

Cybernetic-Enhancement Technology and the Future of Disability Law

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ABSTRACT: Cybernetic devices—extensions, replacements, and upgrades that interface directly with the human nervous system—are becoming increasingly advanced and commonplace. Impending developments in neuroscience technology, including brain–computer interfaces and robotic prosthetics that surpass levels of ordinary human functionality, will raise novel legal and ethical questions. This Note argues that these enhancement technologies will create problems for people covered under the Americans with Disabilities Act (“ADA”). Congress recently amended the ADA to bar courts from taking mitigating factors into account when determining whether a claimant is ADA-protected. The ADA and its amendments embody disability by legislating the existence of disability as within the body of the disabled, rather than as a social construct determined by societal norms. This Note suggests changes to the ADA that would help prepare the ADA for the increasingly broad spectrum of ability that will accompany humanity through the twenty-first century.

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I. INTRODUCTION

The relentless forward march of technology has defined human history.¹ The discoveries of fire and simple tools led to the development of agriculture, which allowed primitive humans the free time necessary to develop written communication.² The Industrial Revolution laid the groundwork for the current Information Revolution.³ From the Internet to global-positioning satellites, recent advances in technology have dramatically changed the way we do business, raise families, and go about our daily lives.⁴

In the near future, advances in neuroscience and robotics will change the way our society views the human body by further reinforcing the concept of the body as a machine with interchangeable, replaceable, and upgradeable parts. This Note focuses on cybernetic technologies—mechanical, electronic devices that link directly with the human nervous system.⁵ As these cybernetic technologies become more advanced, they will approach and then surpass ordinary human function, raising the prospect of enhancing human capabilities well beyond the current baseline standard.⁶ This increase in the breadth and depth of the ability spectrum, spurred by the rising power and popularity of cybernetic-enhancement technologies, may lead society to view the healthy, yet unenhanced, human as “disabled.”⁷

The conflict at the intersection of cybernetic-enhancement technology and disability law is this: “In the future, the disabled may prove *more* abled; we may all want their prostheses.”⁸ This shift in viewpoint will necessitate a

1. See Susan W. Brenner, *Law in an Era of Pervasive Technology*, 15 WIDENER L.J. 667, 668–69 (2006) (noting the importance of technology throughout human history); Kieran Tranter, *Nomology, Ontology, and Phenomenology of Law and Technology*, 8 MINN. J. L. SCI. & TECH. 449, 461–67 (2007) (analyzing philosophical approaches to the relationship between man and technology).

2. See Brenner, *supra* note 1, at 674–77 (describing the earliest tool technologies).

3. See generally JONATHAN BENTHALL, *THE BODY ELECTRIC: PATTERNS OF WESTERN INDUSTRIAL CULTURE* (1976) (detailing the history of technology’s effect on Western civilization from about 1750 onwards).

4. See Brenner, *supra* note 1, at 731–33 (examining the pervasive effects of the Internet).

5. Cybernetics is actually a much broader field than what is covered in this Note—it is based on “communications and control in complex systems.” *Cybernetics and Bionics*, PC AUTHORITY, Dec. 2001, available at <http://www.pcauthority.com.au/Feature/18627,cybernetics-and-bionics.aspx>. I use this term, rather than one of the alternatives such as “bionics,” to emphasize the ability of these technologies to create an integrated man–machine system.

6. See *infra* Part II (examining the steadily accelerating progress in this field).

7. See DAVID M. RORVIK, *AS MAN BECOMES MACHINE: THE EVOLUTION OF THE CYBORG* 59 (1971) (observing how “those without medical deficiencies” may opt to replace their biological parts with mechanical ones); Bert Gordijn, *Converging NBIC Technologies for Improving Human Performance: A Critical Assessment of the Novelty and the Prospects of the Project*, 34 J.L. MED. & ETHICS 726, 730 (2006) (describing one possible scenario for seeing the standard biological human as disabled); *infra* Parts II.B–C (describing the latest in cybernetic technology).

