

## Brave New World: Neurowarfare and the Limits of International Humanitarian Law

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# Brave New World: Neurowarfare and the Limits of International Humanitarian Law

Stephen E. White†

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## Introduction

For the past several years, the Defense Advanced Research Projects Agency (DARPA), the military research and development agency tasked with maintaining U.S. military technological superiority, has engaged in research on direct neurological control of weapon systems.<sup>1</sup> Although international law does not create a *per se* prohibition on the use of these weapons, the potential misuse of such weapons radically challenges traditional notions of criminal responsibility by effacing the distinction between thought and act.<sup>2</sup> This Note suggests that the development of such weapons requires a more expansive doctrine of command responsibility in order not to vitiate established legal principles regarding criminal accountability for war crimes.

Part I of this Note examines DARPA's Human Assisted Neural Devices (formerly Brain-Machine Interfaces) Program. It explores why DARPA regards these devices as a critical technology, how far DARPA has developed the program, and where DARPA will deploy the initial uses of this technology, such as for the control of prosthetics of wounded soldiers and

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1. See NICHOLAS D. EVANS, *MILITARY GADGETS: HOW ADVANCED TECHNOLOGY IS TRANSFORMING TODAY'S BATTLEFIELD . . . AND TOMORROW'S* 207-09 (2004).

2. See *infra* Part II.

the guidance of unmanned aerial vehicles (UAVs). In addition, Part I briefly surveys academic research in the field to determine how far the project has advanced. The classified nature of much of DARPA's research precludes alternative approaches.

Part II considers the use of neurological weapons in the context of international law. First, it investigates the current law on prohibited weapons and describes recent efforts to enlarge the scope of banned weapons. Part II then accounts for the historical difficulties in implementing prohibitions against the use of advanced technologies in war. Indeed, great disparities exist between the law of warfare, which pronounces that the means of injuring enemies is not unlimited, and its implementation. Based on this examination of the current law of warfare, this section concludes that weapons employing brain-machine interfaces most likely do not violate international humanitarian law (IHL).<sup>3</sup>

Nevertheless, weapons employing brain-machine interfaces likely will raise novel issues in the jurisprudence of war crimes. Part III examines these issues. First, Part III delineates the elements that prosecutors must establish in order to prove a war crime under international law. Second, it examines the difficulty in establishing a criterion for determining whether a soldier operating a brain-machine weapon possesses the requisite element of willfulness so as to justify holding him or her criminally responsible for the deaths of non-combatants. Specifically, this section applies the analysis that the International Committee of the Red Cross offered to the drafters of the Rome Statute for determining what a prosecutor must prove to establish the mental element of a war crime.<sup>4</sup> Brain-machine interface weapons significantly complicate conventional approaches to the *actus reus* and *mens rea* requirements of criminal accountability. With regard to the *actus reus* element, Part III provides a brief overview of the state of cognitive neuroscience, particularly the experiments of Benjamin Libet, and suggests that the brain activity triggering the guidance of brain-machine weapons likely occurs before the will to move.<sup>5</sup> Next, it illustrates how the use of brain-machine interfaces will require answers to two unsettled issues regarding the act requirement: what is an act and is the act the object of criminal law or merely a necessary precondition for criminal liability to attach to a putative actor?<sup>6</sup> The use of such weapons, Part III argues, may force a re-examination of the rationale for the act requirement, a prerequi-

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3. See Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts art. 35.2, June 8, 1977, 1125 U.N.T.S. 3 [hereinafter Additional Protocol I to the Geneva Conventions] ("It is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering."); see also A. Koplów, *Tangled Up in Khaki and Blue: Lethal and Non-Lethal Weapons in Recent Confrontations*, 36 GEO. J. INT'L L. 703, 745 (2005).

4. KNUT DÖRMANN, ELEMENTS OF WAR CRIMES UNDER THE ROME STATUTE OF THE INTERNATIONAL CRIMINAL COURT: SOURCES AND COMMENTARY 487-98 (2002).

5. BENJAMIN LIBET, MIND TIME: THE TEMPORAL FACTOR IN CONSCIOUSNESS 122-136 (2004).

6. Antony Duff, *Action, the Act Requirement and Criminal Liability*, in AGENCY AND ACTION 69, 72 (John Hyman & Helen Steward eds., 2004).

site justified as much for evidentiary as for fairness reasons.<sup>7</sup> Part III then explores the problematic aspects of the *mens rea* element in the context of alleged war crimes committed using brain-machine interfaces, noting some of the problems that prosecutors may encounter in establishing either intent or criminal recklessness in situations where weapons that such interfaces control respond before an actor possesses conscious intent. This section concludes that the issues raised are already lurking in criminal law due to new insights of cognitive neuroscience and postulates that the use of brain-machine interfaces may challenge foundational notions of free will that permeate criminal law.<sup>8</sup>

Part IV asserts that the use of brain-machine interfaces to control weapons militates for an increased role for command responsibility. After providing a brief history of this doctrine, Part IV discusses criminal liability of superiors both under both international law and U.S. military law.<sup>9</sup> As weapon systems become increasingly autonomous, a more expansive notion of command responsibility is necessary to preserve criminal liability for war crimes. This broader conception should ensure that criminal liability attaches to those who approve the use of such weapons when they create an unreasonable risk of causing war crimes. Failure to expand the doctrine of command responsibility would allow advances in technology to undermine deeply established legal principles of international criminal law.<sup>10</sup>

## I. DARPA's Brain-Machine Interfaces and Human Assisted Neural Assistance Programs

After the Soviet Union launched Sputnik, the first artificial satellite, on October 4, 1957, President Eisenhower approved the organization of the Advanced Research Projects Agency (ARPA) under the aegis of the Department of Defense.<sup>11</sup> ARPA, subsequently renamed the Defense Advanced Research Projects Agency (DARPA),<sup>12</sup> originally served as an interim space program until the National Aeronautics and Space Administration (NASA) took over civilian space development.<sup>13</sup> Since its inception, DARPA has served two principal functions: first, it performs advanced research to prevent developments in military technology from jeopardizing U.S. military

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7. See WAYNE R. LAFAVE, *CRIMINAL LAW* 303-04 (4th ed. 2003).

8. Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, in *LAW AND THE BRAIN* 207, 222-25 (Semir Zeki & Oliver R. Goodenough eds., 2006).

9. DEP'T OF THE ARMY, *FIELD MANUAL 27-10: THE LAW OF LAND WARFARE* ¶¶ 501, 507(b) (1956).

10. Steve Featherstone, *The Coming Robot Army: Introducing America's Future Fighting Machines*, *HARPER'S MAG.*, Feb. 2007, at 43, 49.

11. ARTHUR L. NORBERG ET AL., *TRANSFORMING COMPUTER TECHNOLOGY: INFORMATION PROCESSING FOR THE PENTAGON: 1962-1986*, at 5 (1996).

12. ARPA/DARPA: The History of the Name, [http://www.darpa.mil/body/arpa\\_darpa.html](http://www.darpa.mil/body/arpa_darpa.html) (last visited Dec. 27, 2007).

13. ALEX ROLAND & PHILIP SHIMAN, *STRATEGIC COMPUTING: DARPA AND THE QUEST FOR MACHINE INTELLIGENCE, 1983-1993*, at 43 (2002).

predominance;<sup>14</sup> second, it accelerates the technological transfer of emergent technologies into military deployment.<sup>15</sup>

Throughout its history, DARPA has had an impressive track record in militarizing its “blue sky”<sup>16</sup> research. During the 1960s and 1970s, DARPA performed much of the initial research on the ballistic missile defense that the Army later developed. It also developed the stealth technologies employed in the F-117 Nighthawk tactical fighter and B-2 bomber.<sup>17</sup> DARPA’s most significant research contributions, however, were the establishment of ARPANET, a distributed packet-switched computer network designed to allow the Air Force to preserve control over its fleet of missiles and bombers in the event of a nuclear strike,<sup>18</sup> and the creation of ARPANET’s two dominant underlying protocols, known as Transmission Control Protocol and Internet Protocol (TCP/IP).<sup>19</sup> DARPA seeded this technology to the National Science Foundation, which created the NSFNET network.<sup>20</sup> DARPA’s Transmission Control and Internet protocols became the basis of the modern internet when the U.S. government decommissioned NSFNET and commercialized its network on April 30, 1995.<sup>21</sup>

One area of research that DARPA currently funds is the Human-Assisted Neural Devices Program, which evolved out of the Brain-Machine Interfaces program initiated in 2002.<sup>22</sup> Despite a general shift in the agency’s priorities in the aftermath of 9/11<sup>23</sup> and budgetary reductions in

14. DARPA Over the Years, <http://www.darpa.mil/body/overtheyears.html> (last visited Dec. 27, 2007).

15. EVANS, *supra* note 1, at 149.

16. Richard N. Flint, *Independent Research and Development Expenditures: A Study of the Government Contract as an Instrument of Public Policy*, 29 LAW & CONTEMP. PROBS. 619 (1964). “Basic or so-called ‘blue sky’ research is defined as the increasing of knowledge in science generally, but not any practical application thereof.” *Id.*

17. DEFENSE ADVANCED RESEARCH PROJECTS AGENCY, DARPA’S STRATEGIC PLAN 7 (2007), available at <http://www.darpa.mil/body/pdf/DARPA2007StrategicplanfinalMarch14.pdf>.

18. PAUL DICKSON, SPUTNIK: THE SHOCK OF THE CENTURY 243-44 (Walker & Co. 2007) (2001).

19. See JOHN DAVIDSON, AN INTRODUCTION TO TCP/IP 2-10 (2007).

20. SHARON K. BLACK, TELECOMMUNICATIONS LAW IN THE INTERNET AGE 4 (2002).

21. *Id.* at 5; see also Nat’l Sci. Found., Fact Sheet: A Brief History of NSF and the Internet (Aug. 13, 2003), [http://www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=103050](http://www.nsf.gov/news/news_summ.jsp?cntn_id=103050).

22. EVANS, *supra* note 1, at 207. The impetus for creating the Brain Machine Interface Program was DARPA’s creation of “Roborat,” a rat with direct neural connections to a wireless brain modem. The movements of the rat could be controlled by remotely stimulating the somatosensory cortical area via the modem so as to mimic sensations to the rat’s whiskers and then rewarding the pleasure center of the rat’s brain, the medial forebrain bundle, by shocking the rat’s brain when it obeyed the operator’s control. See ERIC EISENSTADT, BRAIN MACHINE INTERFACE 2 (2002), available at [http://www.darpa.gov/DARPAtech2002/presentations/dso\\_pdf/speeches/EISENSTADT.pdf](http://www.darpa.gov/DARPAtech2002/presentations/dso_pdf/speeches/EISENSTADT.pdf); see also Duncan Graham-Rowe, *Say Hello to the RoboRat*, NEW SCIENTIST, May 4, 2002, at 6, 6-7.

23. See John Markoff, *Pentagon Redirects its Research Dollars*, N.Y. TIMES, Apr. 2, 2005, at C2. DARPA admitted the change in its priorities in April 2005, noting, *inter alia*, its new direction in advanced weapon system research as opposed to “blue sky” research. *Id.*

the wake of negative newspaper reports on its activities,<sup>24</sup> DARPA has continued to develop this program and budgetary reductions in the wake of negative newspaper reports on its activities. DARPA has announced two goals for the Human Assisted Neural Devices Program (HANDP).<sup>25</sup> First, it seeks to create “novel concepts that will improve warfighter performance on the battlefield.”<sup>26</sup> Second, it attempts to improve prosthetic technology for severely injured veterans.<sup>27</sup>

DARPA has reached important milestones in both aspects of its Human Assisted Neural Devices Program. By 2000, technology developed at Duke University for HANDP had reached the state where a monkey with invasive brain sensors could guide a remote robotic arm linked 950 kilometers away via the Internet,<sup>28</sup> presaging the development of remotely piloted weapons.<sup>29</sup> On March 6, 2007, the U.S. Patent and Trademark Office granted a patent entitled “Apparatus for acquiring and transmitting neural

24. DARPA's funding of the Information Awareness Office (IAO), which John Poindexter, the former National Security Advisor convicted for his role in the 1986 Iran-Contra guns-for-hostages deal, ran, provoked outrage from civil libertarians after the *New York Times* reported its existence in 2002. See John Markoff, *Chief Takes over at Agency to Thwart Attacks on U.S.*, N.Y. TIMES, Feb. 13, 2002, at A27; see also William Safire, *You Are a Suspect*, N.Y. TIMES, Nov. 14, 2002, at A35. One of the most controversial projects under IAO was Futures Markets Applied to Prediction (FutureMap), which contained a component called “Policy Analysis Market,” a “terrorism futures market” that sought to increase the accuracy of military predictions by creating efficient capital markets in which participants, potentially including the actors themselves, could bet on the likelihood of events such as catastrophic terrorist attacks and political assassinations. See JAMES SUROWIECKI, *THE WISDOM OF CROWDS: WHY THE MANY ARE SMARTER THAN THE FEW AND HOW COLLECTIVE WISDOM SHAPES BUSINESS, ECONOMIES, SOCIETIES, AND NATIONS* 79-83 (2004) (arguing the potential effectiveness of such a system); see also DEFENSE ADVANCED RESEARCH PROJECTS AGENCY, REPORT TO CONGRESS REGARDING THE TERRORISM INFORMATION AWARENESS PROGRAM B-8-B-9 (2003), available at <http://www.eff.org/Privacy/TIA/TIA-report.pdf>. Ultimately, Congress ended funding in 2003 for the IAO, subsequently renamed the Terrorism Information Awareness Program, when it passed its defense appropriations bill. See Department of Defense Appropriations Act, Pub. L. No. 108-87, § 8131, 117 Stat. 1054, 1102 (2003). Although the Brain-Machine Interface program was not part of IAO, it also lost funding as part of the reevaluation of DARPA's mission. See Gareth Cook, *Defending DARPA: The Government's Strangest Research Might Be its Best*, BOSTON GLOBE, Aug. 3, 2003, at E1 (arguing for maintenance of funding on the Brain Machine Interface program by distinguishing it from FutureMap).

