduct in war, we may want to broaden our scope to the principles that typically inform *jus ad bellum.*

Given the risks involved with implementing the use of new genomic technology, we could argue that we ought to rely on genomic technology only as a "last resort". We could also argue that given the risks of failure inherent in utilizing a new technology, militarization is appropriate only if there is "reasonable hope of success". As a result, we should only employ genomic technology when we have good reason to believe that we have no other, less risky, options and when the technology might actually work.[10] Looking to these two principles, we can see how considering existing elements of just war theory, may help us as we further develop our framework.

For now, we can use these additional principles as salient considerations when we discuss how to limit the unjustifiable harms of new technologies. Each of these *jus ad bellum* principles can be considered as part of our proportionality principle. [11] This principle will allow us to dispense with the blurry and unreliable distinction between

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[10] My thanks to an anonymous referee for this suggestion.

[11] What makes a harm "unjustifiable" needs to be further clarified. This is a standard that is best elaborated on in discussion of concrete cases as the determination of whether a harm is "unjustifiable" will likely require a weighing of benefits and harms for particular individuals in particular circumstances.

offensive and defensive weapons while still allowing us to consider how to limit the harms that result from employing new technology.

3.2 Principle Two: The Principle of Beneficence for Combatants Receiving Genomic Technology

The principle of beneficence is one of the four traditional basic principles in bioethics. The principle was first proposed in the Belmont Report and was re-affirmed by Beauchamp and Childress when they popularized principles in bioethics. In medicine, to act benevolently toward a patient is to act with their welfare in mind. As Beauchamp explains:

> The principle of beneficence is understood as an abstract norm that includes derivative rules such as 'Do no harm,' 'Balance benefits against risks,' and 'Maximize possible benefits and minimize possible harms.' This principle is satisfied in the research context by intentionally refraining from causing injury and by assuring that risks stand in reasonable relation to probable benefits. (2019, 6.1)

To adapt this general principle for use in the militarized genomic technology context, we can understand this principle to require that we act to promote a combatant's interests when we allow, encourage, or require this combatant, or some other member of the military community, to utilize or be altered by genomic technology.

Let's turn to a new case study to consider how we might utilize this second principle. Imagine that you are a pilot in the US Air Force. To carry out your responsibilities, you are required to be awake for long periods. This makes flying a

plane dangerous. You are given a small pill. Taking it gives you a jolt of energy and a sense of focus that goes well beyond what your typical morning cup of coffee could ever provide. The use of amphetamines or small "go-pills" is common in the Air Force (Kamienski, 2016). Amphetamines can be highly addictive, and yet fatigue can be fatal to combat pilots (ABC News, 2006). So, how should we think about providing, or in some cases requiring, technology that is both potentially harmful and potentially lifesaving to the recipient?

The Treatment/ Enhancement Distinction as a Principle

One standard that we could turn to when considering using new biotechnology is to mandate that the technology can only be used to treat and never to enhance a member of the military. The treatment/enhancement distinction is well-worn territory in the bioethics literature and has been the focus of other work in military ethics (Mehlman, Lin & Abney, 2013). The basic idea is that an acceptable goal of medicine is to treat illness but enhancing human beings is a different undertaking. Furthermore, there are distinct ethical considerations that make enhancement subject to more stringent moral standards.[12] As an example of this distinction, consider a man who takes steroids to have larger arm muscles. In this example, the large muscles are an enhancement and not a treatment. This man is not returned to "normal" human functioning nor brought back to a standard that he previously enjoyed before taking the steroids. Instead of steroid use to increase muscle size, if the man was taking steroids to treat anemia, we would likely understand this as a form of treatment.

The line between treatment and enhancement is the subject of much debate, as is

[12] For more of the debate on the ethics of enhancement see: Alonso & Savulescu, 2021

the usefulness of the distinction (Daniels, 2000). We can see the difficulty of determining whether a change created through a gene therapy is an enhancement or a treatment by turning to the chemical weapon example from above. Like a vaccine, this gene therapy is a preventative measure intended to counteract a harmful effect that would reduce normal human functioning. Still, the chemical weapon gene therapy does not straightforwardly fall into the treatment category. The gene therapy creates a new ability. Making a new capability that the human body does not "naturally" or otherwise possess may suggest that this is an enhancement.

To resist rehashing old debates, I will not attempt to reproduce the various arguments for and against using this distinction here. Instead, it is worth noting that even those who find the distinction useful in other contexts do not universally find it useful in the military setting, where the stakes are higher and the potential benefits of conservation of life counterbalance competing ethical concerns about enhancement. (President's Council on Bioethics, 2003). As this debate is unsettled and so the distinction is difficult to apply in practice, it is not a good candidate principle.

