Neuroethics Meets Just War Theory: Ethical Issues and the Development of the Third Offset Strategy

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"It's incredibly obvious, isn't it? A foreign substance is introduced into our precious bodily fluids without the knowledge of the individual, and certainly without any choice. That's the way your hard-core Commie works."
- Brigadier General Jack D. Ripper (from *Dr. Strangelove*)

Introduction

In 2008, 2009, and 2014 the National Research Council published a series of reports commissioned by the Defense Intelligence Agency (2008), the U.S. Army (2009) and the Defense Advanced Research Projects Agency or "DARPA" (2014). These reports detailed and analyzed new and emerging technologies, many of which focused on cognitive neuroscience and its possible application in the service of national defense measures. This paper will summarize each of the reports and then show that many of the technologies detailed therein have found their way into the recently announced Third Offset Strategy and have also found funding in support of President Obama's 2013 BRAIN (Brain Research through Advancing Innovative Neurotechnology) Initiative. Relevant issues in bioethics/neuroethics as well as Just War ethics will be noted along the way.

On November 15th 2014, then Secretary of Defense Chuck Hagel officially announced the Third Offset Strategy in a speech delivered from the Ronald Reagan Presidential Library in Simi Valley, California.[1] The Third Offset Strategy is an attempt to allow U.S. warfighters to recapture technological superiority over peer and near peer nations and reinsure U.S. battlefield dominance for the next generation of conflicts. Like all technology dependent enterprises, national defense is in continual need of modernization in order to maintain its edge and effectiveness against competitors. The price tag for the strategy is 18 billion dollars over 5 years, starting in 2017.[2] Technologies

that the strategy will focus on developing include those in the fields of robotics, autonomous systems, miniaturization, big data, and advanced manufacturing.[3]

What is now called the First Offset Strategy resulted from the response of the Eisenhower administration to the Warsaw Pact of 1955. The main effort of this strategy was nuclear deterrence and proliferation; the Cold War was the result. The Second Offset Strategy came in the post-Vietnam years and focused on developing technologies aimed at improving capabilities in intelligence, surveillance and reconnaissance platforms, precision guided weapons and stealth technology, as well as space based military communications and navigation.[4] Technologies resulting from this strategy include the Airborne Warning and Control System (AEW&C), the F-117 Stealth Fighter and related stealth technologies, modern precision guided missiles and bombs, the Global Positioning System (GPS), among others. Learning from past conflicts and anticipating future conflicts, the Third Offset Strategy seeks to propel U.S. war fighting capabilities beyond that of peer countries who now have access to the same technologies developed in the previous two strategic efforts.

The Reports of the National Research Council

The National Academy of Sciences was established by congressional charter and received presidential approval from Abraham Lincoln in 1863.[5] The National Research Council was established under the same charter in 1916.[6] The mission of the National Academy of Sciences and the National Research Council is to serve the U.S. Government as an advising body on matters of science and technology. Government agencies may submit an appropriate inquiry to the National Research Council and, upon researching the

issue the council, submits a written report which is then published through the Academy's own press.

The National Academy of Sciences is made up of largely volunteer scientists, researchers and academics who work pro-bono as a form of national service and the Academy receives most of its funding to do its work through the Federal Government.[7] The three reports considered in this paper all came about through a request by a government agency to the National Research Council to offer analysis and advice on the militarization of emerging technologies.

One can see the government's interests in the militarization of neuroscience and related cognitive technologies through examining a series of reports from the National Research Council (NRC). Many of the technologies detailed in those reports have made their way into DARPA's current research programming and have found funding as supportive of the BRAIN Initiative.[8] What follows is a review of each of the relevant reports from the NRC.

In 2008, the NRC published "Emerging Cognitive Neuroscience and Related Technologies."[9] This report stemmed from a task given by the Defense Intelligence Agency to the NRC to "identify areas of cognitive neuroscience and related technologies that will develop over the next two decades and that could have military applications that might also be of interest to the IC."[1011] The report explores such technologies as cognitive enhancement, brain-machine interface, "mind reading" technologies for the purpose of gathering human intelligence, nanotechnologies dedicated to precision delivery of drugs, brain modeling, and genetic screening to reveal specific attributes in individuals. Many similar technologies have found their way into current DARPA research programs.