8. See Steven Kotler, *Vision Quest*, WIRE MAG., Sept. 2002, available at http://www.wired.com/wired/archive/10.09/vision_pr.html (describing the possibility of using a visual implant

reevaluation of our legislative definition of disability. Even as amended, the Americans with Disabilities Act (“ADA”) does not define “impairment” or contemplate the possibility of ordinary human capacities as impairments. Due to the breadth of the field of disability law, this Note focuses on the employment-discrimination provisions of the ADA.

Scholars have argued that one of the defining debates of the early twenty-first century will be over whether and to what extent we should use technology to significantly enhance human capabilities.⁹ The human-enhancement debate covers many different fields, including genetic and pharmacological enhancement.¹⁰ This debate is already well established in the field of bioethics,¹¹ and a new field called “neuroethics” is advancing the debate in the context of neuroscience.¹²

Observers generally divide the debate over human enhancement into two camps: “bioconservatism” and “transhumanism.” On the antienhancement side, bioconservatives argue that the human body is good enough as it is and that using human-enhancement technologies to tamper with its mechanisms is unethical.¹³ They advance the argument that using human-enhancement technologies is cheating at life, similar to how steroid-

to provide features such as night vision and microscopic focusing ability or to simply project a computer-generated image directly into the brain).

9. See JAMES HUGHES, *CITIZEN CYBORG: WHY DEMOCRATIC SOCIETIES MUST RESPOND TO THE REDESIGNED HUMAN OF THE FUTURE* 68–73 (2004) (describing the twenty-first-century political spectrum as including a third axis called “biopolitics,” in addition to the existing axes of economic and cultural politics). An individual’s position on the biopolitical axis depends upon the extent to which that individual is a transhumanist or a “bioLuddite.” *Id.* at 71.

10. See NICHOLAS AGAR, *LIBERAL EUGENICS: IN DEFENCE OF HUMAN ENHANCEMENT* 37–38 (2004) (arguing in support of genetic-enhancement technologies); Henry T. Greely, *Regulating Human Biological Enhancements: Questionable Justifications and International Complications*, 4 SANTA CLARA J. INT’L L. 87, 90–91 (2006) (discussing the recent development of enhancement drugs and the possibility of genetic enhancement).

11. See generally Dov Fox, *Silver Spoons and Golden Genes: Genetic Engineering and the Egalitarian Ethos*, 33 AM. J.L. & MED. 567 (2007) (examining some of the ethical issues surrounding genetic enhancement); Carl E. Schneider, *Bioethics with a Human Face*, 69 IND. L.J. 1075 (1994) (defining the field of bioethics in the middle of the 1990s).

12. See Henry T. Greely, *Neuroethics and ELSI: Similarities and Differences*, 7 MINN. J. L. SCI. & TECH. 599, 599 (2006) (describing neuroethics as “a term to describe the study of the ethical, legal, and social implications of new technologies from neuroscience”). See generally Judy Illes, *Neuroethics in a New Era of Neuroimaging*, in *DEFINING RIGHT AND WRONG IN BRAIN SCIENCE* 99, 99–102 (Walter Glannon ed., 2007) (examining the growing importance of neuroethics as neuroimaging technologies continue to advance); Adina Roskies, *Neuroethics for the New Millennium*, 35 NEURON 21 (2002) (describing the foundation and direction of the field of neuroethics).

13. Institute for Ethics & Emerging Technologies, *About the Institute for Ethics and Emerging Technologies*, <http://www.ieet.org/index.php/IEET/about> (last visited Mar. 27, 2010) (explaining bioconservatives’ views opposing human-enhancement technologies). See generally PRESIDENT’S COUNCIL ON BIOETHICS, *BEYOND THERAPY: BIOTECHNOLOGY AND THE PURSUIT OF HAPPINESS* (2003) (taking the position that the government should heavily regulate human-enhancement technologies).