Humanity as an Alternative Principle

Another potential principle that may be useful in assessing the use of a genomic technology is to require that the biotechnology not alter an individual so much that they are no longer counted as human. There is a lack of consensus on how and if genetic engineering ever changes what it means to be human. This is at least partly because the definition of what constitutes humanity is blurry (Raposo, 2019). As above, these debates are longstanding and unlikely to be settled in such a way that would practically allow this principle to be of use in evaluating biotechnology now.

One standard that is less murky may be illuminated through an appeal to the

discussion of chimera research. Many people are increasingly comfortable with chimera research that could result in the growth of human organs (Crane et al., 2020). Still, creating a conscious animal-human hybrid that functions and acts in human-like ways but with non-human-animal traits would likely be an uncomfortable proposition for most people. Similarly, considerations of genomic editing that limit changes so that human beings do not become "indistinguishable from their weapons," as the President's Council on Bioethics put it, may be a reasonable standard to adopt (President's Council on Bioethics, 2013). Preventing the extreme and more recognizable version of loss of humanity is more manageable than attempting to prevent any alteration at all. The tricky cases will inevitably be those that fall short of this extreme but are still close enough to be undesirable. Keeping in mind the extreme outcome that we are aiming to avoid, a person who is so changed that she becomes indistinguishable from her weapons, is a helpful heuristic.

A Return to the Principle of Beneficence

Yet, relying solely on the humanity principle is still not quite sufficient. There are many ways in which ordinary basic training within the military may alter a combatant so that they are better able to carry out the tasks required of them. This sort of change is anticipated and acceptable. So, how should we think about changes to combatants that involve genomic technology? The principal of beneficence would indicate that in some cases allowing a person to be changed, so that she can better serve a military purpose, is allowable.

However, one limit on this kind of change is that they ought to be undertaken only when they are in the best interest of the combatant herself. In this way, we can rely on a determination of the potential benefits of a change, for the person undergoing the

alteration, considered against the potential harms, to her. In cases when genomic modification is warranted, the permissibility will be dependent upon a consideration of the potential benefits for the combatant in question.[13]

3.3 Principle Three: Nonmaleficence for the Broader Non-Combatant Society

The first two principles I have proposed are primarily focused on protecting members of a military.[14] Yet, it would be a mistake to limit the focus of this framework to combatants. We also ought to consider the impact that the development and use of emerging genomic military technology will have on civilians. This discussion leads me to a third principle: *nonmaleficence for the broader non-combatant society*. As in my consideration of beneficence above, we can draw upon the rich bioethics literature on nonmaleficence to help inform our understanding of this principle. Put simply, in medical practice, the principle of nonmaleficence requires that a physician not harm her patient. Often this principle is understood simplistically as "do no harm".

Nonmaleficence does not entail that we can *never* harm some person, or group of persons but it does entail that we aim to allow the *least* amount of harm. For example, performing surgery harms a patient. There is harm in using a scalpel to cut open a person. However, this harm is outweighed by the anticipated benefits of the surgery and failing to perform the surgery would amount to harming the patient. So, nonmaleficence does not entail that we *never* harm some person, or group of persons

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[13] As I discussed throughout this paper, there are many ways that genomic technology can cause undue harm to individuals.

[14] Although, in some situations, we may want to expand our use of these principles to consider non-combatants.

but it does entail that we aim to do what will result in causing or allowing the least amount of harm.

If we want to further support this concept, we can find a similar principle if we look, once again, to *jus in bello.* Here, scholars often discuss "necessity" or "minimal force". The idea is that when engaged in combat an individual or group should only use the amount of force that is strictly required to accomplish their military objectives. Any additional harm they cause it unethical. So, just as above, some amount of harm is allowable, but we are morally required to minimize these harms as much as possible.

In the military context, the principle of nonmaleficence requires that potential societal benefits of militarizing a new or emerging genomic technology are weighed against the potential societal harms that may result from the use of this technology. The second principle of beneficence above does not require that the benefits of a genomic technology be distributed to the wider civilian population to warrant using these new technologies. Yet, we ought to include a principle which re-enforces our *prima facie* duty to avoid *harming* civilians. In some cases, it may be reasonable for civilians to endure some small harm to avoid some larger harm. So, the principle requires that the harms experienced by civilians as the result of the development or utilization of genomic technology are minimized.