25. Human-Assisted Neural Devices, [http://www.darpa.mil/dso/thrusts/bio/restbio\\_tech/hand/index.htm](http://www.darpa.mil/dso/thrusts/bio/restbio_tech/hand/index.htm) (last visited Jan. 14, 2008).

26. DEP'T OF DEFENSE, RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT) 11 (2005), available at <http://www.dtic.mil/descriptivesum/Y2006/DARPA/0601101E.pdf>.

27. DEP'T OF DEFENSE, RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT) 8-9 (2007), available at <http://www.dtic.mil/descriptivesum/Y2008/DARPA/0601101E.pdf>.

28. Johann Wessberg et al., *Real-Time Prediction of Hand Trajectory by Ensembles of Cortical Neurons in Primates*, 408 NATURE 361, 361-65 (2000); see also Mikhail A. Lebedev et al., *Cortical Ensemble Adaptation to Represent Velocity of an Artificial Actuator Controlled by a Brain-Machine Interface*, 25 J. NEUROSCI. 4681, 4681-93 (2005); Elizabeth A. Thomson, *Monkey Controls Robot Arm Using Brain Signals Sent Over Internet*, MIT TECH TALK, Dec. 6, 2000, at 1.

29. Gregory T. Huang, *Mind Machine Merger: Devices that Connect the Brain with Computers Could Lead to Mind-Controlled Robots, Repair Neurological Disorders, and Even Improve Memory*, TECH. REV., May/June 2003, at 38, 39.

signals and related methods” jointly to Duke and DARPA.<sup>30</sup> The patent application discloses that uses for the technology “include but are not limited to weapons or weapon systems, robots or robot systems.”<sup>31</sup> Application of this technology to prosthetics has already progressed into human trials.<sup>32</sup> In 2006, a tetraplegic human with a rudimentary microelectrode cortical implant demonstrated the feasibility of this technology by manipulating a simulated computer, a television, and a robotic arm.<sup>33</sup> DARPA researchers have started to commercialize this technology. For instance, a former DARPA researcher now heads Cyberkinetics, a private company that is currently testing “BrainGate,” a neural interface designed to permit severely motor-impaired individuals to communicate their thoughts directly to a computer.<sup>34</sup>

HANDP represents the intersection of two lines of technological development long championed at DARPA.<sup>35</sup> The first is tighter coupling between humans and computers, a direction of research that began in early 1970s when the federal government sponsored research in the Brain-Computer Interfaces Project at the University of California, Los Angeles.<sup>36</sup> The second is increased automation in weapon systems.<sup>37</sup> In 1960, J.C.R. Licklider, a psychologist who later served as Director of DARPA, proposed a “man-computer symbiosis” that would serve during an interim period before an “intimate association” between man and computer could yield computers with true artificial intelligence.<sup>38</sup> Licklider noted that the realities of modern warfare would require increasingly quick tactical decisions, necessitating a union of the unmatched serial processing capabilities of computer technology and the massively parallel processing that the structure of the human brain facilitates.<sup>39</sup> In Licklider’s view, people would play an important gap-filling role “when the computer has no mode or rou-

30. Apparatus for Acquiring and Transmitting Neural Signals and Related Methods, U.S. Patent No. 7,187,968 (filed Oct. 23, 2003) (issued March 6, 2007).

31. *Id.* at col. 8, 136-38.

32. Allison Abbot, *Neuroprosthetics: In Search of the Sixth Sense*, 442 NATURE 125, 125-26 (2006).

33. Leigh R. Hochberg et al., *Neuronal Ensemble Control of Prosthetic Devices by a Human with Tetraplegia*, 442 NATURE 164, 164-71 (2006).

34. Cyberkinetics Brain Gate Clinical Trials, [http://www.cyberkineticsinc.com/content/clinicaltrials/braingate\\_trials.jsp](http://www.cyberkineticsinc.com/content/clinicaltrials/braingate_trials.jsp) (last visited Dec. 27, 2007). Academic researchers are working on direct neural interfaces for speech synthesis software. See *Paralyzed Man’s Mind is ‘Read,’* BBC NEWS, Nov. 15, 2007, <http://news.bbc.co.uk/2/hi/health/7094526.stm> (last visited Dec. 27, 2007) (researchers claiming 80% success rate in decoding sound in paralyzed man’s brain). Commercial firms, such as Microsoft, have engaged in related research. See *Using Electroencephalograph Signals for Task Classification and Activity Recognition*, U.S. Patent No. 20,070,185,697 (filed Feb. 7, 2006).

35. Human-Assisted Neural Devices, [http://www.darpa.mil/dso/thrusts/bio/restbio\\_tech/hand/index.htm](http://www.darpa.mil/dso/thrusts/bio/restbio_tech/hand/index.htm) (last visited Jan. 14, 2008).

36. Sixto Ortiz Jr., *Brain-Computer Interfaces: Where Human and Machine Meet*, COMPUTER, Jan. 2007, at 17, 17.

37. See generally J.C.R. Licklider, *Man-Computer Symbiosis*, HFE-1 IEEE TRANSACTIONS ON HUM. FACTORS IN ELECTRONICS 4, 4-11 (1960).

38. *Id.* at 4.

39. See *id.* at 14.

tine that is applicable in a particular circumstance.”<sup>40</sup> Nevertheless, Licklider believed that “man-machine symbiosis” would not likely prove “the ultimate paradigm for complex technological systems” because advances in artificial intelligence might eventually render humans’ role superfluous in tactical warfare decisions.<sup>41</sup>

Licklider proved prescient with respect to the systemic challenges that modern warfare presents. He foresaw that increasing automation would create a continuum of human involvement, as man would need to be “in the loop” before he could delegate his command to expert artificial intelligence systems, which link particular algorithms with the known facts of a specific problem domain to make tactical military decisions.<sup>42</sup> Irrespective of the need for increased mind-machine linkage for such military decision-making, the complexity of military technology, particularly that associated with turbojet aviation and missile design, has necessitated increased automation due to the limitations of human physiology in the context of flight, an automation now achieved largely through avionics.<sup>43</sup> Since the inner ear lacks the capacity to distinguish between accelerating into a turn and slowing down away from it—a sensory deficit that has led many pilots to become disoriented and crash after performing a “graveyard spiral”<sup>44</sup>—early pioneers of aviation recognized the need to augment human abilities by mechanical means.<sup>45</sup> These inventors introduced technologies ranging from gyroscopic stabilizers, which were first introduced in 1891, to automatic stabilizers allowing for hands-free flight, which Orville Wright demonstrated in 1913.<sup>46</sup> The development of faster engines and long-distance flight accelerated the trend toward fuller automation after World War II, with new systems created for navigation, autopilot, and flight management.<sup>47</sup> Given that modern civilian aircrafts often require well over one hundred separate computer systems,<sup>48</sup> military avionics comprise some of the most sophisticated system engineering. Engineers have had to address numerous problems inherent in flight,<sup>49</sup> including how to navigate accurately over long distances, how to create designs that can sustain the stresses resulting from unpredictable weather, how to compensate for the instability of supersonic flight, how to create systems that allow pilots to evade threats, and how to prevent pilots from being overwhelmed with sen-

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40. *Id.* at 7.

41. *Id.* at 2.

42. *Id.* at 6-7.

43. CHARLES E. BILLINGS, HUMAN-CENTERED AVIATION AUTOMATION: PRINCIPLES AND GUIDELINES 13-14 (1996), available at [http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19960016374\\_1996036711.pdf](http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19960016374_1996036711.pdf).

44. WILLIAM LANGEWIESCHE, INSIDE THE SKY: A MEDITATION ON FLIGHT 67, 85-87 (1999).

45. See BILLINGS, *supra* note 43, at 15.

46. CHARLES E. BILLINGS, HUMAN-CENTERED AIRCRAFT AUTOMATION: A CONCEPT AND GUIDELINES 8 (1991), available at [http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19910022821\\_1991022821.pdf](http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19910022821_1991022821.pdf).

47. See *id.* at 17-21.

48. *Id.* at 18.

49. See *id.* at 17-46.

sory data that might cause them to make poor targeting decisions during periods of extreme stress and time pressure.<sup>50</sup> Compounding the difficulty for engineers is the fact that automation often breaks down in an erratic manner.<sup>51</sup> As a result, engineers have understood the need to keep humans, who have a unique ability to respond to unanticipated conditions, involved in the decision-making process.<sup>52</sup>

At the same time, engineers have recognized the need to develop parallel technologies that sometimes automate systems beyond human control.<sup>53</sup> There are two primary reasons for these parallel technologies. First, human limitations may require computer systems to override human control in certain situations.<sup>54</sup> For instance, the maneuvers necessary to avoid incoming missiles may require a computer to take control of a plane because the gravitational forces experienced during successful evasion may cause humans to lose consciousness.<sup>55</sup> Second, the cognitive load imposed on operators under stress may overwhelm their decision-making ability, requiring expert systems to prioritize tasks for humans automatically and to take over for them when they exhibit diminished capacity.<sup>56</sup>

Despite the difficulties of automating aerial weapons, military planners in the United States have recognized that autonomous weapons will be increasingly important in future combat missions.<sup>57</sup> First, autonomous weapons serve as a significant force multiplier.<sup>58</sup> One soldier can now operate several unmanned aerial vehicles (UAVs) at the same time.<sup>59</sup> Further, the Department of Defense's roadmap for the technology anticipates UAVs with the capacity to swarm within ten years.<sup>60</sup> Second, autonomous weapons allow soldiers to stay within U.S. borders while fighting wars.<sup>61</sup>

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50. See *id.*

51. See Leslie Lamport et al., *The Byzantine Generals Problem*, 4 ACM TRANSACTIONS ON PROGRAMMING LANGUAGES & SYSTEMS 382, 382-401 (1982).

52. BILLINGS, *supra* note 43, at 12.

53. See Mark Stefik, *Strategic Computing at DARPA: Overview and Assessment*, 28 COMM. ACM 690, 692 (1985).

54. *Id.*

55. *Id.*

56. In the mid-1980s, DARPA had a program called "The Pilot's Associate," which was designed to create robotic helpers for pilots. See *id.* at 692. Much of this technology has been used in DARPA's current "Augmented Cognition" program, which is closely aligned with the HANDP. See *Improving Warfighter Information Intake Under Stress (AugCog)*, <http://www.darpa.mil/DSO/thrusts/trainhu/warfighter/index.htm> (last visited Jan. 14, 2008); see also Misha Pavel et al., *Augmented Cognition: Allocation of Attention*, in *PROCEEDINGS OF THE 36TH ANNUAL HAWAII INTERNATIONAL CONFERENCE ON SYSTEM SCIENCES* (2002).

57. See OFFICE OF SEC'Y OF DEF., *UNMANNED AIRCRAFT SYSTEMS ROADMAP: 2005-2030*, at i (2005), available at <http://www.acq.osd.mil/usd/Roadmap%20Final2.pdf>.

58. *Id.* at J-8.

59. Control systems for simultaneous control of multiple UAVs are already in testing. See *Raytheon Tests Multiple UAV Control System*, UNITED PRESS INT'L, Apr. 10, 2006, [http://www.upi.com/Security\\_Terrorism/Analysis/2006/04/10/raytheon\\_tests\\_multiple\\_uav\\_control\\_system/1509/](http://www.upi.com/Security_Terrorism/Analysis/2006/04/10/raytheon_tests_multiple_uav_control_system/1509/).

60. See OFFICE OF SEC'Y OF DEF., *supra* note 57, at D9-10.

61. The Predator UAVs operating in Afghanistan are controlled via satellite from Nellis Air Force Base in Nevada. See Brent Sadler, *In the Sights of a Joystick Killing Machine*, CNN, June 9, 2006, <http://www.cnn.com/2006/WORLD/asiapcf/06/09/sadler>.

This serves: (1) a political function, because it requires fewer deployed soldiers and obviates the need for risky pilot rescue missions,<sup>62</sup> (2) a legal function, because it creates a jurisdictional hurdle for the prosecution of soldiers by courts such as the International Criminal Court (ICC),<sup>63</sup> and (3) a technological function, because it may prevent the transfer of sensitive military technology, as engineers can give these weapons the capacity to self-destruct before enemies can capture and reverse-engineer them.<sup>64</sup>

Although DARPA has performed research and development on nearly autonomous “fire and forget” weapon systems,<sup>65</sup> present limitations on technology, the military’s general distrust of completely autonomous systems, and persistent questions on the legality of such systems has led DAPRA to continue to research transitional technologies, such as those associated with its Human Assisted Neural Devices research.<sup>66</sup> In 1985, DAPRA began combining some of its technologies in its Smart Weapons Program,<sup>67</sup> which sought to develop a novel technology for deploying

predator.btsc/index.html (last visited Dec. 27, 2007). The U.S. Air Force flies its Global Hawk UAVs in Iraq from Beale Air Force Base in California. See *CNN Sunday Morning* (CNN television broadcast Nov. 26, 2006), available at <http://transcripts.cnn.com/TRANSCRIPTS/061126/sm.01.html>.

62. The political fallout from the broadcast of Black Hawk helicopter pilots crashing under hostile fire while supporting the U.N. humanitarian mission, UNOSOM II, in Mogadishu led to the U.S. withdrawal from Somalia. See TAYLOR B. SEYBOLT, *HUMANITARIAN MILITARY INTERVENTION: THE CONDITIONS FOR SUCCESS AND FAILURE* 156-57 (2007); see also MARK BOWDEN, *BLACK HAWK DOWN* 379-80 (Signet 2002) (1999).