using athletes are cheating at the Olympics.¹⁴ Biconservatives typically oppose other biotechnologies, such as embryonic stem-cell research,¹⁵ and may advocate categorically banning enhancement technologies.¹⁶

Opposed to the bioconservatives is a movement labeling itself “transhumanism,” a term one author defines as “overcoming human limitations through reason, science, and technology.”¹⁷ Transhumanists view enhancement technology as essential to the further progress of humanity.¹⁸ Some transhumanists support the protection of each individual’s right to use—or refuse—enhancement technology.¹⁹ Transhumanist politics range from libertarian to socialist.²⁰ While some groups believe that society should entrust enhancement technologies to the free market, others believe distribution through social programs will be necessary to protect equality.²¹ Many transhumanist companies, non-profits, non-governmental organizations, and other organizations have recently established themselves.²² Along with bioconservatives, transhumanists will shape the ensuing public debate on human enhancement.

The human-enhancement technologies relevant to this Note begin with the human body and the ways in which our concepts of disability are embedded in that body. Part II.A analyzes the legal discourse of disability and reviews the ADA, relevant jurisprudence, and recent amendments.²³

14. PRESIDENT’S COUNCIL ON BIOETHICS, *supra* note 13, at 308.

15. See HUGHES, *supra* note 9, at 90–91 (noting the George W. Bush administration’s opposition to embryonic stem-cell research).

16. FRANCIS FUKUYAMA, OUR POSTHUMAN FUTURE: CONSEQUENCES OF THE BIOTECHNOLOGY REVOLUTION 208–09 (2002) (“One obvious way to draw red lines is to distinguish between therapy and enhancement The original purpose of medicine is, after all, to heal the sick, not to turn healthy people into gods.”). See generally BILL MCKIBBEN, ENOUGH: STAYING HUMAN IN AN ENGINEERED AGE (2004) (supporting international bans of enhancement and other technologies).

17. SIMON YOUNG, DESIGNER EVOLUTION: A TRANSHUMANIST MANIFESTO 15 (2006).

18. *Id.* (describing biotechnology as the means to “overcome the mental and physical limitations that restrict our freedom”).

19. Brian Alexander, *Is There a Human Right To Be Superhuman?*, MSNBC.COM, May 31, 2006, <http://www.msnbc.msn.com/id/13054181/?GT1=8199>; see also Michael H. Shapiro, *Does Technological Enhancement of Human Traits Threaten Human Equality and Democracy?*, 39 SAN DIEGO L. REV. 769, 834 n.131 (2002) (“[A] First Amendment argument for a right to use intellectual enhancement resources without government interference—as well as the right to refuse such resources—might also be crafted.”).

20. HUGHES, *supra* note 9, at xv.

21. *Id.*

22. See Alexander, *supra* note 19 (describing a conference held at Stanford University titled “Human Enhancement Technologies and Human Rights,” which multiple transhumanist and bioconservative groups attended); see also Humanity+, <http://www.humanityplus.org/> (last visited Mar. 27, 2010) (website for one of the most prominent transhumanism movements); The Singularity Institute for Artificial Intelligence, <http://singinst.org/> (last visited Mar. 27, 2010) (website for an organization advocating transhumanist ideas).

23. *Infra* Part II.A.

Part II.B reviews recent developments in replacement body parts and cybernetic technology, especially those that have the capacity for human enhancement.²⁴ Part II.C calls for action to amend the ADA sooner rather than later, noting the exponentially accelerating advancement of technology.²⁵ Parts III.A and III.B introduce the restoration–enhancement problem, arguing that widespread enhancement is both plausible and likely.²⁶ Part III.C examines several provisions of the ADA Amendments Act of 2008, concluding that the ADA is ill-equipped to function in a nation where cybernetic enhancement is common.²⁷ Part IV argues that Congress should examine the legal and ethical implications of cybernetic-enhancement technology and proposes changes to the ADA that would begin to address these problems.²⁸ It is important to bring the debate over cybernetic enhancement to the national stage quickly, since technology once seen only in science fiction is becoming common, everyday technology at an ever-increasing rate.²⁹