A key admission found early in the report is "…the study of ethical issues related to the design and deployment of distributed human-machine systems is virtually in its infancy and this is deplorable given the great potential of such systems for doing good or harm."[12] This is an important issue as brain-machine interface technology comes to the forefront of defense technology. The report advises that a crucial component of any technology and its related research is that it fall under the "Common Rule" – that is, the set of regulations and protections governing human subjects research in the U.S.[13] Additionally, the authors consider the unresolved dilemma of whether or not "…classified research can ever be ethically sound inasmuch as it lacks transparency, such as in the form of public accountability."[14] Certainly an interesting question to mull over as we consider the use of cognitive neuroscience in the service of nation intelligence and defense measures.

The NRC published "Opportunities in Neuroscience for Future Army Applications" in 2009. The origins of this report stemmed from a request from the Assistant Secretary of the Army (Acquisition, Logistics, and Technology) to "…conduct a study of neuroscience in terms of its potential to support military applications."[15] In the section entitled "Improving Cognitive and Behavioral Performance" the report notes two promising technologies (both were then-current DARPA programs) that improve cognitive abilities of operators. The first was the Neuroscience for Intelligence Analysts system that used electroencephalography (EEG) to "…detect a brain signal corresponding to perceptual recognition (which can occur below the level of conscious attention) of a feature of interest in remote (airborne or space-based) imagery.[16] So, an intelligence analyst equipped with an EEG could have her attention brought to the relevant images

while scanning a reconnaissance photograph, or other object of analysis. The second DARPA technology referenced is similar in nature: the Cognitive Technology Threat Warning System, which used a signal processing system in conjunction with a helmet mounted EEG. The object was to help combatants better identify battlefield threats and then direct the operators' attention to those threats. Such load-shedding technologies can improve a user's level of cognition and attention beyond normal levels.

The report, *Opportunities in Neuroscience for Future Army Applications,* demonstrates the Army's interest in neuroscience and its possible application for a variety of training and battlefield purposes. Although only some of the technologies mentioned in the report have some relevance or relation to later technologies proposed by the Third Offset Strategy, this report, along with the 2008 report for the Defense Intelligence Agency, show that those engaged in national defense are increasingly curious and interested in how the latest brain science might be put to use in military and intelligence operations and training. The 2009 report was not to be the last time the national defense industry approached the NRC for analysis and recommendations on neuroscience and related fields.

In 2010 (just one year after the publication of the 2009 report) DARPA approached the National Academies to

> …develop and articulate a framework for policy makers, institutions, and individual researchers that would help them think through ethical, legal, and societal issues (ELSI) as they relate to research and development on emerging and readily available technologies with military relevance.[17]

The result of this request was *Emerging and Readily Available Technologies and National Security: A Framework for Addressing Ethical, Legal, and Societal Issues.* Unlike the previous two reports for the DIA and U.S. Army respectively, this report had

ethical and legal ramifications of emerging technologies as a central question to the inquiry. This latest report was published in April of 2014, a full 6 months before the announcement of the Third Offset Strategy by Secretary Hagel in November of that year. Perhaps the previous reports were encouraging enough of the possibilities of the science and technology detailed therein and now the task was to find a way to justify the research and military use of such technology to lawmakers and the public at large. The express purpose of the 2014 report is to provide such a framework to address questions of ethics, legality, and societal issues in the face of the militarization of emerging technologies. The technology and applications analyzed in this report closely mirror the technologies listed as part of the Third Offset Strategy: robotics, autonomous systems, miniaturization, big data, and advanced manufacturing. Again, it is possible to see this report as a precursor to, and perhaps justification of, the Third Offset Strategy, or at least as a fortunate convergence of the military's interests in certain emerging technologies.

Like the previous two reports, this report also considers the possibilities for advances in neuroscience to deliver in the areas of cognitive enhancement to combat the effects of sleep deprivation or to enhance attention and working memory,[18] brain-computer interfaces for utilization of communication implants or implants designed to allow a human operator to remotely control a vehicle or other system,[19] and uses in deception operations and interrogation such as brain imaging devices to detect lies in a subject or the use of oxytocin to encourage trust in a human asset.[20] Such uses were analyzed in previous reports and the authors here continue to champion the possibilities of military applications of neurotechnology.

The report considers the following ethical issues in light of the military application of neuroscience: informed and voluntary consent, privacy, safety, responsibility and loss of control, and the impact of classification.[21] Can we order Soldiers to receive "enhancements"? Do certain neurotechnologies have the ability for a third party to override the will of another? How well do we understand the risk to the patient/volunteer when it comes to brain-machine interfaces? Are neurally manipulated soldiers accountable for their actions? Many of these technologies are certainly new ground that provides a host of ethical quandaries that would need exploration before they are field-tested.