63. For information on the jurisdictional reach of the International Criminal Court (ICC) generally, see Rome Statute of the International Criminal Court pt. 2, July 17, 1998, 2187 U.N.T.S. 90 [hereinafter Rome Statute]. Despite U.S. opposition to having its servicemen prosecuted before the ICC, culminating in the American Servicemembers’ Protection Act, Pub. L. No. 107-206, 116 Stat. 899 (2002), the ICC still would have jurisdiction over Americans alleged to have committed war crimes in two cases. First, if the territorial state in which the crime occurred has ratified the Rome Statute, ICC jurisdiction would ensue. See Johan D. van der Vyver, *Personal and Territorial Jurisdiction of the International Criminal Court*, 14 *EMORY INT’L L. REV.* 1, 37 (2000). Second, if the territorial state has not ratified the Statute, the state could make a declaration under Article 12(3) granting jurisdiction for that specific incident. See *id.*; see also Lilian V. Faulhaber, *American Servicemembers’ Protection Act of 2002*, 40 *HARV. J. ON LEGIS.* 537, 545-46 (2003). The International Committee of the Red Cross maintains that permissible universal jurisdiction governs all war crimes and that under the principle *pacta sunt servanda*, state parties to the Geneva Conventions and Additional Protocol I must exercise compulsory jurisdiction for “grave breaches” that constitute war crimes. See DÖRMANN, *supra* note 4, at 128-29; Isabelle Daoust et al., *New Wars, New Weapons? The Obligation of States to Assess the Legality of Means and Methods of Warfare*, *INT’L REV. RED CROSS*, June 2002, at 345, 347.

64. Such a technology exchange occurred, for instance, in April 2001, when a U.S. spy plane collided with a Chinese military jet and the crew of the downed U.S. plane could not destroy the classified technology before making an emergency landing. Eric Eckholm, *Collision with China: Beijing; U.S. Envoy Meets Chinese Foreign Minister as Negotiations on Plane’s Crew Continue*, *N.Y. TIMES*, Apr. 6, 2001, at A10.

65. RICHARD H. VAN ATTA ET AL., *TRANSFORMATION AND TRANSITION: DARPA’S ROLE IN FOSTERING AN EMERGING REVOLUTION IN MILITARY AFFAIRS S-5* (2003), available at [http://web-ext2.darpa.mil/body/pdf/P-3698\\_Vol\\_1\\_final.pdf](http://web-ext2.darpa.mil/body/pdf/P-3698_Vol_1_final.pdf).

66. *Id.* at 59.

67. *Id.* at 23. Although the media characterized weapons equipped with Global Position Systems (GPS) deployed in Desert Storm as “smart bombs,” these weapons did not

unmanned weapons characterized not only by their precision but also by their capacity to linger over an area and accurately target and launch weapons on their own.<sup>68</sup> These weapons have yet to move past the research and development stage, but the Department of Defense projects that it will field an unmanned aerial vehicle with full automation by 2015.<sup>69</sup>

The Department of Defense anticipates that future unmanned aerial vehicles will be linked to a pilot's neuromuscular system so as to transform the pilot "from seeing the plane to being the plane."<sup>70</sup> Paradoxically, weapons that use this transitional brain-interface technology may present more difficult legal issues than those that are fully autonomous "smart" weapons. Autonomous weapons more clearly implicate existing notions of command responsibility than biologically linked "wetware" systems, a point examined in Part IV of this Note.

## II. The Use of Brain-Machine Interfaces in the Context of International Criminal Law

The development and use of weapons coupled with brain-machine interfaces most likely does not violate international criminal law. *Per se* prohibitions on the use of certain types of weapons may occur if either treaties or custom proscribe their use in armed conflict.<sup>71</sup> Even if no such prohibition exists, certain uses of novel instrumentalities of warfare may still constitute war crimes under international treaties or customary law in certain conditions.<sup>72</sup>

Although nations have attempted to regulate the law of war throughout history, the first attempt at creating a binding international treaty to ban the use of a particular weapon was the 1868 St. Petersburg Declaration Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight.<sup>73</sup> International treaties have proscribed the use of other

select their targets, like the smart weapons that DARPA developed. See William J. Broad, *War in the Gulf: High Tech; War Hero Status Possible for the Computer Chip*, N.Y. TIMES, Jan. 21, 1991, at A8; see also VAN ATTA ET AL., *supra* note 65, at 23.

68. VAN ATTA ET AL., *supra* note 65, at 23. Recent developments at DARPA have produced such autonomous UAVs. See, e.g., Erik Sofge, *Top 3 Robots Coming Soon to the Battlefield: Live @ DARPAtech*, POPULAR MECHANICS, Aug. 8, 2007, <http://www.popularmechanics.com/science/robotics/4220197.html>.

69. OFFICE OF SEC'Y OF DEF., *supra* note 57, at D9-10. The U.S. military has used remotely piloted drones in Vietnam, Bosnia, Kosovo, Afghanistan, and Iraq. See James Dao & Andrew C. Revkin, *A Revolution in Warfare*, N.Y. TIMES, Apr. 16, 2002, at F1.

70. OFFICE OF SEC'Y OF DEF., *supra* note 57, at 52.

71. See generally JEAN-MARIE HENCKAERTS & LOUISE DOSWALD-BECK, CUSTOMARY INTERNATIONAL HUMANITARIAN LAW 237-96 (2005) (discussing the types of weapons that customary international law prohibits).

72. See MARCO SASSOLI & ANTOINE A. BOUVIER, HOW DOES LAW PROTECT IN WAR? CASES, DOCUMENTS AND TEACHING MATERIALS ON CONTEMPORARY PRACTICE IN INTERNATIONAL HUMANITARIAN LAW 175, 175-80 (1999).

73. St. Petersburg Declaration Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight, Dec. 11, 1868, 1 AM. J. INT'L. L. (SUPP.) 95 (1907), reprinted in DOCUMENTS ON THE LAWS OF WAR 53 (Adam Roberts & Richard Guelff eds., 3d. ed. 2000).

weapons, including asphyxiating gases,<sup>74</sup> expanding bullets,<sup>75</sup> air-delivered incendiary weapons,<sup>76</sup> landmines,<sup>77</sup> fragmentary weapons that leave shrapnel that surgeons cannot readily detect,<sup>78</sup> and laser weapons designed to blind.<sup>79</sup>

The U.S. Department of Defense requires that all weapons conform to international law.<sup>80</sup> Pursuant to its treaty obligations,<sup>81</sup> the United States has recognized only three weapons that are per se illegal to use in war: poison, chemical weapons, and exploding (dumdum) bullets.<sup>82</sup> Even though brain-machine interface weapons do not fall within these prohibitions, they potentially fall within the ambit of Article 23(e) of the Hague Convention. Article 23(e) prohibits state parties from “employ[ing] arms, projectiles, or materials calculated to cause unnecessary suffering.”<sup>83</sup>

74. Hague Declaration (IV, 2) Concerning Asphyxiating Gases, July 29, 1899, 1 AM. J. INT'L. L. (SUPP.) 157, 157-59 (1907), *reprinted in* DOCUMENTS ON THE LAWS OF WAR, *supra* note 73, at 60-61 [hereinafter Hague Declaration Concerning Asphyxiating Gases].

75. Hague Declaration (IV, 3) Concerning Expanding Bullets, July 29, 1899, 1 AM. J. INT'L. L. (SUPP.) 157, 157-59 (1907), *reprinted in* Documents on the Laws of War, *supra* note 73, at 63-66.

76. *See, e.g.*, Protocol on Prohibitions or Restrictions on the Use of Incendiary Weapons (Protocol III) art. 2, Oct. 10, 1980, 1342 U.N.T.S. 171.

77. *See, e.g.*, Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices (Protocol II), as amended May 3, 1996, 2048 U.N.T.S. 133 [hereinafter CCW Protocol II].

78. *See, e.g.*, Protocol on Non-Detectable Fragments (Protocol I), Oct. 10, 1980, 1342 U.N.T.S. 168 [hereinafter CCW Protocol I].

79. *See, e.g.*, Protocol on Blinding Laser Weapons (Protocol IV), Oct. 13, 1995, 35 I.L.M. 1218 (1996) [hereinafter CCW Protocol IV].

80. U.S. DEP'T OF DEF., THE DEFENSE ACQUISITION SYSTEM ¶ E1.1.15 (2003), *available at* <http://www.at.hpc.mil/Docs/d50001p.pdf>. For additional information on the legal vetting process implemented by the United States, see Daoust et al., *supra* note 63, at 356-57.

81. The United States is currently a party to the following weapons conventions: 1) Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, June 17, 1925, 26 U.S.T. 571, 94 L.N.T.S. 65, 2) Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxic Weapons and on their Destruction, Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 63, 3) Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, Oct. 10, 1980, 1342 U.N.T.S. 137, 19 I.L.M. 1523 [hereinafter Conventional Weapons Convention], 4) CCW Protocol I, *supra* note 78, 5) CCW Protocol II, *supra* note 77, and 6) CCW Protocol on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons, Jan. 13, 1993, 1015 U.N.T.S. 163.

82. *See* DÖRMANN, *supra* note 4, at 281-96. The Rome Statute recognizes the prohibition of poison; asphyxiating, poisonous or chemical gases; and expanding bullets in Article 8(2)(b)(xvii), Article 8(2)(b)(xviii), and Article 8(2)(b)(xix) respectively. *Id.*

83. Hague Convention IV Respecting the Laws and Customs of War on Land, Oct. 18, 1907, 36 Stat. 2227, 1 Bevans 631 [hereinafter Hague Convention IV]. The United States is a signatory to this Hague Convention. DOCUMENTS ON THE LAWS OF WAR, *supra* note 73, at 77. This Hague Convention attained the status of customary international law when the International Military Tribunal at Nürnberg tried Nazi war criminals after World War II. *Id.* at 68. The UN Secretary General confirmed the Hague Convention's status as customary international law in his statements regarding the establishment of the International Criminal Tribunal for the former Yugoslavia. The Secretary-General,

Additional Protocol I of the Geneva Conventions may also require that the United States impose certain restrictions on the use of brain-machine interface weapons, as the Department of Defense has recognized that certain aspects of the Protocol have attained the status of customary international law.<sup>84</sup> Under Article 35 of Additional Protocol I, parties to an armed conflict do not have unlimited discretion in their choice of weapons and must not use weapons that will "cause superfluous injury or unnecessary suffering" or that "are intended, or may be expected to cause widespread, long-term and severe damage to the natural environment."<sup>85</sup> Under Article 36 of Additional Protocol I, state parties to the Protocol must assess, "[i]n the study, development, acquisition or adoption of a new weapon . . . whether its employment would, in some or all circumstances, be prohibited" under the Protocol or international laws applicable to the contracting state.<sup>86</sup> The Rome Statute contains similar provisions that might apply to U.S. servicemen who find themselves under the jurisdiction of the International Criminal Court.<sup>87</sup>

Under international law, the use of brain-machine interface weapons must also comply with the customary law of war. Many treaties, including treaties that the United States has ratified, explicitly recognize the role that customary law plays in circumscribing the range of permissible weapons.<sup>88</sup> For example, paragraph 8 of the preamble to the 1907 Hague Convention IV, known as the "Martens Clause,"<sup>89</sup> requires state parties to ensure that "the inhabitants and belligerents remain under the protection and governance of the principles of the law of nations, derived from the usages established among civilized peoples, from the laws of humanity, and from the dictates of public conscience."<sup>90</sup> Since the seventeenth century, the general customary law has been that states may employ only those weapons that military necessity justifies during war.<sup>91</sup> If the cause of the war is deemed just, however, states have a great deal of latitude with respect to their choice of weapons and to the manner in which they employ

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*Report of the Secretary-General Pursuant to Paragraph 2 of Security Council Resolution 808, ¶¶ 41-44, delivered to the General Assembly, U.N. Doc. S/25704 (May 3, 1993).*

84. Theodor Meron, *The Time Has Come for the United States to Ratify the Geneva Protocol I*, 88 AM. J. INT'L. L. 678, 681 (1994) (quoting U.S. DEP'T OF DEF., CONDUCT OF THE PERSIAN GULF WAR: FINAL REPORT TO CONGRESS, PURSUANT TO TITLE V OF THE PERSIAN GULF CONFLICT SUPPLEMENTAL AUTHORIZATION AND PERSONAL BENEFITS ACT OF 1991 App. O, O-13 (1992)).

85. Additional Protocol I to the Geneva Conventions, *supra* note 3.

86. *Id.*; see also Daoust et al., *supra* note 63, at 347-54.

87. Article 8(2)(b)(xx) of the Rome Statute prohibits weapons "which are of a nature to cause superfluous injury or unnecessary suffering" or "which are inherently indiscriminate in violation of the international law of armed conflict" if the weapons fall within inclusive regulations forbidding their use and are listed in the annex to the Statute. DÖRMANN, *supra* note 4, at 297-313.

88. See U.S. DEP'T OF DEF., *supra* note 84.

89. Hague Convention IV, *supra* note 83, at 70.

90. KRIANGSAK KITTICHAISAREE, INTERNATIONAL CRIMINAL LAW 85 (2002).

91. Stefan Oeter, *Methods and Means of Combat*, in THE HANDBOOK OF HUMANITARIAN LAW IN ARMED CONFLICT 105, 105-06 (Dieter Fleck ed., 1995).

them.<sup>92</sup> As Hugo Grotius recognized, even if the principle of military justifies the means and weapons employed, i.e. they are necessary to overcome an armed enemy, a number of factors, primarily necessity and proportionality, still constrain the right of states to use such weapons.<sup>93</sup> Since World War II, customary international law has imported many of these factors via instruments developed under international human rights (IHR) law, a domain of law that has largely developed in parallel with international humanitarian law (IHL).<sup>94</sup>

Whether the Martens Clause binds parties that have refused to ratify weapons' treaties remains a disputed area of law.<sup>95</sup> In 1996, the International Court of Justice (ICJ) issued an advisory opinion on the legality of nuclear weapons that relied upon the Martens Clause.<sup>96</sup> The Russian Federation argued that the ratification of the Geneva Conventions rendered the Martens Clause superfluous.<sup>97</sup> Great Britain, however, maintained that the Martens Clause still possesses independent force, although it argued that it did not create a per se prohibition on the use of nuclear weapons.<sup>98</sup> Even if the Martens Clause does restrict the choice of weapons for all nations, exactly which weapons fall within its purview is also contested.<sup>99</sup>

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92. Grotius secularized the concept of just war, which writers such as Maimonides and Aquinas first proposed. MICHAEL WALZER, *JUST AND UNJUST WARS: A MORAL ARGUMENT WITH HISTORICAL ILLUSTRATIONS* 168 (Basic Books 2d ed. 1977). He defined three cases that justified war: for defense, for repossessing stolen property, and for retribution. JUDITH GARDAM, *NECESSITY, PROPORTIONALITY AND THE USE OF FORCE BY STATES* 32-37 (2004); see also WALZER, *supra*, at 21-47.