II. RECENT DEVELOPMENTS IN AMERICAN DISABILITY LAW AND CYBERNETIC-ENHANCEMENT TECHNOLOGIES

A. HISTORY OF DISABILITY LEGISLATION

1. The Americans with Disabilities Act of 1990

The Americans with Disabilities Act of 1990 protects the disabled against many forms of discrimination.³⁰ The ADA defines disability as “a physical or mental impairment that substantially limits one or more of the major life activities of [an] individual; a record of such impairment; or being regarded as having such an impairment.”³¹ Selected areas of ADA-prohibited

24. *Infra* Part II.B.

25. *Infra* Part II.C.

26. *Infra* Parts III.A–B.

27. *Infra* Part III.C.

28. *Infra* Part IV.

29. See Martha J. Farah et al., *Neurocognitive Enhancement: What Can We Do and What Should We Do?*, in *DEFINING RIGHT AND WRONG IN BRAIN SCIENCE*, *supra* note 12, at 289, 298–99 (concluding that national policymakers should begin considering the impact of neurocognitive enhancement soon); *infra* Part II.C (describing the law of accelerating returns).

30. Americans with Disabilities Act of 1990, 42 U.S.C. §§ 12101–12213 (2006); see also Peter David Blanck & Mollie Weighner Marti, *Attitudes, Behavior and the Employment Provisions of the Americans with Disabilities Act*, 42 *VILL. L. REV.* 345, 345–49 (1997) (explaining Title I of the ADA); Michael H. Gottesman, *Disability, Federalism, and a Court with an Eccentric Mission*, 62 *OHIO ST. L.J.* 31, 31–33 (2001) (detailing the twenty years of advocacy leading up to passage of the ADA). See generally Ruth Colker, *The ADA's Journey Through Congress*, 39 *WAKE FOREST L. REV.* 1 (2004) (examining the legislative history of the ADA and describing Congress's intent for the statute as “broad”); Nancy Lee Jones, *Overview and Essential Requirements of the Americans with Disabilities Act*, 64 *TEMP. L. REV.* 471 (1991) (providing a broad overview of the ADA).

31. 42 U.S.C. § 12102(2).

discrimination include employment, education, and public access.³² Covered under Title I, a typical ADA employment case involves a suit by an employee who claims her employer refused to provide her with an accommodation for her disability.³³ Much of the litigation under the ADA relates to employment discrimination.³⁴

One important question Congress left unresolved in the ADA is whether courts should take mitigating measures into account when determining whether an individual is disabled. The Supreme Court resolved this question in *Sutton v. United Air Lines, Inc.*, where the Court held that courts must take mitigating measures such as medication or mechanical devices into account when determining if someone is disabled.³⁵ In *Sutton*, the defendant airline refused to hire the plaintiff twins due to their extreme nearsightedness.³⁶ The Court concluded that the plaintiffs were not disabled within the meaning of the ADA because with the aid of corrective lenses, they were not substantially limited in a major life activity.³⁷ The *Sutton* Court reasoned that, under the ADA, “[a] disability exists only when an impairment ‘substantially limits’ a major life activity, not where it ‘might,’ ‘could,’ or ‘would’ be substantially limiting if mitigating measures were not taken.”³⁸ Lower courts have generally followed this reasoning,³⁹ and subsequent Supreme Court jurisprudence has upheld it.⁴⁰ Scholars and disability advocates have widely criticized the *Sutton* ruling as over-limiting the ADA’s coverage; claimants who were obviously “disabled” were denied coverage because of the “mitigating measures” they employed.⁴¹

32. *Id.* § 12101; see *Robertson v. Las Animas County Sheriff’s Dep’t*, 500 F.3d 1185, 1195–96 (10th Cir. 2007) (examining an ADA public-access claim brought by a prison inmate with a cochlear hearing implant). See generally Blanck & Marti, *supra* note 30 (analyzing the ADA’s Title I employment-discrimination provisions with empirical methods).