In the section "Prosthetics and Human Enhancement" the report notes, "To date, prosthetic devices are under development only for the replacement of lost human function (e.g. a prosthetic limb)".[22] However, despite the current therapeutic trend for such devices, there is always the question of if/how such technology might be used to create a stronger, faster, more resilient, more lethal soldier or find a use in developing a more lethal combat exoskeleton. Does the costs/benefit analysis support the militarization of this technology? How do we add this functionality to a soldier and then take it away when she/he retires from military duty – can we enhance a soldier for a mission and then "normalize" them upon completion of the mission? If we make a super soldier, how that that enhancement affect other parts of their lives (being a mother, father, wife, or husband for instance)? A war-fighting enhancement may be a determent to other aspects of the soldier's life.

It seems that since this report was so closely followed by the announcement of the Third Offset Strategy that this report serves as something of a precursor to and moral

justification of the Third Offset Strategy and the technologies it seeks to fund and develop. This 2014 report builds on many of the same findings and issues that are addressed in the earlier reports, and many technologies that seem to be part of the Third Offset Strategy and that are in development by DARPA are found within the pages of these reports. I now turn to those technologies that are currently being investigated or are in some stage of development.

Biotechnology and the Third Offset Strategy

Specific technologies that are explicitly part of the Third Offset Strategy are difficult to identify due to the vague pronouncements of those who have discussed the strategy in public. In announcing the strategy, Secretary Hagel mentioned the five main technological fields that would define the strategy: robotics, autonomous systems, miniaturization, big data, and advanced manufacturing.[23] Looking back to the summaries presented of the three reports by the National Research Council – these five fields seem familiar.

This section will focus on technologies that have been mentioned in the press as having to do with the Third Offset Strategy that also have some integral human component. Specifically, I will discuss two types of militarized biotechnologies: centaurs (human machine teaming) and implants that purportedly offer some enhancement. Additionally, this section will conclude with a look at technologies currently in research and development by DARPA in support of the BRAIN Initiative.

Human-machine teaming, or "centaurs," is where each component, the machine and human, are joined at the hip, each bringing their unique advantages. Military futurist Paul Scharre has said that the idea is to combine "…machine precision and reliability,

human robustness and flexibility."[24] This idea of human-machine teaming is not limited to the usual example of militarized exoskeletons, but also includes the idea of "cognitive teaming", that is, human-machine co-thinking and co-decision making to produce a better result. According to former Deputy Secretary of Defense Robert "Bob" Work, "Human-machine collaboration is allowing a machine to help humans make better decisions faster."[25]

One example of this type of cognitive teaming technology is that of the F-35 Joint Strike Fighter. Rather than simply being a traditional fighter jet, Work describes the F-35 as "…a flying sensor/computer that sucks in an enormous amount of data, correlates it, analyzes it, and displays to the pilot on his helmet...We are absolutely confident that F-35 will be a war-winner. That is because it is using the machine to make the human make better decisions."[26] The pilot is the human component and decision maker, but (s)he is making those decisions based on the correlated information presented by the machine component of the onboard systems. Both are vital components, not only the high tech sensors and computers, but also a pilot trained and familiar with the technology who can utilize it in effective and creative ways to fulfill a given mission.

When coming to this sort of human-machine teaming or cognitive teaming, Work, borrowing an example from the comics, wants us to think about it more in terms of Ironman rather than comparing it to the Terminator. Rather than independent militarized, lethal, autonomous systems, Work wants more of a system like JARVIS (the AI system that is built into Tony Stark's Ironman suit). Work envisions, "a machine to assist a human where the human is still in control in all matters, but the machine makes the human much more powerful and much more capable."[27] The teaming of the human and

the machine is what makes the craft work properly. This is what the Pentagon seems to hope for in future military systems.

One example of human-machine teaming is the "Grey Eagle—Apache Run" where human pilots of the Apache attack helicopter control Grey Eagle drones from the cockpit.[28] Another is militarized exoskeletons that promise to "…provide superior protection from enemy fire and in-helmet technologies that boost the user's communications ability and vision."[29] The baseline idea remains consistent – human-machine teaming can provide human operators with the ability to make faster, better battlefield decisions when they are presented with relevant information and/or capabilities stemming from an advanced technological system.