To understand the importance of this principle and the importance of considering civilians, let's turn to a new case study: In 2013, researchers discovered that acetaminophen, the active drug in many popular over the counter painkillers, may dull empathy (Hamblin, 2013). Follow-up studies suggest that acetaminophen may dull other emotions as well (Noor, 2020). Now, imagine that it is possible to produce a stronger version of this effect by enhancing the chemical compound that already is used in over-the-counter painkillers, or perhaps even by genetically modifying combatants.

We could engineer combatants so that they are unbothered by empathy for those who are targets of violence, unaffected by sadness when they are separated from their families, and unconcerned about their own safety as they no longer experience fear. These emotionally modified combatants may be ideal soldiers.[15] However, now consider what would happen if these changes lingered when the emotionally manipulated combatants return to civilian life.

In developing the second principle, I considered how genomic technology may negatively impact the combatants who receive modifications. Now, let's consider how civilians who are not direct recipients of the technology may still experience resultant harms. In the genetically modified emotions case that I have describe above there could be serious harms to civilians.

Imagine that one of these emotionally manipulated soldiers returns to her family and is no longer capable of resuming her loving familial relationships. She is no longer able to feel empathy when her partner has trouble at work. She no longer feels sadness when her son falls and is in pain. And she cannot bring herself to worry when her daughter engages in risky teenage behavior. As a result, this former combatant may have a much harder time acting as a loving partner or capable mother.[16] Beyond, the

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[15] There are good reasons to want to avoid this kind of emotional modification. It may be that for the sake of the combatants themselves we should avoid imposing these harms. Separately, we may want combatants to fully access their emotional responses to ensure that the ethics in and of war are upheld. In fact, access to emotional capabilities may even be necessary for soldiers to be adequately responsive to their ethical responsibilities.

[16] In recent work, Adam Henschke has defined these kinds of harms as "disenhancements". He argues that in military contexts, we ought to consider how any potential biotechnological

harms that attach in this scenario to the former combatant, there is great harm experienced by her loved ones.

Separately, we can imagine harms to civilians who are not family members of combatants. Imagine that a genetically modified combatant returns from military service and engages in risky and illegal behavior because she no longer fears or cares for her own, or others', safety and well-being. This combatant may no longer obey speed limits, laws against theft, or prohibitions against violence. Any resulting harms to society, or individuals, can be attributed to the use of the genomic technology.

The sort of genetic change that I'm imagining in this fictionalized case study may be allowable if we were to evaluate it only through reference to the first two principles. It may be that the changes we are discussing are in some ways in the best interest of the combatant who was altered. However, given potential harms that may result from these changes to the wider civilian population, we ought to refrain from engaging in this sort of modification. The third principle is therefore necessary to understand this additional dimension of ethical concern.

4: An Application: Irreversible Genomic Technology

In considering the ethics of using genomic technology in military contexts, others have noted that reversibility is an essential component in determining whether we should develop the technology (Evans & Moreno, 2014). As this principle of reversibility has been the focus of scholarship that deals with the ethics of using genomic technology, I

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intervention might be simultaneously helpful, in some contexts, but harmful in others. For a rich discussion of this topic, see: Henschke, 2025.

end my paper by considering reversibility and applying the proposed framework to assess irreversible genomic technology in military contexts. The purpose of this analysis is twofold. First, this process will illustrate how we can use the proposed framework. Second, my discussion suggests concrete steps we ought to take in crafting policy on the use of irreversible genetic technology in a military context.

To begin, it will help to define "reversibility." It is, put simply, that anything that is done to an individual ought to be possible to undo (Moreno, 2013). Reversibility gets a lot of play in the discussion of the ethics of genomic technology, and it is easy to see why. Irreversible changes to an individual, or more drastically, to both an individual and her offspring raise thorny questions about risk, identity, and consent.[17]

4.1 Irreversible Germline Editing:

Starting with the most dramatic form of irreversibility in genomic technology, the most obviously concerning irreversible changes caused by genomic editing would be those that alter the germline. This sort of modification carried out in a military family, for example, would have implications for future people who cannot consent to those changes. While it may seem far-fetched, it is possible to imagine that some families may opt to genetically engineer their future children through germline editing to equip them with enhancements that would enable them to best succeed in the military.[18] Furthermore, it may be possible to imagine some nation incentivizing these sorts of family planning decisions.

Examining the Case:

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[17] I discussed the implications of genome editing on human identity in section 3.2.

[18] I also considered the treatment/enhancement distinction in more depth in 3.2.