33. Blanck & Marti, *supra* note 30, at 353.

34. *Id.*

35. *Sutton v. United Air Lines, Inc.*, 527 U.S. 471, 482 (1999); see also Debra Burke & Malcolm Abel, *Ameliorating Medication and ADA Protection: Use It and Lose It or Refuse It and Lose It?*, 38 AM. BUS. L.J. 785, 793–800 (2001) (describing the history of the mitigating-measures issue and analyzing the *Sutton* case); Ian D. Thompson, Note, *Medicating the ADA—Sutton v. United Airlines, Inc.: Considering Mitigating Measures To Define Disability*, 28 PEPP. L. REV. 257, 268–74 (2000) (analyzing the mitigating-measures aspect of the Court’s holding in *Sutton*).

36. *Sutton*, 527 U.S. at 475–76.

37. *Id.*

38. *Id.* at 482.

39. See *Spades v. City of Walnut Ridge*, 186 F.3d 897, 900 (8th Cir. 1999) (holding that the ADA did not cover the plaintiff’s medication-controlled depression); *Popko v. Pa. State Univ.*, 84 F. Supp. 2d 589, 594 (M.D. Pa. 2000) (holding the same for a plaintiff with epilepsy).

40. *Murphy v. United Parcel Serv., Inc.*, 527 U.S. 516, 518–19 (1999) (holding that the plaintiff’s medication-controlled high blood pressure is not a disability within the meaning of the ADA).

41. NAT’L COUNCIL ON DISABILITY, *RIGHTING THE ADA* 43–47 (2004).

2. The 2008 Amendments to the ADA

In response to these criticisms, Congress passed the Americans with Disabilities Act Amendments Act (“ADAAA”) in 2008.⁴² In the ADAAA, Congress emphasized that it meant for the original ADA to extend broad coverage to people with disabilities.⁴³ The Amendments explicitly reject the Supreme Court’s holding in *Sutton* that courts determining whether an individual is disabled must take into account mitigating factors actually employed by the plaintiff.⁴⁴ The applicable language of the ADAAA reads as follows:

- (E)(i) The determination of whether an impairment substantially limits a major life activity shall be made without regard to the ameliorative effects of mitigating measures such as—
- (I) medication, medical supplies, equipment, or appliances, low-vision devices (which do not include ordinary eyeglasses or contact lenses), prosthetics including limbs and devices, hearing aids and cochlear implants or other implantable hearing devices, mobility devices, or oxygen therapy equipment and supplies;
 - (II) use of assistive technology;
 - (III) reasonable accommodations or auxiliary aids or services;
- or
- (IV) learned behavioral or adaptive neurological modifications.⁴⁵

The amendments also clarify that when an ADA claimant argues disability solely under the “regarded as” prong, the employer need not provide reasonable accommodation; however, the claimant may sue for discrimination under the third prong “whether or not the impairment limits or is perceived to limit a major life activity.”⁴⁶

The ADA and its recent amendments reflect Congress’s current view of disability and of the body: the baseline “able” person is the average, functioning human with all original parts intact, and no additions or modifications are relevant in the eyes of the law to the determination of whether someone is disabled. While current disability law is certainly well-

42. ADA Amendments Act of 2008, Pub. L. No. 110-325, 122 Stat. 3553 (to be codified in scattered sections of 42 U.S.C.); see Reuters, *Senate Measure Would Expand Disabilities Act*, N.Y. TIMES, Sept. 12, 2008, at A16 (noting the Senate’s approval of these amendments).

43. ADA Amendments Act § 2(a)(1).

44. *Id.* § 2(b)(2).

45. *Id.* § 3(4)(E).