The notion that high tech implants can enhance human capabilities has been a possibility that has been considered by the National Research Council as well as others. One hoped for technology is the implantation of a device that allows the brain to plug directly into a computer system, allowing for a socket or some other communication system to pass and process information both ways.[30] In addition to communications and information processing, militarized implants could allow Soldiers to more effectively control a combat exoskeleton or improve human sight or hearing capabilities.[31] Battlefield medicine is another area where implant technology could prompt a breakthrough. DARPA is researching implants that can speed up the body's natural healing and recovery response to injury.[32]

Many current DARPA technologies center on implant-based technology. The following technologies are just a few examples that DARPA highlights on their DARPA and the BRAIN Initiative webpage.[33] Electrical Prescriptions (ElectRx) would allow for

ultraminiaturized devices to modulate organ functions in an effort to promote bodily healing. Hand Proprioception and Touch Interface (HAPTIX) is an implantable device that would deliver natural feeling touch sensations to prosthetic wearing amputees. Neural Engineering Systems Design (NESD) is an implantable technology that would allow signal resolution and data transfer between the human brain and the digital world. Reliable Neural-Interface Technology (RE-NET) is an implant that proposes to extract information from the nervous system that would be needed for a human operator to effectively control an exoskeleton or interface with other complex technologies. Restoring Active Memory (RAM) is a program seeking to develop an implantable neural interface device to help restore the memory functions of brain-wounded individuals. Finally, the Systems Based-Neurotechnology for Emerging Therapies (SUBNETS) is a research program seeking to create implantable devices to combat neuropsychological illnesses. Implantable devices to heal and interface with the digital world seem to be a DARPA explicit focus when it comes to the BRAIN Initiative and neurotechnology.

With implants and the possibility of enhancing a Soldier's abilities beyond normal human levels, or adding an ability to directly connect the brain to a computer, militarized technology takes a transhuman turn. Such technologies will force us to rethink what it means to be human. Certainly implants are already in use, usually to correct some physical defect: cochlear implants, pace makers, etc. But what do we make of explicitly militarized neurotechnologies? Such questions lead to the final section of neuroethics and the Third Offset Strategy.

Ethical Issues

In 2003, *Nature* published a short editorial piece titled "The Silence of the Neuroengineers."[34] In the piece the authors note the great advances that have been made in brain-machine interfaces and pose an ethical concern with the fact that much of the neuroscience behind that technology was (and still is) funded by DARPA – an organization with explicitly militarized goals. Rather than demonizing DARPA or the need for innovative research in national defense measures, the authors simply wished for a more robust engagement on the possible consequences of neuroscience and engineering for the military. Certainly, considering ethical issues a risk/benefit analysis should be a part of any kind of research, especially research involving humans and research in support of national defense. The following section will highlight a few ethical questions and concerns regarding the previously mentioned technology supporting the Third Offset Strategy.

In his book *Mind Wars: Brain Science and the Military in the 21st Century*, Jonathan Moreno questions if it is even possible to do science properly under the classified system of military secrecy: "Yet science and secrecy are almost antithetical concepts. For science to advance effectively there must be wide dissemination of results."[35] In order for science to be properly understood as science, the results must be made available for scrutiny, replication, and made part of the wider dialogue of scientific research and advancement. Research done secretly, under classification, may not meet the standards set by the rest of society for what constitutes science. Although, as Moreno points out, the DoD and CIA are subject to the framework of the Common Rule for research requiring human subjects,[36] it remains problematic that those agencies could conduct human subjects research under an umbrella of secrecy. However, adherence to

the Common Rule and the presence Institutional Review Boards (IRBs) reviewing research with an eye towards the protection of human subjects is encouraging.

The authoritarian culture of the military provides additional concerns when it comes to getting volunteers for such research. The principles of autonomy and informed consent are cornerstones of modern bioethics, but how do those principles play out in a culture where subordinates are expected to follow orders, usually without question, and execute the given mission? What protections are put into practice when it comes to getting volunteers for a militarized "enhancement" or brain-machine interface technology?

Harvard psychology professor Steven Pinker told CNN in an interview, "We have little to no idea how exactly the brain codes complex information" and cited the problems from foreign objects triggering brain inflammation that can cause serious neurological issues.[37] So, questions on what possible unintended consequences could occur when placing an implant or performing certain brain-machine interfaces still remain. Again it is worth asking what protections are in place for volunteers for these types of research programs.