Let's start with the first principle: the principle of proportionality in combat. Remember, this principle ought to be understood to require that the harms that result from using irreversible genomic technology in combat be offset by the benefits of using this technology. We can tweak the case so that this principle is satisfied. Imagine that the changes to the germline are completed so that the experience of physical pain is reduced. And it turns out that this ends up being a largely protective measure, as these soldiers are rarely physically present on battlefields. Yet, the change provides a sense of security to members of the military.

Moving to the second principle, we have *prima facie* obligations to act in the best interest of combatants receiving genomic technology. So, is irreversible germline editing in the best interest of those individuals who would be the bearers of this technology?

Questions of consent, autonomy, and nonmaleficence are salient when we acknowledge our lack of understanding of the risks of germline editing for future generations (Bergman, 2019). The possibility of unintended impacts is frightening. One reason that there is currently international consensus that germline editing is too risky is because it is not yet clear what the off-target impacts of any editing of this sort may cause. Moreover, genetically engineering future individuals to serve military interests contradicts an important principle in pediatric research ethics and medical treatment. That is the right to an open future (Wilfond & Ross, 2009). This principle states that it is essential that children are not unduly limited in their ability to select their own path through life unencumbered by decisions made by adults when they were children.

However, it is possible that offering enhancements may not result in a limitation of future options but actually offer more choices for that child. For example, she could flourish if she wants to join the military, but she could also succeed in something else.

So, she has more options because of genetic engineering. Yet, these modifications may come with pressure to conform and utilize the enhancements that were developed for use in the military. Furthermore, the unintended consequences of this kind of gene editing may produce other impacts that limit the child in unknowable ways. In considering our obligations to act in the best interests of those who would receive genetic technology, we should consider the *prima facie* obligations that arise from the second principle. So, it seems that germline editing would likely cause a great amount of harm and would not be in the overall interest of those who would receive the technology.

When we consider the third principle, new concerns emerge: Editing some individuals, while not editing others, may cause discrimination and stratification in the military and in broader civilian communities. Those from communities with access to this technology may have more opportunities given their unique and enhanced abilities. The resulting socioeconomic stratification is not a concern unique to the military context (Mulvihill et al., 2017). However, it is notably salient in this area.

This discussion of germline technology suggests that the technology fails to meet the standards indicated by two of the three principles (the second and third principles). As a result, we have good reason to avoid utilizing or developing germline editing technologies within a military context.

4.2 Irreversible Somatic Editing:

Turning now to somatic genome editing, we encounter a more complicated case of the ethical challenges that may arise in militarizing genomic technology. Somatic genome editing cannot be as easily dismissed as germline editing. To help see this, imagine a soldier who receives gene therapy to make her arm and leg muscles stronger. Let's say that this change makes it much easier for her to carry heavy equipment for long

distances.[19] This soldier's enhanced ability to carry heavy equipment saves her from injury at various points while serving her country. However, at the end of this soldier's eight-month deployment, she leaves the military and returns to civilian life. As a civilian, she retains the genetic modification. As a result, she has arm muscles larger than those achievable from even intensive body building.

Examining the Case:

We can begin to adjudicate the use of this technology by appealing to considerations that arise when we consider again the second principle: *beneficence for combatants receiving genomic technology*. While the genomic modification helped this soldier avoid what could have been serious injury, thus offsetting some potential harms, there are a couple of concerns that we may still have. First, it is already difficult for veterans to re-adjust to civilian life (Koenig et al., 2014, 418). As a qualitative interview study with returning Iraq and Afghanistan veterans found:

> One source of readjustment difficulty may be due to medical and psychological trauma and *reverse culture shock* related to the socio-cultural differences

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[19] This example is not all that far-fetched. Josiah Zayner, a biohacker, injected himself with a gene therapy that he says targeted the myostatin gene. He intended to "knockout" this gene, suppressing its function and so suppressing the mechanism that tells his muscles to stop growing. He stated that he was "hoping to see localized muscle growth in my forearm. That's what I would hope because it was a localized injection to a specific area." (CBC , 2017).

> between military and civilian cultures and their associated identities. As veterans transition from military to civilian cultures, they create identities tailored to specific social and cultural contexts. For example, military behavior appropriate during deployment may be inappropriate upon returning home, suggesting complex sociocultural tensions between military and civilian identities. (Koenig et al., 2014)

A constant physical reminder of experience in the military due to a body changed to be genetically primed for combat may make the re-entry process more difficult.

Yet, even if we could retain the positive benefits of this genomic technology and make the enhancement reversible, there are lingering ethical challenges that accompany that decision. In his discussion of reversibility of neurological enhancements in the military, Moreno points out:

> There's the problem of when somebody leaves the service and they've been accustomed to a certain device that expands their consciousness. What happens when they have to give it up? A lot of veterans, people who've done 3 or 4 tours, when they have to turn in their rifle, the first thing they do is go out and buy a gun. The whole ethical question of what you can do to a soldier or a fighter, and then what you can take away from them, is a lot different from messing with a computer. (Moreno, 2012).