46. *Id.* § 4(a); see also Dale Larson, Comment, *Unconsciously Regarded as Disabled: Implicit Bias and the Regarded-As Prong of the Americans with Disabilities Act*, 56 UCLA L. REV. 451, 485–86 (2008) (commending the ADAAA for expanding coverage under the “regarded as” prong of the disability test).

intentioned in its goal to eliminate disability discrimination, Congress will have to revisit the issue of mitigation when the mitigating factors become more significant. In the near future, advances in neuroscience and robotics may give rise to a restructured division between the disabled, the abled, and the “better abled,” as both disabled and healthy humans increasingly choose to replace or augment their limbs, organs, and even parts of their brains with mechanical upgrades.⁴⁷

B. *WE CAN REBUILD HIM, WE HAVE THE TECHNOLOGY: CURRENT REPLACEMENTS AND UPGRADES FOR HUMAN BODY PARTS*

More and more Americans are living with various mechanical devices implanted in their bodies, many of which are necessary to sustain life.⁴⁸ Modern medical science treats human bodies like machines—when parts wear out, we replace them. These parts fit into three main categories: joints and internal organs, brain–computer interfaces, and prosthetic limbs. All three areas have the potential for human enhancement.

1. Joints and Internal Organs

In an ironic twist, Arnold Schwarzenegger, who played the robotic Terminator in the 1984 science-fiction movie of the same name, is now part machine.⁴⁹ The California Governor’s artificial components include a metallic hip joint and a femur held together with screws and a metal plate.⁵⁰ Joint replacement has become quite common; an estimated one million joint-replacement surgeries occurred in the United States in 2008.⁵¹

Joint-replacement surgeries are the simplest example of what modern medical science can do to replace or modify human body parts. Current implantable medical devices range from machined-carbon heart valves and

47. See *infra* Part III.B (explaining how this scenario is likely to occur).

48. See Ellen M. McGee, *Should There Be a Law? Brain Chips: Ethical and Policy Issues*, 24 T.M. COOLEY L. REV. 81, 83–84 (2007) (listing and citing studies or research papers for many current body-part-replacement technologies, such as an artificial heart, artificial lungs, and hydraulic limbs for the paralyzed).

49. William Saletan, *Grandpa’s Got a Brand New Hip. And Elbow. And . . .*, WASH. POST, Sept. 14, 2008, at B2.

50. *Id.* Mr. Schwarzenegger has also had two heart valves replaced, although the new valves are not mechanical. *Id.* With regard to his surgeries, he said, “This is what happens when you are the Terminator. They switch body parts.” *Id.*

51. *Id.*

drug injectors to pacemakers.⁵² In fact, doctors can update the newest pacemakers wirelessly over the Internet.⁵³

Modern medical science can also replace the functions of vital organs. One author notes the importance of the kidney-dialysis machine at the beginning of the modern era of the mechanical medical device: “[The dialysis patient’s] case is symbolic of a dawning era in modern medicine. By all established criteria she should be dead. The kidney is a vital organ and life is not possible without it. Her kidney function is fatally defective, yet, because of a machine, she continues to live.”⁵⁴

2. Brain Implants and Brain–Computer Interfaces

Implanted medical devices have even moved to the most complex of human organs: the brain. Over 30,000 people worldwide have implants for deep-brain electrical stimulation, a technique whereby small electrodes generate scripted pulses of electricity to produce certain neural firing patterns.⁵⁵ These implants mainly serve to treat Parkinson’s disease, but some companies are pushing for FDA approval to use the devices for other conditions such as epilepsy, Tourette’s syndrome, pain, and depression.⁵⁶ Current deep-brain stimulation implants, which are about the size of peas, can download updated information wirelessly through the skull.⁵⁷

Perhaps the most significant development in brain technology is the brain–computer interface (“BCI”), a device that can directly impart sensory information to and receive instructions from the brain.⁵⁸ Many different BCI systems are under development.⁵⁹ They range from the non-invasive—such as calculating signals from an EEG skullcap—to the quite invasive

52. See HAROLD M. SCHMECK, JR., *THE SEMI-ARTIFICIAL MAN: A DAWNING REVOLUTION IN MEDICINE* 92–93 (1965) (describing the earliest pacemakers in the 1960s and noting that the two potential ways to install a pacemaker, “[b]izarre as they both seemed . . . were both possible”); McGee, *supra* note 48, at 84 (describing various mechanical organs).