Writing of the "dual use" dilemma, where one is forced to confront the fact that a therapeutic technology could also have a second use that may be more nefarious than intended by the designers, author and journalist Annie Jacobsen questions the impulse behind the previously mentioned DARPA technologies supporting the BRAIN Initiative. Many of those technologies have, according to DARPA's write up on their webpage, therapeutic interests: restoring memory to the brain-wounded, restoring touch sensation to amputees through innovative prosthetics, etc. However, as Jacobsen notes,

"…DARPA's stated goal is advancing weapons technology, not curing …illness. What is DARPA's primary goal in researching the brain?"[38] Certainly DARPA is not the VA, they are not in the business of helping veterans to heal, so questions of dual use and what are DARPA's primary motives are worth asking. Can prosthetics used to impart a sensation of touch be used to build a better killer robot or combat exoskeleton? Can implants designed to improve the cognitive functions of the brain wounded also be used to improve a healthy brain, resulting in a smarter soldier? Can an implant used to remove a fear or guilt response to prevent PTSD also cause a soldier to lose moral sensibility in war and possibly lead to an atrocity? What happens when a soldier's tour of duty is over – do we remove the enhancement? At what cost or side effect to the soldier? Does DARPA, a government agency with a mission to improve America's war fighting abilities, have an ethical obligation to be upfront about their interests in specific technologies, or does some research need to remain classified in order to better protect Americans by keeping our enemies from tapping into our national defense measures? Tough questions, but worth tackling by voters, legislative bodies and policy advisors.

One aspect of Just War Theory is "jus in bello" – that is, concerning what is right conduct in war. It seems that jus in bello concerns might be applicable to brain research in the service of national defense. How far can and should we go in tampering with evolution, personal identity, and "improving" humans in an effort to attaining battlefield superiority? If we don't have such capabilities, will our enemies develop them first to our expense and regret? Do we compromise our values in terms of bioethics and human subjects protection in order to preserve our values of a secure, superior nation? Such

questions are worth considering as funding is poured into DARPA and the Third Offset Strategy.

Conclusion

As a soldier and citizen, I firmly believe that our nation should make robust efforts to attain a strong military, able to defeat any enemy on any field of battle. To that extent, I am excited by the prospect of the Third Offset Strategy and the technologies it seeks to develop and field. However, as a chaplain, one charged with being the commander's primary advisor on matters of morals and ethics, I do share many of the ethical concerns addressed above: how will these technologies affect the troopers outfitted with them? What would such "enhancements" mean to them as husbands and wives, mothers and fathers, etc.? What will such "enhancements" mean once the soldier is no longer a soldier and has exited military service? Can they safely be removed? At what cost? Is military science taking a transhuman turn, and if so, do we properly understand the consequences for altering or seeking to improve upon evolutionary human systems?

DARPA seems to be aware of such concerns, which is apparently why they commissioned the 2014 report in the first place – to address emerging technologies in light of ethical, legal and societal implications. Hopefully the neuroengineers are no longer silent and do have a moral stake in the technologies they develop. The sometimes-competing values of a strong secure nation and robust human protection in military research will likely remain in tension for the foreseeable future. What is needed then, is a continued dialogue on how to best navigate those tensions and keep our security and our values in place.