Questions about depriving someone of an enhancement or treatment that they have previously been able to access are not unique to the military context. For example, these questions arise in the literature on device removal following brain implant research (Sierra-Mercado et al., 2019). Here, we learn that it can be jarring and is unfair to deprive someone of access to a change, treatment, or enhancement they previously

enjoyed or relied upon. This may lend itself to allowing veterans to retain genomic changes even when there is an option for reversibility.

Yet, as Moreno further notes, allowing veterans to maintain genomic changes, or creating irreversible changes, raises other issues. Potential security concerns arise when non-active military personnel harbor genomic changes that the US military wants to keep secret. When the secrets of military biotechnology exist within the bodies of civilians, new concerns about privacy, autonomy, and coercion arise (Moreno, 2012). More work needs to be done to determine if germline changes are in the best interest of combatants.

Finally, let's turn to consider the third principle. Remember that genomic editing physically alters the DNA of an individual. This change may be harmful to the individual receiving the genomic technology *and* this change may have implications for the broader society. We have already discussed problems of stratification and discrimination in the case above. These broader societal implications that may result from utilizing irreversible genomic technology are hard to understate.

Yet, even given these serious ethical concerns about irreversible somatic genome editing, remember that somatic gene therapies may allow combatants to withstand brutal conditions, heal quickly, or rapidly process information that could save their lives. Even considering the many risks, it is difficult to overstate potential benefits.

As a result, the three principles do not suggest a straightforward rejection or acceptance of irreversible somatic genome editing. Germline editing is more straightforwardly an untenable form of technology for militarization – at least at this time. Meanwhile, it is unclear how we should proceed with irreversible somatic genomic editing. Although, given the ethical concerns raised above, we ought to

proceed carefully and very cautiously, if at all, with this technology.

5: Conclusion and Future Work:

I began this paper by arguing that as genomic technology rapidly advances, we have a short period of time before we reach an inflection point. We urgently need to consider which, if any, emerging genomic technologies can be militarized ethically. This paper has outlined three principles that, when taken together, offer a broad sketch of a principlism framework that we can use to begin this conversation.

We started with a discussion of the principle of proportionality in combat. Throughout that discussion, I argued that any harm that results from using genomic technology in combat must be outweighed by the benefits we gain from utilizing the technology. In discussing this principle, I explored alternative ways of limiting the potential harm of new and emerging genomic technology, including a potential appeal to the distinction between offensive and defensive technologies. Ultimately, I concluded that framing the principal around proportionality was a better way to achieve our goals. Still, when discussing and weighing the potential risks and benefits of militarized genomic technologies, we may want to look to additional principles commonly discussed in just war theory to further help us illuminate underappreciated risks and benefits of the use of these technologies in combat.

Next, I considered the principle of beneficence for combatants receiving genomic technology. There, I explored how this principle requires that we act to promote combatants' best interests when we allow, encourage, or require combatants to utilize or be altered by genomic technology. In developing this principle, I considered alternative options such as the treatment/enhancement distinction and a humanity

standard. Ultimately, I rejected both of these alternatives to focus on the more straightforward principle of beneficence.

Finally, I concluded my discussion of the principles by considering nonmaleficence for the broader non-combatant society. Here, I expanded my focus so to discuss the implications of the use and development of emerging genomic military technology on civilians. I explored how nonmaleficence requires that we aim to do what will result in causing or allowing the least amount of harm. Although, I did not argue that all harm is prohibited, I discussed our *prima facie* duties to avoid harming civilians. In this section of the paper, I paid particular attention to potential harms that might occur when veterans return to civilian life after utilizing genomic technology during their deployment.

After outlining these principles, I utilized the framework I proposed to consider the ethics of developing two kinds of irreversible genomic technology. I was able to conclude that we should avoid the militarization of germline editing. However, when considering somatic genomic editing, the verdict was not as straightforward. As we discovered throughout our evaluation of these technologies, using the framework won't allow us to definitively answer every difficult question that arises. Nonetheless, utilizing the framework, we can ask and frame difficult questions about these new genomic technologies in a military context.