93. Military theorists have proposed such factors as "legitimacy (just cause), immediacy (imminent danger), indispensability (no practical alternative), discrimination (respect for the principle of noncombatant immunity), proportionality (damage must not exceed the importance of the objective), and responsibility (the decision must be made by a competent authority who is accountable to judicial review)." HOWARD M. HENSEL, *THE LAW OF ARMED CONFLICT: CONSTRAINTS ON THE CONTEMPORARY USE OF MILITARY FORCE* 8 (2005); see also GARDAM, *supra* note 92, at 36. For a discussion of the development of the relatively recent doctrine of proportionality, see HENSEL, *supra*, at 8-19.

94. Dale Stephens, *Human Rights and Armed Conflict: The Advisory Opinion of the International Court of Justice in the Nuclear Weapons Case*, 4 *YALE HUM. RTS. & DEV. L.J.* 1, 12-13 (2001).

95. Rupert Ticehurst, *The Martens Clause and the Laws of Armed Conflict*, *INT'L REV. RED CROSS*, Apr. 30, 1997, at 125, 125-34.

96. *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, 1996 I.C.J. 226, 227-29 (July 8).

97. Article 1, paragraph 2 of Protocol I to the Geneva Conventions explicitly states: "[i]n cases not covered by this Protocol or other international agreements, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience." Additional Protocol I to the Geneva Convention, *supra* note 3, art. 1(2). The Russian Federation position, however, is that "today the 'Martens Clause' may formally be considered inapplicable." Written Statement and Comments of the Russian Federation on the Issue of the Legality of the Threat or Use of Nuclear Weapons 13 (Jun. 16, 1995).

98. Letter from the Legal Advisor to the Foreign Commonwealth Office of the United Kingdom of Great Britain and Northern Ireland, together with the Written Statement of the Government of the United Kingdom (Jun. 16, 1995); see generally Ticehurst, *supra* note 95.

99. HENCKAERTS & DOSWALD-BECK, *supra* note 71, at 237-96.

Based on a ten-year study, the International Committee of the Red Cross (ICRC) determined that the Martens Clause precluded weapons including poison, biological and chemical weapons, expanding and exploding bullets, weapons using primarily non-detectible fragments to injure, booby traps, and blinding laser weapons.<sup>100</sup> The Red Cross also found severe limitations on the use of landmines, incendiary weapons, and nuclear weapons.<sup>101</sup> Some international humanitarian law scholars, however, have contested the ICRC's conclusions. These scholars have noted a lack of case law on weapons, such as blinding laser weapons.<sup>102</sup> Further, they have pointed to recent national court decisions upholding the legality of some weapons that the Red Cross found heavily restricted, such as flechette shells used in the Gaza Strip<sup>103</sup> and cluster bombs employed in Zagreb.<sup>104</sup> Finally, they have emphasized denials of customary military prohibitions on the use of incendiary weapons, such as American and British military officials' affirmation of the legality of the use of white phosphorous in Falujah, Iraq.<sup>105</sup>

Thus, *ex ante*, even though "the right of the Parties to the conflict to choose methods or means of warfare is not unlimited,"<sup>106</sup> international law most likely does not prohibit brain-machine interfaced weapons. Nevertheless, fully autonomous weapons may lack the ability to distinguish between legitimate combatants and people who have surrendered and thereby gained certain rights as non-combatants.<sup>107</sup> Several reasons warrant drawing this conclusion. First, in the majority of cases, brain-machine interface weapons may provide an unparalleled degree of precision in discriminating between legitimate and prohibited targets under international humanitarian law.<sup>108</sup> During World War II, the allied forces deployed crude unmanned guided missiles,<sup>109</sup> while reconnaissance planes equipped with Maverick missiles flew in the Vietnam War.<sup>110</sup> Given that these weapons did not lead to findings of violations of international

100. *Id.*

101. *Id.* at 244.

102. See David Turns, *Weapons in the ICRC Study on Customary International Humanitarian Law*, 11 J. CONFLICT & SECURITY L. 201, 205-11 (2006).

103. *Id.* at 214-15.

104. *Id.*

105. *Id.* at 223-24.

106. Hague Convention IV, *supra* note 83, art. 22.

107. See, e.g., Additional Protocol I to the Geneva Conventions, *supra* note 3, art. 51(4).

108. See OFFICE OF SEC'Y OF DEF., *supra* note 57, at 74.

109. See GEOFFREY PERRET, *WINGED VICTORY: THE ARMY AIR FORCES IN WORLD WAR II* 88 (1993).

110. The United States employed significant numbers of non-lethal UAVs during the Vietnam War as part of the "McNamara Line." Known at the time as Remotely Piloted Vehicles, such weapons as the Teledyne Ryan reconnaissance UAV and its higher-altitude successors provided imagery of North Vietnamese positions. See JEFFREY A. DREZNER, *INNOVATIVE MANAGEMENT IN THE DARPA HIGH ALTITUDE ENDURANCE UNMANNED AERIAL VEHICLE PROGRAM: PHASE 11 EXPERIENCE 4* (1999). Unmanned QU-22B Pave Eagle planes circled over combat positions and relayed information from ground sensors to the Infiltration Surveillance Center at the U.S. Air Force Base in Thailand. See WILLIAM ROSENAU, *SPECIAL OPERATIONS FORCES AND ENEMY GROUND TARGETS: LESSONS FROM VIETNAM AND THE*

humanitarian law, it is unlikely that the use of more precise weapons would give rise to the presumption that their deployment violated international humanitarian law. In fact, unmanned aerial vehicles piloted via brain-machine interfaces could prove more accurate in their targeting than even present-day non-interfaced incarnations of these weapons.<sup>111</sup> The current generation of UAVs employs conventional guidance systems, and some of them have been armed and installed with Hellfire missiles, missiles used to attack tanks and bunkers.<sup>112</sup> The United States has carried out tactical strikes with these drones to target particular individuals, including Bin Laden and Mullah Mohammed Omar in Afghanistan,<sup>113</sup> and the Pentagon claims that use of these drones has reduced military and civilian casualties.<sup>114</sup> Because military forces have used these weapons in their prior incarnations for nearly one hundred years without challenges to their legality under international law, they seem to have achieved general acceptance under international humanitarian law as legitimate weapons for use in combat missions. Furthermore, given that these drones have served in reconnaissance operations during humanitarian missions in Kosovo,<sup>115</sup> it seems unlikely that international humanitarian law will prohibit their use, at least *ex ante*. In the future, international humanitarian law, however, could theoretically distinguish between their use for reconnaissance and military strike purposes.

Second, the United States may use such weapons domestically in homeland operations.<sup>116</sup> This factor may be used to assess their legality because the domestic use of UAVs suggests that they are not inherently indiscriminate; the United States presumptively would not jeopardize its own citizens by using indiscriminate or disproportionate weapons.

Third, international law has proven extremely solicitous about condemning aerial bombardment due to its clear military utility in modern warfare. Although the 1899 and 1907 Hague Declarations prohibited the use of projectiles launched from balloons, no formal treaty either expressly or implicitly regulates air combat.<sup>117</sup> Moreover, those prohibitions that

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PERSIAN GULF WAR 12 (2001); Russ Mitchell, *The Pilot, Gone; The Market, Huge*, N.Y. TIMES, Mar. 31, 2002, at C1.

111. See OFFICE OF THE SEC'Y OF DEF., *supra* note 57, at 74.

112. Susan H.H. Young, *Gallery of USAF Weapons*, AIR FORCE MAG., May 2007, at 135, 142-44.

113. James Dao, *A Nation Challenged: The Air War; The New Air War: Fewer Pilots, More Hits and Scarcer Targets*, N.Y. TIMES, Nov. 29, 2001, at B1.

114. *Id.* (relating reports of civilian casualties due to the weapons).

115. *Crisis in the Balkans: Drone Planes En Route*, N.Y. TIMES, Mar. 30, 1999, at A10. These UAVs, however, did not have the capacity to fire missiles.

116. Caitlin Harrington, *Global Hawks Fly Homeland Defence Missions over US*, JANE'S DEFENCE WKLY., Nov. 29, 2006, at 8.

117. THE HAGUE CONVENTIONS AND DECLARATIONS OF 1899 AND 1907, at 220-24 (James Brown Scott ed., 1918) (comparing the 1899 Hague Declaration I and the 1907 Hague Declaration XIV Prohibiting the Discharge of Projectiles and Explosives from Balloons); see Javier Guisábeiz Gómez, *The Law of Air Warfare*, INT'L REV. RED CROSS, June 30, 1998, at 347.

nations have proposed, such as the 1923 Hague Rules of Aerial Warfare,<sup>118</sup> have never been ratified.<sup>119</sup> Despite the enormous number of civilian casualties of aerial bombardment in Dresden, Tokyo, London, Hiroshima, and Nagasaki during World War II, no defendant was ever prosecuted for war crimes in connection with this method of warfare.<sup>120</sup> In contrast to the body of law that has emerged recently to protect non-combatants and to reinforce the principles of international human rights law,<sup>121</sup> international humanitarian law during World War II was more concerned with protecting soldiers than civilians.<sup>122</sup> Thus, it may not prove too surprising that the Nuremberg Tribunal's only trial associated with "indiscriminate bombing" involved the prosecution of a Japanese judge for convicting two American pilots for fire-bombing Japanese cities.<sup>123</sup> Due to the general paucity of international law prohibiting the use of new weapons,<sup>124</sup> it seems unlikely that the use of brain-interface weapons would fail to survive legal scrutiny under international humanitarian law as long as remote pilots could control these weapons with a high degree of accuracy.

### III. Novel Issues of Law That Brain-Machine Interfaces Raise in the Context of International Criminal Law

Even if the use of a weapon such as a brain-machine interface guided drone or missile is not prohibited per se under international criminal law, criminal liability may still attach to soldiers who use the weapons to commit certain crimes under both domestic and international law. The War Crimes Act of 1996 criminalizes, inter alia, grave breaches of the Geneva Conventions and the Additional Protocols to which the United States is a party. It also criminalizes violations of Articles 23, 25, 27, and 28 of the Annex to Hague Convention IV.<sup>125</sup> Under the Geneva Conventions, "willful killing" constitutes a war crime.<sup>126</sup> Moreover, under the specific Arti-

118. Hague Draft Rules of Aerial Warfare 1923, 17 AM. J. INT'L. L. (SUPP.) 245, 245-60 (1923), reprinted in DOCUMENTS ON THE LAWS OF WAR, *supra* note 73, at 141-53.

119. Documents on the Laws of War, *supra* note 73, at 139-41.

120. Chris af Jochnick & Roger Normand, *The Legitimation of Violence: A Critical History of the Laws of War*, 35 HARV. INT'L. L.J. 49, 91 (1994).

121. See YORAM DINSTEIN, *THE CONDUCT OF HOSTILITIES UNDER THE LAW OF INTERNATIONAL ARMED CONFLICT* 24 (2004) (observing the overlap between non-derogable human rights and IHL).

122. *Id.* at 10-11 (noting that the impetus for the creation of the Red Cross was to protect wounded soldiers and that the first Geneva Convention applied to the wounded armies in the field and the second to prisoners of war).

123. Jochnick & Normand, *supra* note 120, at 91.

124. Howard S. Levie notes that because of the secrecy of weapons development and the proportionally greater secrecy protecting them as they become more dangerous, "it is extremely doubtful that" Article 36 of Additional Protocol I to the Geneva Conventions, which limits the types of weapons that state parties may develop, "represents anything more than a pious wish of the few accepted by the many with tongue in cheek." *THE CODE OF ARMED CONFLICT* § 32.1 (1986).

125. United States War Crimes Act of 1996 § 2401, 18 U.S.C. § 2401 (1996).

126. Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field art. 50, Aug. 12, 1949, 6 U.S.T. 3114, 75 U.N.T.S. 85 (willful killing of protected persons wounded or sick on land); Geneva Convention Rela-

cles of the Hague Convention enumerated in the War Crimes Act, acts constituting war crimes include killing enemies who have capitulated, attacking undefended towns, or conducting sieges or bombardments on hospitals.<sup>127</sup> Servicemen may also fall under the war crimes jurisdiction that the International Criminal Court claims.<sup>128</sup> Under the Rome Statute, a soldier who kills one or more persons protected under the Geneva Conventions during an international armed conflict may be tried for war crimes before the International Criminal Court.<sup>129</sup>

In addition, violations under the customary laws of war and under international humanitarian law may also lead to criminal liability. Many of the accused war criminals tried in the aftermath of World War II were found guilty of having transgressed customary law,<sup>130</sup> such as the widespread prohibition against murder, a war crime explicitly recognized under the Charter of the International Military Tribunal at Nuremberg.<sup>131</sup> More recently, the International Criminal Tribunal for the Former Yugoslavia held that murder in an international conflict would qualify as a war crime under the “willful killing” criterion. The Tribunal also found that acts or omissions that violate existing treaties or customary laws of war were war crimes.<sup>132</sup> Many international human rights conventions, such as the International Covenant on Civil and Political Rights and the American Convention on Human Rights, have explicitly established that the right to life is non-derogable,<sup>133</sup> and case law has established the existence of a related

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tive to the Treatment of Prisoners of War art. 51, Aug. 12, 1949, 6 U.S.T. 3217, 75 U.N.T.S. 287 (willful killing of protected persons wounded, sick or shipwrecked at sea); *id.* art. 130 (willful killing of prisoners of war); Geneva Convention Relative to the Protection of Civilian Persons in Time of War art. 147, Aug. 12, 1949, 6 U.S.T. 3516, 75 U.N.T.S. 287 (willful killing of civilians).