Endnotes

[1] Chuck Hagel. "Defense Innovation Days" Opening Keynote Address (3 September 2014). http://www.defense.gov/News/Speeches/Speech-View/Article/605602 (Accessed June 2016)
[2] Mackenzie Eaglen. "What is the Third Offset Strategy?" *Real Clear Defense*. (February 16 2016). http://www.realcleardefense.com/articles/2016/02/16/what_is_the_third_offset_strategy_109034.html (Accessed June 2016).
[3] Hagel. "Defense Innovation Days"
[4] Tomes, Robert. "The Cold War Offset Strategy: Assault Breaker and the Beginning of RSTA Revolution." *War on the Rocks,* (20 November 2016). https://warontherocks.com/2014/11/the-cold-war-offset-strategy-assault-breaker-and-the-beginning-of-the-rsta-revolution/ (Accessed 27 March, 2017).
[5] National Academies of Science, Engineering, and Medicine. FAQ http://www.nationalacademies.org/about/faq/index.html (Accessed June 2016)
[6] National Academies. FAQ.
[7] National Academies. FAQ.
[8] Defense Advanced Research Projects Agency. "DARPA and the Brain Initiative." http://www.darpa.mil/program/our-research/darpa-and-the-brain-initiative (Accessed June 2016).
[9] National Research Council. *Emerging Cognitive Neuroscience and Related Technologies.* (Washington D.C.: The National Academies Press, 2008).
[10] National Research Council, *Emerging Cognitive Neuroscience and Related Technologies*, 1.
[11] "IC" = Intelligence Community.
[12] National Research Council, *Emerging Cognitive Neuroscience and Related Technologies*, 8.
[13] National Research Council, *Emerging Cognitive Neuroscience and Related Technologies*, 114.
[14] National Research Council, *Emerging Cognitive Neuroscience and Related Technologies*, 118.
[15] National Research Council. *Opportunities in Neuroscience for Future Army Applications.* (Washington D.C.: National Academies Press, 2009), 1.
[16] National Research Council. *Opportunities in Neuroscience for Future Army Applications*, 68.
[17] National Research Council. *Emerging and Readily Available Technologies and National Security: A Framework for Addressing Ethical, Legal, and Societal Issues.* (Washington D.C.: National Academies Press, 2014), ix.
[18] National Research Council. *Emerging and Readily Available Technologies and National Security*, 69.
[19] National Research Council. *Emerging and Readily Available Technologies and National Security*, 70.
[20] National Research Council. *Emerging and Readily Available Technologies and National Security*, 71.
[21] National Research Council. *Emerging and Readily Available Technologies and National Security*, 70.
[22] National Research Council. *Emerging and Readily Available Technologies and National Security*, 93.
[23] Hagel. "Defense Innovation Days"
[24] Sydney J Freedburg, "Centaur Army: Bob Work, Robotics, and the Third Offset Strategy." *Breaking Defense*, (9 November 2015). http://breakingdefense.com/2015/11/centaur-army-bob-work-robotics-the-third-offset-strategy/ (Accessed June 2016).
[25] Freedburg. "Centaur Army"
[26] Freedburg. "Centaur Army"
[27] Sydney Freedberg, "Ironman, not the Terminator: The Pentagon's Sci-Fi Inspirations" *Breaking Defense*. (3 May 2016). http://breakingdefense.com/2016/05/iron-man-not-terminator-the-pentagons-sci-fi-inspirations/ (Accessed June 2016)
[28] Richard Whittle. "Grey Eagle—Apache Run Shows Tech's Not Enough; Ya Gotta Have Doctrine." *Breaking Defense.* (7 May 2015). http://breakingdefense.com/2015/05/grey-eagle-apache-run-shows-techs-not-enough-to-use-drones-ya-gotta-have-doctrine/ (Accessed June 2016)
[29] Ryan Browne. "U.S. Military Spending Millions to Make Cyborgs a Reality." CNN. (7 March 2016). http://www.cnn.com/2016/03/07/politics/pentagon-developing-brain-implants-cyborgs/index.html (Accessed June 2016).

[30] Greg Stevens, "The Military Paves the Way for Super-Humanitarian Cyborgs." *Second Nexus*. (29 March 2016). http://secondnexus.com/technology-and-innovation/military-humanitarian-cyborgs/ (Accessed June 2016).
[31] Browne. "U.S. Military Spending Millions to Make Cyborgs a Reality."
[32] Mia De Graaf. "Micro-chipped Super Soldiers Are Already a Reality" *Daily Mail*. (28 September 2015). http://www.dailymail.co.uk/news/article-3252239/Micro-chipped-super-soldiers-reality-book-claims-Implants-combat-PTSD-make-military-resilient-warfare-rolled-couple-years.html (Accessed June 2016).
[33] Defense Advanced Research Projects Agency. "DARPA and the Brain Initiative."
[34] "The Silence of Neuroengineers" *Nature.* Vol 423, No 6942. (19 June 2003).
[35] Jonathan Moreno. *Mind Wars: Brain Science and the Military in the 21st Century.* (New York: Bellevue Literary Press, 2012), 39.
[36] Moreno, *Mind Wars: Brain Science and the Military in the 21st Century,* 196.
[37] Browne, "U.S. Military Spending Millions to Make Cyborgs a Reality."
[38] Annie Jacobsen. *The Pentagon's Brain: An Uncensored History of DARPA, America's Top Secret Military Research Agency.* (New York: Little, Brown and Company, 2015) 424.