Still, future work is necessary to help us further clarify and refine the principles so we can begin to answer some of these newly framed and ethically fraught questions. In particular, our discussion throughout the fourth section indicates that future work on the ethics of utilizing genomic technology ought to focus on the ethics of *jus post bellum.* Additionally, more work may help us clarify how we think about the risks and benefits of new and emerging technology. Are there certain risks that are never

allowable? Should alternatives always be considered first before we look to genomic technology? What risks ought we take or allow given the high stakes inherent in the military context? Answering these, and other, questions will help us further refine and operationalize the existing principles. To do that, we may want to consider other principles commonly discussed in bioethics, including justice and autonomy. We may also want to return to additional principles discussed in the literature on just war theory, such as right intention and legitimate authority. Finally, as we continue to discuss this framework, and other related ethical structures, we may find that the development of new principles is warranted.

For now, by considering the issues that arise when we apply the three proposed principles to specific genomic technologies, we have begun a necessary discussion. Ideally, these conversations on the ethics of the militarization of emerging genomic technology will continue before we reach an inflection point. There is a dire need to work collaboratively to generate international consensus on these issues, and I hope that my proposed framework provides us with a place to start.

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References:

1. ABC News. 2006. "U.S. Combat Pilots on Speed." ABC News. Accessed January 5, 2024. https://abcnews.go.com/2020/story?id=123779&page=1.

2. ACMG Board of Directors. 2015. "Clinical Utility of Genetic and Genomic Services: A Position Statement of the American College of Medical Genetics and Genomics." *Genetics in Medicine* 17 (6): 505–507. https://doi.org/10.1038/gim.2015.41.

3. Alonso, Marcos, and Julian Savulescu. 2021. "He Jiankui´s Gene-editing Experiment and the Non-identity Problem." *Bioethics*. https://doi.org/10.1111/bioe.12878.

4. Beauchamp, Tom, and Childress, James F. 1994. *Principles of Biomedical Ethics*, 4th ed. Oxford University Press.

5. Bergman, Mary Todd 2019. "Harvard Researchers Share Views on Future, Ethics of Gene Editing." *Harvard Gazette,* January 9. https://news.harvard.edu/gazette/story/2019/01/perspectives-on-gene-editing/.

6. Betapudi, Venkaiah, Goswami, Reena, Silayeva, Liliya, and Chilukuri Nageswararao. 2020. "Gene Therapy Delivering a Paraoxonase 1 Variant Offers Long-term Prophylactic Protection Against Nerve Agents in Mice." *Science Translational Medicine* 12 (527): https://doi.org/10.1126/scitranslmed.aay0356.

7. CBC/Radio-Canada. 2017. "Meet the Human Guinea Pig Who Hacked His Own DNA." *CBC Radio*, November 10. https://www.cbc.ca/radio/quirks/.

8. Christensen, Jen. 2024. "More People Need Transplants Than There Are Organ Donors. Pigs Might Be a Solution." *CNN*, May 9. Accessed May 10, 2024. https://www.cnn.com/2024/01/30/health/pig-organ-transplant-xenotransplantation/index.html.

9. Crane, Andrew. T., Shen Francis X., Brown Jennifer L., Hatta Taichi, Fujita Misao, and Low Walter C. 2020. "The American Public Is Ready to Accept Human-Animal Chimera Research." *Stem Cell Reports* 15 (4): 804–810. https://doi.org/10.1016/j.stemcr.2020.08.018.

10. CRISPR Therapeutics. 2021. "CRISPR/Cas9." *CRISPRTX*. Accessed June 16, 2025. https://web.archive.org/web/20211122142219/http://www.crisprtx.com/gene-editing/crispr-cas9

11. Cyranoski David, and Heidi Ledford. 2018. "Genome-edited Baby Claim Provokes International Outcry." *Nature* 563 (7733): 607–608. https://doi.org/10.1038/d41586-018-07545-0.

12. Cyranoski David. 2020. "What CRISPR-baby Prison Sentences Mean for Research." *Nature* 577 (7789): 154–155. https://doi.org/10.1038/d41586-020-00001-y.

13. Daniels, Norman. 2000. "Normal Functioning and the Treatment-Enhancement Distinction." *Cambridge Quarterly of Healthcare Ethics* 9: 309.

14. Defense Advanced Research Projects Agency. 2017. "Safe Genes." *DARPA*: *Defense Advanced Research Projects Agency*. Accessed March 30, 2021. https://www.darpa.mil/program/safe-genes.

15. Defense Advanced Research Projects Agency. 2018. "Dialing Up the Body's Defenses Against Public Health and National Security Threats." *DARPA: Defense Advanced Research Projects Agency*. https://www.darpa.mil/news-events/2018-05-25.