127. Hague Convention IV, *supra* note 83, art. 23–27.

128. *Id.* art. 1.

129. Rome Statute, *supra* note 63, art. 8(2)(a)(i). Servicemen piloting missiles or drones using brain-machine interface weapons potentially may be liable under other provisions of the ICC, such as Article 8(2)(a)(iii) (willfully causing great suffering, or serious injury to body or health), Article 8(2)(b)(i) (intentionally directing attacks against civilians), Article 8(2)(b)(iii) (intentionally directing attacks against humanitarian aid workers or UN peacekeeping forces), Article 8(2)(b)(iv) (intentionally launching an attack with the knowledge of the incidental loss of life or injury to civilians or long-term and severe damage to the environment when the harm engendered is disproportionate to the military utility of the offensive), Article 8(2)(b)(v) (attacking or bombarding undefended property lacking a military purpose), Article 8(2)(b)(vi) (killing or wounding combatants who have surrendered), and Article 8(2)(b)(ix) (intentionally attacking non-military targets such as hospitals and monuments). DÖRMANN, *supra* note 4, at 38–43. Violations of these ICC articles would also constitute breaches of the Geneva Conventions. *Id.* This Note, however, limits itself to a discussion of the war crime of unlawful willful killing.

130. See HENCKAERTS & DOSWALD-BECK, *supra* note 71, at 573–74.

131. Charter of the International Military Tribunal art. 6(b), Aug. 8, 1945, 59 Stat. 1544, 82 U.N.T.S. 279. See HENCKAERTS & DOSWALD-BECK, *supra* note 71, at 311.

132. Prosecutor v. Kordic, Case No. IT-95-14/2-T, Judgment, ¶ 233 (Feb. 26, 2001); Prosecutor v. Delalic (The Celibici case), Case No. IT-96-21-T, Appeal Chamber Judgment, ¶¶ 422–23 (Feb. 20, 2001).

133. DINSTEN, *supra* note 121, at 23–24.

peremptory norm that prohibits murder.<sup>134</sup>

Because prosecuting a drone pilot who had used a brain-machine interfaced weapon to kill a civilian or non-combatant for war crimes would require the prosecutor to prove that he or she had violated existing laws criminalizing "willful killing," the potential liability of these pilots under international humanitarian law is unclear. Under the principle of legality enshrined in both the instruments and the customs of international criminal law, courts do not have the power to try an individual accused of a criminal offense if the act or omission for which he or she has been charged has not previously been established as illegal.<sup>135</sup> To narrow the scope of the examination, this Note will analyze the potential problems that could arise as a result of alleged war crimes that implicate the use of such a weapon by applying the relevant provisions of the Rome Statute. Other tribunals would likely apply similar rules.

Under the Rome Statute, the war crime of willful killing requires that the prosecutor prove that the defendant killed or caused the death of one or more people whom he or she knew was protected under at least one of the Geneva Conventions during an international war.<sup>136</sup> Furthermore, the elements of Article 8 war crimes, such as willful killing, must be interpreted within the framework of international law.<sup>137</sup> Under recent international criminal tribunal case law,<sup>138</sup> individual accountability for the crime of willful killing requires that the prosecutor prove both the *actus reus*, that the death resulted from a voluntary act or willful omission,<sup>139</sup> and the

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134. See, e.g., International Covenant on Civil and Political Rights art. 6, Dec. 19, 1966, S. Exec. Doc. No. 95-2, 999 U.N.T.S. 171; Organization of American States, American Convention on Human Rights arts. 31-51, Nov. 22, 1969, O.A.S.T.S. No. 36, 1144 U.N.T.S. 123; see also W.P. Gormley, *The Right to Life and the Rule of Non-Derogability: Peremptory Norms of Jus Cogens*, in *THE RIGHT TO LIFE* 120, 138 (Bertrand G. Ramcharan ed., 1985). But see David Weissbrodt & Beth Andrus, *The Right to Life During Armed Conflict: Disabled Peoples' International v. United States*, 29 HARV. INT'L L.J. 59 n.39 (1988) (noting the lack of any provision regarding the "derogation from the right to life during war" in the ICCPR in contradistinction to the ACHR).

135. Relevant provisions include, inter alia, the first paragraph of the Third Geneva Convention art. 99; the Fourth Geneva Convention art. 67, Additional Protocol I art. 75(4)(c); Additional Protocol II art. 6(2)(c); and the Rome Statute arts. 22(1), 24(1)-(2). HENCKAERTS & DOSWALD-BECK, *supra* note 71, at 371. Under Rome Statute art. 22(2), the ICC does not have the power to reason by analogy to enlarge the scope of the crime by broadening the definition of the crime. *Id.*

136. See Preparatory Comm'n for the Int'l Criminal Court, *Report of the Preparatory Commission for the International Criminal Court, Addendum: Finalized Draft Text of the Elements of Crimes* 18-19, UN Doc. PCNICC/2000/INF/3/Add.2 (July 6, 2000).

137. *Id.* at 18.

138. See, e.g., Prosecutor v. Delali et al., Case No. IT-96-21-T, Judgement, ¶¶ 326-27 (Nov. 16, 1998) (defining the requisite *actus reus* and *mens rea* of crimes before the International Criminal Tribunal for Yugoslavia); see also Prosecutor v. Akayesu, Case No. ICTR-96-4, Judgment, ¶ 589 (Sept. 2, 1997) (defining the elements of murder as a crime against humanity as including, inter alia, an unlawful act or omission and an intent).

139. The *actus reus* requirement, however, must be construed from the statute since it is not directly a constituent element of the crime in Article 8(2)(a)(i). See Rome Statute, *supra* note 63, arts. 8(2)(a)(i), 30(2)(a), 31(1)(a). Article 31(1)(a), however, arguably only exonerates a defendant if he or she suffers from an organic brain defect. See *id.* art. 31(1)(a).

*mens rea*, that the defendant possessed a culpable state of mind at the time of the killing.<sup>140</sup> The International Committee for the Red Cross has found that these principles accord with all modern domestic criminal legal systems.<sup>141</sup> The Rome Statute requires the presumption of the defendant's innocence unless all of the elements of the crime is satisfied with respect to the requisite mental state defined in the statute.<sup>142</sup>

In the absence of case law under the Rome Statute, it is unclear whether the court will require an independent finding that the *actus reus* element is satisfied.<sup>143</sup> If it does, it is still unclear how the International Criminal Court will define the element and its role in assessing the defendant's guilt.<sup>144</sup> If criminal intent implicates volitional action, as some scholars have argued, the court may subsume the principle within the concept of *mens rea*, or it may define *actus reus* as a voluntary or conscious act.<sup>145</sup> Such a definition would create a separate requirement for criminal culpability since theoretically the *actus reus* for the crime could exist when the requisite *mens rea* does not.<sup>146</sup>

Traditionally, two separate justifications exist for requiring that a court find the *actus reus* element satisfied before imposing criminal liability. The first is based on evidentiary concerns; the other, fairness concerns.<sup>147</sup> With respect to the evidentiary justification, the act requirement could have been required because there has been no means to prove conclusively what an actor was thinking at the moment that he or she committed an offense, making any attempt to criminalize bad thoughts futile due to a lack of evidence.<sup>148</sup> As for the fairness justification, Anglo-American notions of criminal justice preclude punishment in the absence of an attendant social harm and, therefore, Anglo-American criminal law has refused to criminalize someone solely for his or her bad thoughts or "for

140. *Id.* art. 31.

141. Preparatory Comm'n for the Int'l Criminal Court, Working Group on Elements of Crimes, *Request from the Governments of Belgium, Finland, Hungary, Mexico, the Republic of Korea and South Africa and the Permanent Observer Mission of Switzerland to the United Nations Regarding the Text Prepared by the International Committee of the Red Cross on the Mental Element in the Common Law and Civil Law Systems and on the Concepts of Mistake of Fact and Mistake of Law in National and International Law*, annex, U.N. Doc. PCNICC/1999/WGEC/INF.2/Add.4 (Dec. 15, 1999) [hereinafter ICC Report].

142. See Rome Statute, *supra* note 63, art. 66.

143. Recent international tribunal case law does little to clarify how the *actus reus* requirement might function in the context of brain-machine interface issues. See, e.g., Prosecutor v. Tadic, Case No. IT-94-1-T, Opinion and Judgment, ¶ 679 (May 7, 1997) (stating that "participation in the commission of the crime does not require an actual physical presence or physical assistance" but also that "mere presence at the scene of the crime without intent is not enough").

144. *Id.* ¶¶ 678-710.

145. See Michael Corrado, *Is There an Act Requirement in the Criminal Law?*, 142 U. PA. L. REV. 1539, 1544 (1994).

146. *Id.* at 1546 (describing the position of Michael Moore); see generally, MICHAEL MOORE, *ACT AND CRIME: THE PHILOSOPHY OF ACTION AND ITS IMPLICATIONS FOR CRIMINAL LAW* (1993).

147. *Powell v. Texas*, 392 U.S. 514, 542-44 (Black, J., concurring)

148. LEO KATZ, *BAD ACTS AND GUILTY MINDS: CONUNDRUMS OF THE CRIMINAL LAW* 153 (1987).

being a poor species of humanity.”<sup>149</sup> This fairness concern reflects the awareness that highly ethical actions may sometimes appear otherwise and that punishing bad thoughts might have perverse social consequences.<sup>150</sup> Kantian deontological ethics, for instance, recognizes that a person who regularly thinks bad thoughts and yet does good deeds may actually prove the highest moral exemplar.<sup>151</sup> Such a person obeys ethical duties not because nature has endowed him or her with the gift of being virtuous, but rather because he or she chooses to do right out of a sense of duty notwithstanding his or her awareness that he or she possesses the freedom to do otherwise.<sup>152</sup> Punishing such a person would not serve a rehabilitative or retributive purpose and, thus, criminal law has refused to stigmatize those who contemplate bad deeds but do not actually perform them.<sup>153</sup>

The requirement of a voluntary act seems to have attained the status of customary law. Anglo-American law has long required proof of *actus reus* as a *sine qua non* for attaching criminal liability to an actor.<sup>154</sup> In the United States, any domestic statute creating a crime without incorporating the requirement will not pass constitutional scrutiny.<sup>155</sup> Similarly, in civil law countries, the voluntary act element exists as a necessary condition for imposing criminal liability.<sup>156</sup> In France, for instance, the prosecutor must prove both *l'élément matériel*, which corresponds to *actus reus*, and *l'élément moral*, which corresponds to *mens rea*.<sup>157</sup> Further, under Islamic law, criminal sanctions depend on finding volitional acts; killings that result from unconscious acts are treated as homicide by mistake (*qatl al-khata'*), a crime qualitatively different from and less severely punished than willful murder (*qatl al-'amd*), a transgression that follows from intentional acts.<sup>158</sup>

Resolving the issue of whether a pilot remotely connected by a brain-machine interfaced UAV could incur criminal liability for having killed a person that the Geneva Conventions protect would prove particularly problematic because of the uncertain status of the role that the *actus reus* requirement plays in determining criminal responsibility.<sup>159</sup> Before the existence of this type of weapons system, courts had no occasion to resolve whether the condition exists merely because of the evidentiary impossibility of proving a thought crime or because the requirement in fact possesses

149. LEO KATZ ET AL., FOUNDATIONS OF CRIMINAL LAW 325 (1995).

150. KATZ, *supra* note 148, at 152-63.

151. IMMANUEL KANT, THE METAPHYSICS OF MORALS 145-47 (Mary J. Gregor ed. & trans., Cambridge Univ. Press 1996) (1785).

152. *Id.* at 150-51.

153. See KATZ, *supra* note 148, at 156, 164.

154. See LAFAYE, *supra* note 7, at 303.

155. See LAFAYE, *supra* note 7, 302-03 nn. 16-17 (referring to particular cases).

156. See CATHERINE ELLIOTT, FRENCH CRIMINAL LAW 59 (2001).

157. See *id.*

158. See MATTHEW LIPPMAN ET AL., ISLAMIC CRIMINAL LAW AND PROCEDURE: AN INTRODUCTION 50-51 (1988).

159. See LAFAYE, *supra* note 7, at 302-07 (describing the necessity of an act and the voluntary nature of an act in criminal law).

an independent significance.<sup>160</sup> In cases where pilots using brain-machine interface weapons are charged with war crimes, however, the issue may prove dispositive. The pilot may have fired his weapon without having made either a conscious or voluntary act before the ensuing deaths occurred.<sup>161</sup>

One of the justifications for employing a brain-machine interface is that the human brain can perform image calculations in parallel and can thus recognize items, such as targets, and classify them in 200 milliseconds,<sup>162</sup> a rate orders of magnitude faster than computers can perform such operations.<sup>163</sup> In fact, the image processing occurs faster than the subject can become conscious of what he or she sees.<sup>164</sup> Studies of patients with damage to the striate cortex possess what neuropsychologists term “blindsight,” an ability to predict accurately where objects are positioned, even when they are placed outside these patients’ field of vision.<sup>165</sup> The existence of this ability suggests the operation of an unconscious visual perception system in the human brain.<sup>166</sup> These blindsight patients often exhibit “levels of accuracy well beyond the performance of normal observers making judgments close to the threshold of awareness,”<sup>167</sup> particularly with regard to locating ‘unseen’ objects.<sup>168</sup> The speed of visual

160. See *id.* at 303-04 (highlighting the necessity for an act in criminal law.)

161. See LAFAYE, *supra* note 7, at 302-07 (noting the necessity of an act as well as its voluntary nature in the criminal law context); Stefik, *supra* note 53, at 692 (describing a scenario in which a mechanized pilot assistant would take over the controls and maneuver a plane after the pilot became unconscious).