53. See McGee, *supra* note 48, at 84 (describing the Internet capabilities of the latest pacemakers).

54. SCHMECK, *supra* note 52, at 4.

55. McGee, *supra* note 48, at 84.

56. *Id.*; see also *Davenport v. Medtronic, Inc.*, 302 F. Supp. 2d 419, 423–25 (E.D. Pa. 2004) (describing a patient’s deep-brain stimulation implant in the context of a medical-malpractice case). The effect of human-enhancement technologies on the field of health law is beyond the scope of this Note, although the field will face many of the same issues.

57. McGee, *supra* note 48, at 84.

58. See Eric Chan, Comment, *The Food and Drug Administration and the Future of the Brain-Computer Interface: Adapting FDA Device Law to the Challenges of Human-Machine Enhancement*, 25 J. MARSHALL J. COMPUTER & INFO. L. 117, 117–18 (2007) (defining the brain–computer interface).

59. See NAT’L RESEARCH COUNCIL, *EMERGING COGNITIVE NEUROSCIENCE AND RELATED TECHNOLOGIES* 84–85 (2008) (describing BCI systems that operate through functional neuroimaging).

implantation of devices inside the skull.⁶⁰ Generally, the more invasive methods provide greater accuracy and reliability.⁶¹ One researcher explains that living with a non-invasive BCI is similar to “listening to a symphony from the street outside the concert hall,” while living with an invasive BCI is more like “sitting in the front row.”⁶² One of the major backers of BCI research is the Defense Advanced Research Projects Agency (“DARPA”), the U.S. military’s primary research and development institution.⁶³ DARPA recently invested twenty-four million dollars in several BCI technologies.⁶⁴

Applications of BCI are many and varied. Over one hundred thousand people who were once totally deaf can now hear due to cochlear implants, devices that bypass the outer mechanisms of the ear by directly stimulating the inner ear.⁶⁵ Neuroelectric implants in the eye or visual cortex provide vision for the formerly blind.⁶⁶ The InnerSpace Foundation, a transhumanist organization, once offered a prize for demonstration of a working memory device that interfaces with the brain.⁶⁷ The non-profit X PRIZE Foundation recently held a workshop, intended to develop a prize to spur competition and growth in the field of BCI at the Massachusetts Institute of Technology.⁶⁸ BCI technology is also the key to effective control

60. *Id.* at 51–66.

61. *Harnessing the Power of the Brain: Scott Pelley Reports How Brain Computer Interface May Help the Paralyzed in the Future*, CBS NEWS, Nov. 2, 2008, <http://www.cbsnews.com/stories/2008/10/31/60minutes/main4560940.shtml> [hereinafter *Harnessing*].

62. *Id.*

63. HUGHES, *supra* note 9, at 40; Carl Zimmer, *Mind over Machine*, POPULAR SCI., Feb. 2004, at 46, 48.

64. Zimmer, *supra* note 63, at 48; *see also* Stephen E. White, Note, *Brave New World: Neurowarfare and the Limits of International Humanitarian Law*, 41 CORNELL INT’L L.J. 177, 177–83 (2008) (examining DARPA’s goals and recent research initiatives in the field of brain-computer interfaces).

65. McGee, *supra* note 48, at 83.

66. *See* Kotler, *supra* note 8 (describing the world’s first successful vision-replacement experiment, after which the patient could see well enough to drive a convertible around the hospital parking lot).

67. *See Don’t Leave Your Memory at Home: A Conversation with Pete Estep of InnerSpace Foundation*, H+ MAG., Fall 2008, at 24, 24–27, available at http://www.hplusmagazine.com/hplus_mag_fall_2008.pdf [hereinafter *Don’t Leave Your Memory at Home*] (describing the InnerSpace Foundation and its “Learning Prize,” awarded to the developer of “a device that allows storage and later retrieval of memory information” (internal quotation marks omitted)). The Chairman of the InnerSpace Foundation emphasized the importance of the project, noting that “the human brain is a magnificent . . . collection of abilities, but for fast and accurate storage and retrieval of important information, even a humble keychain flash drive has overtaken us.” *Id.* at 25.