16. De Castro, Mauricio, Biesecker Leslie G., Turner Clesson, Brenner Ruth, Witkop Catherine, Mehlman Maxwell, Bradburne Chris and Green Robert C. 2016. "Genomic Medicine in the Military." *Npj Genomic Medicine* 1 (1): 1–4. https://doi.org/10.1038/npjgenmed.2015.8.

17. Evans, Nicholas G., and Jonathan. D. Moreno. 2014. "Yesterday's War; Tomorrow's Technology: Peer Commentary on 'Ethical, Legal, Social and Policy Issues in the Use of Genomic Technologies by the US Military.'" *Journal of Law and the Biosciences* 2 (1): 79–84. https://doi.org/10.1093/jlb/lsu030.

18. Greene, Marsha., and Master, Zubin. 2018. "Ethical Issues of Using CRISPR Technologies for Research on Military Enhancement." *Journal of Bioethical Inquiry* 15 (3): 327–335. https://doi.org/10.1007/s11673-018-9865-6.

19. Guerrini, Christi. J. 2021. "Four Misconceptions About Investigative Genetic Genealogy." *Journal of Law and the Biosciences* 8: https://doi.org/10.1093/jlb/lsab001.

20. Hamblin, James. 2013. "What's Tylenol Doing to Our Minds?" *The Atlantic.* https://www.theatlantic.com/health/archive/2013/04/whats-tylenol-doing-to-our-minds/275101/.

21. Henschke, Adam. 2025. "On the Enhancement of Soldiers, Disenhancement, and the Importance of Context." *Journal of Military Ethics*, April, 1–16. doi:10.1080/15027570.2025.2487329.

22. Howard, Don. 2022. "In Defense of (Virtuous) Autonomous Weapons." *Notre Dame Journal on Emerging Technologies.* 3 (2): 230 –260.

23. Imperial War Museums. "How Gas Became A Terror Weapon In The First World War." Retrieved March 5, 2021. https://www.iwm.org.uk/history/how-gas-became-a-terror-weapon-in-the-first-world-war.

24. Kaiser, Jocelyn M. 2020. "Genetic Modification Could Protect Soldiers from Chemical Weapons." *Science | AAAS*. https://www.sciencemag.org/news/2020/01/genetic-modification-could-protect-soldiers-chemical-weapons.

25. Kamienski, Lukasz. 2016. "The Drugs That Built a Super Soldier." *The Atlantic*. https://www.theatlantic.com/health/archive/2016/04/the-drugs-that-built-a-super-soldier/477183/.

26. Koenig, Christopher. J., Maguen, Shira, Monroy Jose D., Mayott, Lindsay and Seal, Karen H. 2014. "Facilitating Culture-centered Communication between Health Care Providers and Veterans Transitioning from Military Deployment to Civilian Life." *Patient Education and Counseling* 95 (3): 414–420. https://doi.org/10.1016/j.pec.2014.03.016.

27. Koplin, Julian J. and Savulescu, Julian. 2019. "Time to Rethink the Law on Part-Human Chimeras." *Journal of Law and the Biosciences* 6 (1): 37–50. https://doi.org/10.1093/jlb/lsz005.

28. Kwisda, Koko, White, Lucie, and Hübner, Dietmar. 2020. "Ethical Arguments Concerning Human-Animal Chimera Research: A Systematic Review." *BMC Medical Ethics* 21 (1): 24. https://doi.org/10.1186/s12910-020-00465-7.

29. Levy, Jack. S. 1984. "The Offensive/Defensive Balance of Military Technology: A Theoretical and Historical Analysis." *International Studies Quarterly* 28 (2): 219–238. https://doi.org/10.2307/2600696.

30. Maxwell, Megan D., et al. 2020. "Educating Military Primary Health-Care Providers in Genomic Medicine: Lessons Learned from the MilSeq Project." *Genetics in Medicine* 22. https://doi.org/10.1038/s41436-020-0865-7.

31. McGuire, Amy. L. and Burke, Wylie. 2008. "An Unwelcome Side Effect of Direct-to-Consumer Personal Genome Testing: Raiding the Medical Commons." *JAMA* 300 (22): 2669–2671. https://doi.org/10.1001/jama.2008.803.

32. McGuire, Amy. L. et al. 2020. "The Road Ahead in Genetics and Genomics." *Nature Reviews Genetics* 21 (10): 581–596. https://doi.org/10.1038/s41576-020-0272-6.

33. McIntyre, Alison. 2019. "Doctrine of Double Effect." *The Stanford Encyclopedia of Philosophy*. https://plato.stanford.edu/archives/spr2019/entries/double-effect/.