162. See PATRICIA S. CHURCHLAND, *NEUROPHILOSOPHY: TOWARD A UNIFIED SCIENCE OF THE MIND-BRAIN* 35-36 (1989). Scientists like Kalanit Grill-Spector and Nancy Kanwisher contend that recognition and classification are simultaneous. See Kalanit Grill-Spector & Nancy Kanwisher, *Visual Recognition: As Soon As You Know It Is There, You Know What It Is*, 16 *PSYCHOLOGICAL SCI.* 152, 152-58 (2005). On the other hand, Marios G. Philiastides and Paul Sajda conclude that they are sequential. See Marios G. Philiastides & Paul Sajda, *Temporal Characterization of the Neural Correlates of Perceptual Decision Making in the Human Brain*, 16 *CEREBRAL CORTEX* 509, 509-17 (2006).

163. See, e.g., CHURCHLAND, *supra* note 162, at 35-36.

164. See Adam D. Gerson et al., *Cortically Coupled Computer Vision for Rapid Image Search*, in *IEEE TRANSACTIONS ON NEURAL SYSTEMS & REHABILITATION ENGINEERING* 174, 177-79 (2006). A DARPA-funded study to investigate how brain-interface devices could be used to harness the image recognition capabilities of humans to triage satellite data for computer processing found that non-invasive electrodes registered activity in the subjects’ brains in the bilateral occipital area 150 milliseconds after seeing an image for five milliseconds, frontal activity 250 milliseconds later in the areas associated with motor control, and activity over parietal electrodes starting at 350 milliseconds and extending to about 350 milliseconds after the initial stimulus. *Id.* at 174-78. Thus, a computer hooked up to the brain could recognize accurate targeting data before the subject even pressed a button. *Id.* at 177-79. Honeywell recently announced its collaboration with DARPA to create an “Image Triage System” that will operate up to six times faster than current computers by attaching sensors to evaluate signals from the human brain. Press Release, Honeywell, Honeywell Technology to Help U.S. Military Rapidly Analyze Intelligence and Keep Troops Out of Harm’s Way (Nov. 15, 2007), available at <http://online.wsj.com/public/article/PR-CO-20071115-903208.html?mod=crnews>.

165. See Adam Zeman, *Consciousness*, 124 *BRAIN* 1263, 1276 (2001).

166. See *id.* at 1276-77.

167. *Id.* at 1276.

168. See *id.* at 1276-77.

recognition varies depending on its degree of the perceived object's multivalence; ambiguous objects take more time to process.<sup>169</sup> If neural-interfaced weapons were designed to fire at the time of recognition rather than after the disambiguation process, a process that would likely need to occur for the pilot to differentiate between combatants and protected persons,<sup>170</sup> the pilot firing them presumably would lack criminal accountability for the act implicit in willful killing. Because of the way brain-interfaced weapons may interrupt the biology of consciousness, reasonable doubt may exist as to whether an actor performed a conscious act in the event of a contested incident.

The use of machine interfaces may also lead to problematic results in the context of determining whether or not a volitional act took place.<sup>171</sup> The recognition of movement and motion planning register different electrical patterns of brain activity, and brain-machine interface studies rely on discriminating between different types of neural activity.<sup>172</sup> Advances in neuro-imaging now make it possible to use computers to make increasingly accurate predictions about what a subject will do before he or she actually does it. A recent journal article reported that a computer can make a correct prediction of what a subject will do 71% of the time by analyzing the electrical activity generated by the subject's medial prefrontal cortex when he or she makes a decision.<sup>173</sup> Theoretically, a brain-machine interface weapon could fire a weapon based on such a predictive response, thereby making it uncertain whether or not a volitional act actually took place.<sup>174</sup> Even without the use of the predictive capability of computers or without the problem of disambiguation, such a system could target weapons at the time the individual first evinced neural activity in his or her motor cortex, a measurement known as a *Bereitschaftspotential*, or readiness potential. *Bereitschaftspotential* precedes volitional motor activity by up to

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169. Curiously, the human brain recognizes faces faster than objects. If an object such as a face is ambiguous, however, the usual 170 milliseconds recognition time is delayed. See Topi Tanskanen et al., *Face Recognition and Cortical Responses Show Similar Sensitivity to Noise Spatial Frequency*, 15 *CEREBRAL CORTEX* 526, 532-33 (2005). This may prove problematic in the IHL context because brain-machine interface pilots must distinguish between faces of combatants and protected persons. If the targeting device is calibrated to target based on the initial recognition, a plausible fact given that one pilot may guide several UAVs and, therefore, latency between thought and action must be minimized to maintain operational control, the device may lead to indiscriminate attacks. See Stefik, *supra* note 53, at 12.

170. See Tanskanen et al., *supra* note 169, at 526, 529-33 (analyzing cortical correlates of face recognition and examining responses of subjects in an experiment); see also Stefik, *supra* note 53 (discussing developments in technology).

171. See LIBET, *supra* note 5, at 140, 144-45.

172. For a detailed discussion of various approaches to decoding these types of neural activities for brain-machine interfaces, see Lakshminarayan Srinivasan et al., *General-Purpose Filter Design for Neural Prosthetic Devices*, 98 *J. NEUROPHYSIOLOGY* 2456 (2007).

173. See John-Dylan Haynes et al., *Reading Hidden Intentions in the Human Brain*, 17 *CURRENT BIOLOGY* 323, 324 (2007).

174. In some instances, IHL may sanction moving along the continuum of machine autonomy. For instance, if the brain-interface component revealed that the pilot was highly stressed, having a computer make the final targeting decision arguably could diminish indiscriminate attacks.

one second.<sup>175</sup> Such a probabilistic system theoretically would allow computers to have more time to calculate guidance trajectories.<sup>176</sup>

In summary, a brain-interface guided weapon could circumvent the pilot's normal volitional processing signals and rely solely on the recognition activity, thereby making it impossible for courts to determine whether a volitional act occurred before weapon targeting. Alternatively, a brain-interface guided weapon could employ a combination of sensory recognition of the pilot's incipient volitional thought and probabilistic software calculations in such a way that a prosecutor could never definitively prove anything more than the most attenuated guilt for misdirected attacks on protected persons.

In this context, the lack of a specific *actus reus* provision in the Rome Statute further complicates the *actus reus* issue.<sup>177</sup> Although the Final Preparatory Committee had drafted a definition of *actus reus*, it was ultimately omitted from the Rome Statute,<sup>178</sup> because the Working Group could not agree on how to draft the provision in a way that imposed liability for omissions constituting a severe breach of duty but did not criminalize passivity to such an extent as to make it tantamount to a war crime.<sup>179</sup> In a footnote to its report, the Working Group reserved the right to reopen the issue,<sup>180</sup> but as of yet it has not done so.<sup>181</sup> Because "it is not clear whether an act is supposed to be required as the object of criminal liability, or only as necessary condition of liability,"<sup>182</sup> the principle of legality may preclude a court from imposing one of the highest forms of criminal opprobrium on someone in this novel situation, especially because the individual may very well lack conscious control of his or her actions.

Even if the International Criminal Court were to resolve the *actus reus* issue and a prosecutor could prove this element of the crime, a court would also need to find that the pilot possessed the requisite *mens rea* regarding the ends of the attack. The ICC provision defining the war crime of willful killing<sup>183</sup> does not directly specify the criterion for determining what the prosecutor must prove to establish the defendant's willfulness.<sup>184</sup> As a

175. Zeman, *supra* note 165, at 1268.

176. In other words, if brain activity occurs at a time at which a computer can calculate that the activity will result in a volitional motor activity at time t+1, then the computer can begin making its calculations at time t rather than at t+1. The design of neural prosthetic devices relies on estimating users' intentions based on Bayesian probabilities. See Srinivasan et al., *supra* note 172, at 2470.

177. WILLIAM A. SCHABAS, AN INTRODUCTION TO THE INTERNATIONAL CRIMINAL COURT 87 (2001).

178. *Id.*

179. *See id.* (providing additional citations to the relevant provisions of the Report of the Ad Hoc Committee on the Establishment of an International Court and the Reports of the Preparatory Committees). The manner in which the ICC resolves the definitional ambiguity of *actus reus* will likely prove pivotal in cases involving attempt liability under Article 25(3)(f) of the Rome Statute. *Id.*

180. *Id.*

181. *Id.*

182. Duff, *supra* note 6, at 72-73.

183. Rome Statute, *supra* note 63, art. 8(2)(a)(i).

184. DÖRMANN, *supra* note 4, at 39.

result, it is not clear whether the International Criminal Court will apply the definition specified in Article 30(2) or a narrower meaning.<sup>185</sup> Article 30(2) specifies that “unless otherwise provided,” the defendant lacks criminal responsibility in the absence of proof that he or she committed the crime with intent and knowledge.<sup>186</sup> Recent case law from the International Criminal Tribunals has held that grave breaches of the Geneva Convention require the presence of certain types of awareness on the part of the actor.<sup>187</sup> These include actual knowledge, whether demonstrated or constructive,<sup>188</sup> intent to kill or inflict grievous bodily harm,<sup>189</sup> or reckless disregard above ordinary negligence.<sup>190</sup> Because the ICC will apply customary international rules in the absence of specific provisions within the Rome Statute,<sup>191</sup> the International Committee of the Red Cross presented the Preparatory Commission for the International Criminal Court Working Group on the Elements of Crimes with an analysis of the mental state requirement under the Anglo-American and civil law traditions.<sup>192</sup> Ultimately, the Red Cross concluded that the two traditions had essentially similar notions of the mental state required to prove a defendant’s guilt.<sup>193</sup> Criminal liability attaches if either of two conditions is met. First, criminal liability attaches if the defendant exhibited common law intent, which is tantamount to *dolus directus* in the first or second degree under the civil law.<sup>194</sup> Second, criminal liability attaches if the defendant acted with common law recklessness, which equates to either the degree of *dolus eventualis* under civil law or criminal negligence, which corresponds to a lesser degree of *dolus eventualis*.<sup>195</sup>

There are at least four potential problems in analyzing whether pilots of brain-interface guided unmanned aerial vehicles satisfy the *mens rea* element of alleged war crimes. The first two potential problems are substantive. First, just as it would be difficult to prove intent with respect to the act element, it may prove impossible to satisfy the necessary condition of finding that the defendant possessed a culpable state of mind in relation to the killing itself.<sup>196</sup> Second, the nature of the interface may deprive the pilot of the ability to make a conscious choice to refrain from the criminal act.<sup>197</sup> These issues arise for two reasons. For one, the apparent simultaneity of the intent, act, and belief observed in everyday actions can be divided into

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185. *Id.* (noting that the ICC drafters discussed the discrepancy but did not come to a resolution).

186. Rome Statute, *supra* note 63, art. 30(2).

187. DÖRMANN, *supra* note 4, at 41.

188. *Id.* at 41 n.16.

189. *Id.* at 42 n.19.

190. *Id.* at 43 n.22.

191. See Rome Statute, *supra* note 63, arts. 21(1)(b)-(c).

192. ICC Report, *supra* note 141.

193. *Id.*

194. *Id.*

195. *Id.*

196. OFFICE OF THE SEC’Y OF DEF., *supra* note 57, at 65.

197. See Stefik, *supra* note 53, at 692.

discrete timeframes with this particular type of weapon.<sup>198</sup> For another, the particular way that the interface operates may interrupt the conventional sequence of neurological activity that underlies volitional movement and the conscious intent that underlies ordinary actions.<sup>199</sup>

The analysis of the biological process of thought and action in this narrow situation, however, may have much broader implications for criminal cases. This analysis demonstrates the weaknesses of existing notions of criminal responsibility and requires a reassessment of their validity. In some of the most puzzling experiments carried out in cognitive neuroscience, Benjamin Libet, a physiologist at the University of California, San Francisco, discovered that although the decision to act occurs about 200 milliseconds before any volitional movement takes place, neurological activity precedes this decision.<sup>200</sup> In fact, this activity occurs in the motor cortex 350 milliseconds before the decision to act and nearly 550 milliseconds before the ultimate reaction takes place.<sup>201</sup> Libet performed his early experiments on subjects who had had electrodes implanted in their brains prior to brain surgery.<sup>202</sup> By directly applying electricity to these electrodes, Libet could make his subjects feel various types of sensations.<sup>203</sup> By varying the duration of the electrical pulses, he observed that the patients needed about 500 milliseconds of continuous stimulation before they exhibited an awareness of the sensation that he aroused.<sup>204</sup> Further experiments confirmed that if patients received less than this duration of stimulation, they would not feel it.<sup>205</sup> Libet interpreted these results to prove that the half second of stimulation is necessary for the patient to achieve a conscious experience of the sensation, which Libet termed the "neuronal adequacy" of consciousness.<sup>206</sup> Upon achieving neuronal adequacy, the patient "automatically"<sup>207</sup> referred the experience "backwards in time"<sup>208</sup> so as to create the mental narrative that he or she was aware of the sensation immediately after it happened.<sup>209</sup>

In a later experiment, reported in 1983, Libet monitored the brain activity of subjects who were instructed to attend to a timing device consisting of a dot of light that swept in a clockwise circle like a very fast second

198. See Ortiz, *supra* note 36, at 18-21.

199. See *id.*; see also OFFICE OF THE SEC'Y OF DEF., *supra* note 57, at 65.

200. SUSAN BLACKMORE, CONSCIOUSNESS: A VERY SHORT INTRODUCTION 87 (2d. ed., 2005).

201. *Id.*

202. *Id.* at 33.

203. See *id.*

204. *Id.* at 33-34.

205. *Id.* at 34.

206. *Id.*; see also BENJAMIN LIBET, *Neuronal vs. Subjective Timing for Conscious Sensory Experience*, in NEUROPHYSIOLOGY OF CONSCIOUSNESS: SELECTED PAPERS OF BENJAMIN LIBET 66, 79-80 (1993).

207. Daniel C. Dennett & Marcel Kinsbourne, *Time and the Observer: The Where and When of Consciousness in the Brain*, 15 BEHAV. & BRAIN SCI. 183, 196 (1992).