34. Mehlman, Maxwell and Lin, Patrick and Abney, Keith. 2013. “Enhanced Warfighters: Risk, Ethics, and Policy.” *Case Legal Studies Research Paper* No. 2013. https://doi.org/10.2139/ssrn.2202982.

35. Mehlman, Maxwell. J. and Yeheng, Tracy L. 2014. "Ethical, Legal, Social, and Policy Issues in the Use of Genomic Technology by the U.S. Military." *Journal of Law and the Biosciences* 1 (3): 244–280. https://doi.org/10.1093/jlb/lsu021.

36. Moreno, Jonathan D. 2012. *Mind Wars: Brain Science and the Military in the Twenty-First Century*. Bellevue Literary Press.

37. Moreno, Jonathan. D. 2013. "Mind Wars." *Monash Bioethics Review* 31 (2): 83–99. https://doi.org/10.1007/BF03351549.

38. Mulvihill, John. J., Capps, Benjamin, Joly, Yann, Lysaght, Tamra, Zwart Hud A. E., and Chadwick. 2017. "Ethical Issues of CRISPR Technology and Gene Editing Through the Lens of Solidarity." *British Medical Bulletin* 122 (1): 17–29. https://doi.org/10.1093/bmb/ldx002.

39. Noor, Poppy. 2020. "Over-the-Counter Painkiller Could Alleviate Emotional Pain – But Should You Use It?" *The Guardian*. https://www.theguardian.com/lifeandstyle/2020/feb/18/painkiller-emotional-pain-acetaminophen-paracetamol.

40. National Institutes of Health (NIH). 2019. "Gene Editing – Digital Media Kit." https://www.nih.gov/news-events/gene-editing-digital-press-kit.

41. National Army Museum. "Battle of Loos." Retrieved March 5, 2021. https://www.nam.ac.uk/explore/battle-loos.

42. President’s Council on Bioethics. 2003. *Beyond Therapy: Biotechnology and the Pursuit of Happiness*. Washington, DC: Government Printing Office.

43. Rabin, Roni. C. 2022. "Patient in Groundbreaking Heart Transplant Dies." *The New York Times*, March 9. https://www.nytimes.com/2022/03/09/health/heart-transplant-pig-bennett.html.

44. Rabin, Roni. C. 2021. "In a First, Surgeons Attached a Pig Kidney to a Human, and It Worked." *The New York Times,* October 20. https://www.nytimes.com/2021/10/19/health/kidney-transplant-pig-human.html.

45. Raposo, Vera. L. 2019. "Gene Editing, the Mystic Threat to Human Dignity." *Journal of Bioethical Inquiry* 16 (2): 249–257. https://doi.org/10.1007/s11673-019-09906-4.

46. Ross, and Philip Stratton-Lake. 2002. *The Right and the Good*. Clarendon Press; Oxford University Press.

47. Sierra-Mercado, Demetrio, et al. 2019. "Device Removal Following Brain Implant Research." *Neuron* 103 (5): 759–761. https://doi.org/10.1016/j.neuron.2019.08.024.

48. Shah, Morial. 2019. "Genetic Warfare: Super Humans And The Law." *North Carolina Central University Science & Intellectual Property Law Review* 12 (1). https://archives.law.nccu.edu/siplr/vol12/iss1/2.

49. Su, Yeyang, Howard Heidi C. and Borry, Pascal. 2011. "Users' Motivations to Purchase Direct-to-Consumer Genome-wide Testing: An Exploratory Study of Personal Stories." *Journal of Community Genetics* 2 (3): 135–146. https://doi.org/10.1007/s12687-011-0048-y.

50. United Nations. 1925. "Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare." June 17. https://www.refworld.org/docid/4a54bc07d.html.

51. Warrick, Joby. 2021. "The Syrians Executed the Most Deadly Chemical Weapons Attack in Generations—With U.N. Inspectors There." *Newsweek*,

February 27. https://www.newsweek.com/2021/03/12/syrians-executed-most-deadly-chemical-weapons-attack-generations-un-inspectors-there-1572442.html.

52. Wallach, Wendell. 2015. *A Dangerous Master: How to Keep Technology from Slipping Beyond Our Control*. Basic Books.

53. Wilfond, Benjamin and Friedman Ross, Lainie. 2009. "From Genetics to Genomics: Ethics, Policy, and Parental Decision-making." *Journal of Pediatric Psychology* 34 (6): 639–647. https://doi.org/10.1093/jpepsy/jsn075.

54. Walzer, Michael. 2006. *Just and Unjust Wars*, 4th ed. New York: Basic Books.