208. *Id.*

209. See *id.* at 183-96.

hand.<sup>210</sup> Libet instructed his subjects to perform two separate actions.<sup>211</sup> First, they were told to wait for one complete revolution of the dot and then to flex their wrist whenever they wanted to.<sup>212</sup> Second, they were asked to associate the position of the dot with the time at which they first became aware of their intention to act.<sup>213</sup> By measuring brain activity, Libet observed the sequence of events and time that elapsed between the onset of pre-volitional cerebral activity (termed readiness potential or RP), the decision to act, the beginning of the movement, and the moment the subjects became conscious of their intent to move.<sup>214</sup> Although the interpretation of this data is subject to extensive debate because it appears to undermine the existence of free will,<sup>215</sup> numerous studies, including a recent experiment using trans-cranial magnetic stimulation have confirmed these empirical results.<sup>216</sup>

Some scholars have disputed the legal implications of these and other studies regarding the neurological basis of consciousness.<sup>217</sup> For example, Stephen Morse argues that because criminal law is normative, i.e. the criteria that it sets for criminal responsibility exists independently from anything exogenous to law, the implications of recent scientific studies will do little to alter long established legal norms.<sup>218</sup> “Brains,” Morse asserts, “do not commit crimes; people commit crimes.”<sup>219</sup> Given that in particular instances “we will virtually never have direct neuroscientific evidence contemporaneous with the time of the crime . . . [a]t most, we will have *ex ante* or *ex post* evidence that can produce inferences of varying validity about brain structure and function at the time of the crime.”<sup>220</sup> In the case of brain-interface controlled weapons, such evidence, however, most likely will exist. This evidence could present a severe challenge to conventional ideas underpinning the normative values of criminal law in both interna-

210. Benjamin Libet et al., *Time of Conscious Intention to Act in Relation to Onset of Cerebral Activity (Readiness-Potential): The Unconscious Initiation of a Freely Voluntary Act*, 106 BRAIN 623, 624-25 (1983).

211. *Id.* at 625.

212. *Id.*

213. *Id.*

214. See LIBET, *supra* note 5, at 137.

215. See BLACKMORE, *supra* note 200, at 88; LIBET, *supra* note 5, at 144-45.

216. Hakwan C. Lau et al., *Manipulating the Experienced Onset of Intention After Action Execution*, 19 J. OF COG. NEUROSCI. 81, 89 (2007).

217. See Jeffery Rosen, *The Brain on the Stand*, N.Y. TIMES MAG., Mar. 11, 2007, at 5-6, 9.

218. See Stephen J. Morse, *Brain Overclaim Syndrome and Criminal Responsibility: A Diagnostic Note*, 3 OHIO ST. J. CRIM. L. 397, 400 (2006).

219. *Id.* at 397. Morse, however, does note two cases where neuroscience evidence may prove relevant: (1) to show “appearances are deceptive,” i.e. that the defendant who appeared to act “consciously was in fact unconscious or in an automatic state,” and (2) to provide probative evidence when evidence with respect to the defendant’s behavior is in doubt, i.e. to show that blunt force trauma to the defendant that occurred prior to the crime affected his or her capacity to possess the *mens rea* necessary for the criminal charge. *Id.* at 400-01.

220. *Id.* at 400.

tional humanitarian law and domestic legal systems.<sup>221</sup>

The essential problem that this type of weapon creates is that its implementation may deprive the actor of a “veto” power over his or her action and thus make it impossible for him or her to exercise conscious control over his or her actions. Given Libet’s experimental results, neuroscientists and philosophers have offered several interpretations for these counterintuitive findings, the most radical being that humans lack free will.<sup>222</sup> If humans lack free will, the entire criminal law system would need reevaluation and reimplementation so as to reorient its foundation from retributivism towards deterrence.<sup>223</sup>

Libet himself offers a less drastic interpretation of the findings. Libet conjectures that consciousness plays a role in suppressing impulses.<sup>224</sup> This view, which some have labeled “free won’t,”<sup>225</sup> substantially undermines criminal accountability, at least in the context of alleged crimes committed by means of brain-machine interfaced weapon systems.<sup>226</sup> Libet notes that an interval of 100 milliseconds elapses between the time when neuronal activity registers a willingness to perform an act and the time when the primary motor cortex activates the spinal motor nerve cells that propagate the signal resulting in the motor act.<sup>227</sup> If research confirms Libet’s theory, prosecutors might not be able to prove the requisite *mens rea* to establish criminal liability for brain-interfaced drone pilots. The brain-interfaced machine’s design may prevent a pilot from possessing conscious criminal intent and may deprive the pilot of the ability to consciously refrain from carrying out the prohibited action.<sup>228</sup> Recent studies on patients suffering from Lesch-Nyhan syndrome, which results from a series of genetic mutations that cause the afflicted person to lack the ability to refrain from horrific self-mutilating behavior despite both an awareness of its destructiveness and the desire to stop, has lent additional credence to Libet’s claim.<sup>229</sup>

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221. See Greene & Cohen, *supra* note 8, at 224 (asserting that “advances in neuroscience are likely to change the way people think about human action and criminal responsibility”).

222. See BLACKMORE, *supra* note 200, at 88.

223. See Greene & Cohen, *supra* note 8, at 221-22.

224. See LIBET, *supra* note 5, at 145 (noting that “what we are sure of is the ability of the conscious will to block or veto the volitional process and prevent the appearance of any motor act” and that “conscious free will could control the outcome of an unconsciously initiated process.”).

225. See BLACKMORE, *supra* note 200, at 89.

226. See DANIEL C. DENNETT, *FREEDOM EVOLVES* 236-37 (2003) (urging an alternative explanation for Libet’s results: “Libet tacitly presupposes that you can’t start thinking seriously about whether to veto something until you’re conscious of what it is that you might want to veto, and you have to wait 300 milliseconds or more for this, which gives you only 100 milliseconds in which to ‘act’”).

227. See LIBET, *supra* note 5, at 111-12.

228. See generally Shaun Gallagher, *Where’s the Action? Epiphenomenalism and the Problem of Free Will*, in *DOES CONSCIOUSNESS CAUSE BEHAVIOR?* 109, 114 (Susan Pockett et al. eds., 2006) (explaining that Libet’s findings indicate that initiation of a voluntary act begins unconsciously and uncontrollably, before the person knows he wants to act).

229. See Richard Preston, *An Error in the Code*, *NEW YORKER*, Aug. 13, 2007, at 30.

The two procedural issues that arise from the use of brain-machine interface weapons relate to uncertainties of evidence law with regard to brain-scan data. Although arguably not a *jus-cogens* norm,<sup>230</sup> international human rights' treaties have upheld a search and seizure privacy right.<sup>231</sup> The Rome Statute arguably requires the International Criminal Court to recognize this privacy right.<sup>232</sup> The Rome Statute provides the accused the right "not to be compelled to testify or to confess guilt."<sup>233</sup> Therefore, a defendant probably has the right to refuse to offer self-incriminating data reflecting his or her brain activity at the time of the crime. A challenge to the admissibility of brain scans in the context of war crimes, however, will likely arise in the context of brain-monitored interrogations<sup>234</sup> before it arises in the context of war crimes' prosecutions for acts involving brain-machine interfaced weapons. Recent developments in functional magnetic resonance imaging have allowed researchers to discern whether or not a suspect is telling the truth by observing certain types of brain activity.<sup>235</sup> Presumably, subjects accused of crimes because of incriminating brain scans will object to the admissibility of this type of evidence first.

Further, rules of legal ethics may create problems.<sup>236</sup> Although the International Criminal Court has yet to formalize the law governing the lawyers practicing before it,<sup>237</sup> many American jurisdictions have professional rules correlative to the Model Rules of Professional Responsibility

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230. See FRANCISCO F. MARTIN ET AL., INTERNATIONAL HUMAN RIGHTS AND HUMANITARIAN LAW: TREATIES, CASES, AND ANALYSIS 36 (2006) (arguing that the right to privacy is not a *jus-cogens* norm). But see George E. Edwards, *International Human Rights Law Challenges to the New International Criminal Court: The Search and Right to Privacy*, 26 YALE J. INT'L L. 323, 329-30. In the United States, the issue of whether the defendant could be compelled to offer his or her brain scans in this context is unclear, although the Supreme Court has ruled for the admissibility of arguably similar evidence. For instance, it held that the introduction of some types of physically intrusive evidence, such as a blood sample obtained against the defendant's wishes after an automobile accident, does not violate the Fourth Amendment. *Schmerber v. California*, 384 U.S. 757, 770-71 (1966). The Court has noted, however, that evidence involving "intrusions into the human body" would require a balancing test in which "the individual's interest in privacy and security are weighed against society's interest in conducting the procedure." *Winston v. Lee*, 470 U.S. 753, 760 (1985). Furthermore, the Court held that courts would have to factor in "the extent of the intrusion upon the individual's dignitary interests in personal property and bodily integrity." *Id.* at 761. Plaintiffs may find this last factor insuperable, thereby precluding them from compelling the defendant to turn over his brain scans in this particular context. *Id.*

231. See, e.g., International Covenant on Civil and Political Rights, *supra* note 134, art. 17.

232. Rome Statute, *supra* note 63, art. 21(1)(b)-(c).

233. *Id.* art. 67(1)(g).

234. See generally Sean Kevin Thompson, Note, *The Legality of the Use of Psychiatric Neuroimaging in Intelligence Interrogation*, 90 CORNELL L. REV. 1601 (2005) (examining the use of functional Magnetic Resonance Imaging technology in the interrogation of foreign detainees).

235. See *id.* at 1608-09 (quoting Tatia M.C. Lee et al., *Lie Detection by Functional Magnetic Resonance Imaging*, 15 HUM. BRAIN MAPPING 157, 158 (2002)).

236. See discussion *infra* pp. 204-05.

237. The Presidency of the International Criminal Court proposed a draft Code of Professional Conduct for Counsel before the International Criminal Court. See Presidency of the Int'l Criminal Court, Proposal for a Draft Code of Professional Conduct for

(Model Rules) of the American Bar Association (ABA). An American lawyer defending a pilot of a brain-machine interfaced UAV accused of war crimes would have to adhere to these rules.<sup>238</sup> Under the Model Rules, lawyers have a duty of candor before the tribunal that could potentially disqualify many American lawyers from representing these types of defendants.<sup>239</sup>

Under the Model Rules, lawyers may not knowingly “make a false statement of fact”<sup>240</sup> to the tribunal or “fail to disclose a material fact to a third person when disclosure is necessary to avoid assisting a criminal or fraudulent act by a client.”<sup>241</sup> Similarly, under the Rome Statute, a lawyer arguing the defendant’s innocence while in the possession of brain-scan data may commit an offense because making such an argument may be tantamount to intentionally presenting evidence that the party knows is false.<sup>242</sup> It is unclear whether a defense lawyer privy to incriminating brain-scan evidence would have to disqualify himself or herself from the case because the evidence may so clearly amount to an indicia of guilt that to allege otherwise would constitute a material misstatement before the tribunal.<sup>243</sup> Most likely, a lawyer in this situation would assert ethical propriety by first arguing that the evidence against his or her client was unreliable and then asserting that criminal defendants have a right to have zealous representation.<sup>244</sup> If the ethics rule precluded the defendant from obtaining his or her choice of counsel, however, he or she may possess a colorable claim that the ICC has violated his or her due process rights.<sup>245</sup>

#### IV. An Argument for Enlarging the Scope of Command Responsibility

In order to vindicate the victims of alleged war crimes using brain-machine interfaced weapons or other autonomous weapon systems, international humanitarian law theorists ought to reevaluate the doctrine of command responsibility. If theorists do not reevaluate this doctrine and the weapons that fall into a per se prohibition, several unsatisfactory conse-

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Counsel before the International Criminal Court, U.N. Doc. ICC-ASP/3/11/Rev.1 (2004).

238. Lonnie T. Brown, Jr., *Foreward: Ethics 2000 and Beyond: Reform or Professional Responsibility as Usual*, 2003 U. ILL. L. REV. 1173, 1174 (2003).

239. See MODEL RULES OF PROF'L CONDUCT R. 3.3 (2003).

240. *Id.* at 3.3(a)(1).

241. *Id.* at 3.3(a)(3).

242. Rome Statute, *supra* note 63, art. 70(1)(b).

243. See MODEL RULES OF PROF'L CONDUCT R. 1.16(b)(2) (2003) (“[A] lawyer may withdraw from representing a client if . . . the client persists in a course of action that the lawyer reasonably believes is criminal or fraudulent.”); *Id.* R. 3.3(a)(1) (2003) (“A lawyer shall not knowingly . . . make a false statement of fact . . . to a tribunal or fail to correct a false statement of material fact or law . . . .”)

244. See Russell G. Pearce, *Lawyers as America's Governing Class: The Formation and Dissolution of the Original Understanding of the American Lawyer's Role*, 8 U. CHI. L. SCH. ROUNDTABLE 291 (2001) (“The criminal defendant [is] always entitled to zealous representation in order to vindicate the defendant's basic constitutional rights.”).

245. See Rome Statute, *supra* note 63, art. 67(1)(d) (defendant possesses the right to legal assistance of his choosing).

quences will result. First, given that a defendant's guilt would prove particularly difficult to establish under the existing rubric of criminal law,<sup>246</sup> international humanitarian law would not create legal disincentives for pilots using such weapons to take unreasonable risks to civilian safety during wartime.<sup>247</sup> Second, international humanitarian law would create perverse incentives that would encourage the development of an entire classes of weapons that the state could use to evade criminal penalties for even the most serious types of war crimes.<sup>248</sup> Any principle of accountability in international criminal law needs to take into consideration various factors, including ending the victimization process, avoiding future wars, rehabilitating the victims, and reconciling the members of society ravaged by conflict.<sup>249</sup> In order to achieve these goals, international humanitarian law will need to attach liability for these crimes to certain classes of actors, without enlarging the scope of liability so far as to stigmatize them unfairly as war criminals.<sup>250</sup>

Given that increasingly autonomous weapons may fail to discriminate between legitimate targets and protected persons, international humanitarian law could create an outright proscription on their use. As noted in Part I, such a prohibition, however, might create the unintended consequence of hindering research into weapon systems that may prove more accurate than existing weapons. Alternatively, international humanitarian law could establish criminal liability for pilots of brain-machine interfaced UAVs or for the operators who launch "fire and forget" weapons. This response raises the issues outlined in Part III. Moreover, because it is unlikely that the operator or actor will know the probability of error associated with targeting these weapons, attributing guilt to them may prove difficult given the likelihood of factors contributing to their misuse.<sup>251</sup> As

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246. See discussion *supra* pp. 194–201.

247. See Joseph P. "Dutch" Bialke, *Al-Qaeda & Taliban Unlawful Combatant Detainees, Unlawful Belligerency, and the International Laws of Armed Conflict*, 55 A.F. L. REV. 1, 9–10 (2004) (stating that international laws of armed conflict protect citizens by providing "positive incentive[s] to constrain their behavior as well as the potential for future punishment for failing to do so").

248. See Andrew T. Guzman, *Saving Customary International Law*, 27 MICH. J. INT'L L. 115, 167 (2005) (analyzing the cost-benefit analysis states engage in when considering an action that would violate customary international law).

249. M. Cherif Bassiouni, *Searching for Peace and Justice: The Need for Accountability*, 59 LAW & CONTEMP. PROBS. 9, 23–24 (1996).

250. See Dakota S. Rudesill, Note, *Precision War and Responsibility: Transformational Military Technology and the Duty of Care Under the Laws of War*, 32 YALE J. INT'L L. 517, 531–33 (2007) (arguing that the heightened ability to control high-technology military weapons entails a heightened responsibility for the effects of their use).

251. Many of the current drone pilots may possess less understanding of the risks attendant with their planes than traditional pilots, who presumably have an incentive to know the limits of their crafts out of an instinct for self-preservation. See Dan Kois, *How to Fly a Drone: Just Pretend Like You're Playing Playstation*, SLATE, Aug. 9, 2006, <http://www.slate.com/id/2147400>. Drone pilots also have less specialized training than ordinary pilots because remote-controlled planes are simpler to fly and do not cost as much to replace as advanced military jets. See *id.* The selection process for drone pilots currently favors those who have demonstrated analogous skills playing video games. *Id.* One of the top Army UAV pilots is in fact normally a cook. *Id.*

complex systems rely on greater numbers of distributed components, failures due to the complexity and tight coupling of components are statistically assured.<sup>252</sup> This reality provides support for aligning accountability for alleged war crimes committed with such weapons with higher level control, such as that which the developers of these weapons<sup>253</sup> and the military commanders that demand or sanction their use possess.<sup>254</sup> Criminal accountability based on proximity to the crime would place a disproportionate share of responsibility on operators of weapons systems due to their positional role as the last actor in the sequence of events that led to the crimes.<sup>255</sup> The errant bombing of civilians that brain-interfaced weapons produce might result from a number of plausible causes, including errors in the underlying algorithms of the expert systems controlling the targeting system, failures in sensors on remote weapons that the pilot relies upon, or particular genetic qualities of the operator's brain that may cause a weapon to act unpredictably.<sup>256</sup> In any of these cases, a court would have to assess the validity of a superior orders<sup>257</sup> defense, requiring a complex

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252. Mathematical proofs establish that the coupling of distributive computing systems increases the likelihood of system failures due to low-probability events, thus limiting the theoretical reliability of any such system. See Lampport et al., *supra* note 51, at 382-401.

253. See Jack Beusmans & Karen Wieckert, *Computing, Research, and War: If Knowledge is Power, Where is Responsibility?*, 32 COMM. ACM 939, 942-46 (1989) (arguing that "responsibility for using an autonomous weapon rests not only with the commanding officer who orders the use of a weapon and the operator who decides to use it, but also with the weapon designers who encapsulate knowledge of real targets and how to locate them"). Under IHL, private individuals who work on development of such weapons could find themselves liable for war crimes under the precedent established in the Nürnberg cases. For instance, in the Zyklon B Case, the suppliers of the rat poison Zyklon B were found guilty of war crimes because they had knowledge that the gas was being used to kill humans and because the deaths would not have occurred but for the presence of the gas. See *United Kingdom v. Tesch et al. (Zyklon B Case)*, 1 I.L.R. 93 (1946); YUSUF AKSAR, IMPLEMENTING INTERNATIONAL HUMANITARIAN LAW: FROM THE AD HOC TRIBUNALS TO A PERMANENT INTERNATIONAL CRIMINAL COURT 86-87 (2004); see also DÖRMANN, *supra* note 4, at 35-36 (describing the liability of private actors for war crimes and the continuum of guilt found in the Zyklon B Case).

254. See Beusmans & Wieckert, *supra* note 253, at 943.

255. See Jan Hoekema, *Third Session: Panel Discussion on "Revisiting Humanitarian Law"* (Dec. 8, 2000), in PROTECTING CIVILIANS IN 21ST CENTURY WARFARE 91, 102-03 (2001) (proposing that "with the development of modern high-tech, remote control warfare, the need has arisen for new forms of humanitarian law to protect civilians" and noting the difficulties in apportioning guilt in situations involving system failures, such as when NATO forced bombed a Chinese embassy in Belgrade).

256. Recent research in neuroscience reveals that focal bilateral damage to the ventromedial prefrontal cortex, a brain area involved in processing emotions, creates idiosyncratic moral reasoning. Although this type of brain abnormality leads to utilitarian moral judgments that may produce pilots more likely to make decisions in accordance with IHL, other types of hidden brain damage may lead to very different results. See Michael Koenigs et al., *Damage to the Prefrontal Cortex Increases Utilitarian Moral Judgments*, 446 NATURE 908, 908-11 (2007).

257. A soldier before the ICC would likely assert the superior orders' defense by claiming that he or she was under a legal obligation to obey his or her superior officer, he or she did not know the order was unlawful, and the order was not "manifestly unlawful." See Rome Statute, *supra* note 63, art. 33. The validity of the defense of superior orders in IHL is unclear. See JOHN R.W.D. JONES & STEVEN POWLES, INTERNATIONAL

examination of the biological processes of decision-making and a difficult product liability analysis, all of which will do little to bring about the goals of rehabilitating victims and transforming society.<sup>258</sup> International humanitarian law, therefore, should focus on enhancing the existing doctrine of command responsibility. To make criminal accountability easier to determine, it should create incentives to produce maximally predictable and accurate weapons and to clarify the lines of authority in wartime in order to make criminal accountability easier to determine.

Under existing international humanitarian law, a superior officer may incur criminal liability for war crimes that his or her subordinates committed if certain conditions are met.<sup>259</sup> The U.S. Supreme Court defined these principles in the trials of World War II war criminals.<sup>260</sup> In *In re Yamashita*, the Court held that commanders possess a legal duty to take "appropriate measures" within their power "to control the troops under [their] command for the prevention of the specified acts which are violations of the law of war."<sup>261</sup> An international tribunal delineated the scope of command responsibility when it held that liability will attach only on a showing of "personal dereliction." Personal dereliction is either an act that is "directly traceable" to the actor or a criminally negligent omission by the actor to properly supervise his or her subordinates that amounts to "wanton, immoral disregard."<sup>262</sup> Additional Protocol I of the Geneva Conventions, which defines the law of war for international conflicts, codified the law of command responsibility.<sup>263</sup> Moreover, recent international criminal case law has established the basis of the duty under the common law.<sup>264</sup> The International Criminal Tribunal for Yugoslavia held that for successful prosecution of commanders for dereliction of command responsibility by means of an omission pursuant to a duty to control an act committed or about to be committed by a subordinate, the prosecution must establish three elements.<sup>265</sup> First, it must show that the defendant was a supe-

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CRIMINAL PRACTICE 443-44 (comparing the position of the ICTY and ICTR, which do not recognize the defense, with the position of the ICC).

258. Civil law is grappling with similar issues arising from system errors, many of which result from both human and machine errors. A well-known case concerned the Therac-25, a computer-controlled radiotherapy machine, which delivered fatal doses of radiation to several cancer patients due to errors in the underlying software and operators overriding protective shutdowns. See NANCY G. LEVESON, *SAFWARE: SYSTEM SAFETY AND COMPUTERS* 515-55 (1995); see also Robert D. Sprague, *At What Point Does Liability Hit Home?*, IEEE SOFTWARE, July 1995, at 93, 93-94.

259. See JONES & POWLES, *supra* note 257, at 443-60 (citations omitted).

260. *Id.* at 426 (citing *In re Yamashita*, 327 U.S. 1, 43 (1946)).

261. *Id.*

262. *Id.*

263. Additional Protocol I of the 1977 Geneva Conventions of 1949 delineates the liability of commanders for failing to act in Article 86 and the scope of the duty to act imposed upon military commanders in Article 87. See JONES & POWLES, *supra* note 257, at 429; see also HENCKAERTS & DOSWALD-BECK, *supra* note 71, at 556 n.27.

264. See, e.g., JONES & POWLES, *supra* note 257, at 432 (citing Prosecutor v. Delali, Case No. IT-96-21-T, Judgement, ¶ 333 (Nov. 16, 1998)).

265. *Id.* at 429.

rior.<sup>266</sup> Second, it must prove that the commander knew or possessed information that would allow him or her to suspect that his or her subordinates were in the process of breaching or were about to breach the laws of war.<sup>267</sup> Third, it must demonstrate that the commander did not take appropriate measures to prevent the criminal acts of his or her subordinates.<sup>268</sup>

In the context of brain-machine interfaced weapons and autonomous weapons generally, establishing the second and third prongs would likely require prosecution of high-level civilian developers and officers with access to classified data regarding the target accuracy of such weapons and the known limits of their reliability. By bringing cases against designers of weapon systems and those who create such weapons, international humanitarian law would rectify some of the limitations of the existing systems of weapons control. Many high-level weapon designers have escaped prosecution for design of indiscriminate or disproportionate military systems due to states' reluctance to try them. No justification appears to exist for offering amnesty to former enemies and ostensible war criminals other than that states have sometimes determined that gaining an important military advantage by acquiring pioneering technical research may outweigh upholding their obligations under international humanitarian law. For instance, after World War II, the Nazi engineer Wernher von Braun evaded war crimes' charges because the United States sought his expertise in designing rockets that were critical for military dominance in the Cold War. In comparison, twenty-four defendants who had overseen the slave labor used to construct von Braun's notoriously indiscriminate V-1 bombs and V-2 ballistic missiles and who had run its various concentration camps did not escape criminal punishment.<sup>269</sup> Similarly, the United States shielded from prosecution Lieutenant General Shiro Ishii, an instrumental figure in Japan's development of biological warfare during World War II.<sup>270</sup> American officials struck the deal with Ishii despite requests for his prosecution by the Soviet Union, which had tried those who had participated in research into germ warfare for war crimes.<sup>271</sup>

Putting engineers on notice of their potential liability may create incentives for them to create less indiscriminate and disproportionate weapons. A view of command responsibility would also create de facto liability for those most responsible for sanctioning the use of such weapons. International humanitarian law's disparate treatment of actors and

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266. *Id.* at 430.

267. *Id.*

268. *Id.*

269. See DENNIS PISZKIEWICZ, WERNHER VON BRAUN: THE MAN WHO SOLD THE MOON 49-52 (1998) (noting that the U.S. Army refused to let Wernher von Braun return to Germany to testify for the defense in *United States v. Andrae*, even though some of the defendants faced death sentences, because of fears that von Braun would incriminate himself).

270. STEPHEN ENDICOTT & EDWARD HAGERMAN, THE UNITED STATES AND BIOLOGICAL WARFARE: SECRETS FROM EARLY COLD WAR AND KOREA 37-38 (1998).

271. *Id.*

high officials, many of whom enjoy immunity from prosecution while in office under long established, though increasingly challenged, principles of customary law or legislation,<sup>272</sup> leads to the perception that international humanitarian law is unfairly applied, especially as between the victors and the vanquished.<sup>273</sup> By enlarging the scope of command responsibility liability for the use of brain-machine interfaced, autonomous, or distributed weapons systems, international humanitarian law can ensure that advances in technology do not subvert its goals of minimizing collateral harm to non-combatants by allowing for the existence of certain types of crimes for which no liability would attach.

## Conclusion

Despite the pronouncement by the International Court of Justice that international law has provided effective means of limiting the use of particularly horrific or indiscriminate weapons under international law,<sup>274</sup> the historical record belies such a statement. Multilateral treaties have outlawed few weapons and have always done so after the weapons have proven outdated as a result of improvements in military technology.<sup>275</sup> With the possible exception of the prohibition on blinding laser weapons,<sup>276</sup> the customary law of war has not prohibited the use of weapons *ex ante*.<sup>277</sup> Although some have argued that new law is not necessary and that the greatest gains for international humanitarian law will occur if scholars and practitioners convince state parties to ratify existing treaties, the better view is that weapons such as neural-interfaced or autonomous drones represent a discrete advance in the history of warfare that will require novel legal instruments to regulate their development and use.

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272. The ICJ has held that foreign ministers, prime ministers, and heads of state enjoy immunity from universal jurisdiction under customary international law. Concerning the Arrest Warrant of 11 April 2000 (Dem. Rep. Congo v. Belg.), 2002 I.C.J 121 (Feb. 14). *But see* AMNESTY INT'L, Universal Jurisdiction: Belgian Court Has Jurisdiction in Sharon Case to Investigate 1982 Sabra and Chatila Killings 5-13 (2002), available at [http://web.amnesty.org/library/pdf/IOR530012002ENGLISH/\\$File/IOR5300102.pdf](http://web.amnesty.org/library/pdf/IOR530012002ENGLISH/$File/IOR5300102.pdf).

273. Anne-Sophie Massa, *NATO's Intervention in Kosovo and the Decision of the Prosecutor of the International Criminal Tribunal for the Former Yugoslavia Not to Investigate: An Abusive Exercise of Prosecutorial Discretion?*, 24 BERKELEY J. INT'L L., 610, 611-12 (2006).

274. Legality of the Threat or Use of Nuclear Weapons, *supra* note 96, at 256-57.

275. Mark Osiel, *Obedying Orders: Atrocity, Military Discipline, and the Law of War*, 86 CAL. L. REV. 939, 992 n.199 (1998).

276. CCW Protocol IV, *supra* note 79.

277. Osiel, *supra* note 275, at 992 n.199.