68. Posting of Rod Furlan to Singularity Hub, *Igniting a Brain-Computer Interface Revolution—BCI X PRIZE*, <http://singularityhub.com/2010/01/21/igniting-a-brain-computer-interface-revolution-bci-x-prize/> (Jan. 21, 2010).

of prosthetic limbs; scientists have reliably demonstrated a monkey's ability to control external mechanical limbs with its brain alone.⁶⁹

Invasive-human-BCI experiments include devices such as the BrainGate, which successfully enabled an almost totally paralyzed patient to control the cursor on a computer screen.⁷⁰ He could use the Internet, check e-mail, and do most tasks that he would otherwise have performed with a mouse.⁷¹ CBS's 60 Minutes recently featured another recipient of the BrainGate interface—a professor with amyotrophic lateral sclerosis (more commonly known as Lou Gehrig's disease) whose condition now limits him to eye movement only.⁷² With his new BCI, the professor is able to communicate more easily and even returned to work at his lab.⁷³ Along with other similar technologies, the BrainGate is in human clinical trials and well on its way to the marketplace.⁷⁴ Its creators envision that devices such as the BrainGate will one day enable users to control any device that is connected to a computer.⁷⁵

Although many obstacles to BCI development remain, such as the development of scar tissue around the electrodes and the difficulties of connecting to individual neurons, several recent discoveries may significantly decrease these obstacles.⁷⁶ In October 2008, scientists announced the development of a brain implant with "roving" electrodes that seek out and connect directly to individual neurons.⁷⁷ This new technology

69. See Michael D. Lemonick & Kristina Dell, *Robo-Monkey's Reward*, TIME, Oct. 27, 2003, available at <http://www.time.com/time/magazine/article/0,9171,1005971,00.html> (detailing the results of a brain-computer-interface experiment). Scientists outfitted a monkey with a device that listened to the nerve signals directed towards its arm. *Id.* The nerve signals went into a robotic arm that moved as the monkey's did while the monkey played a simple video game. *Id.* After a few weeks, the monkey stopped moving his real arm and controlled the robotic arm through thought alone. *Id.*

70. Chan, *supra* note 58, at 125–26.

71. *Id.*

72. *Harnessing*, *supra* note 61. The fact that a show as popular as 60 Minutes ran a feature on BCI technology indicates that this issue is well on its way into mainstream public debate: "Quietly in a number of laboratories, an astounding technology is developing that directly connects the human brain to a computer. It's like a sudden leap in human evolution—a leap that could one day help paralyzed people to walk again and amputees to move bionic limbs." *Id.*

73. *Id.*

74. *Id.*; see also BrainGate, Clinical Trials, <http://www.braingate2.org/clinicalTrials.asp> (last visited Mar. 27, 2010) (describing the clinical trials for the BrainGate device).

75. *Harnessing*, *supra* note 61.

76. See Chan, *supra* note 58, at 135–37 (describing several current problems with BCI technology).

77. Paul Marks, *Roving Brain Electrodes Reverse Paralysis in Monkeys*, NEW SCIENTIST, Oct. 15, 2008, <http://technology.newscientist.com/article/dn14948-roving-brain-electrodes-reverse-paralysis-in-monkeys.html>.

could significantly increase accuracy of the electrical signal.⁷⁸ The development of electrodes coated in carbon nanotubes has decreased the likelihood of scar-tissue problems in the brain.⁷⁹ Finally, researchers have successfully grown human-nerve cells into a working electric circuit that could provide a better gateway or buffer interface between the brain and the electronics in a prosthetic limb.⁸⁰

3. Advanced Prosthetic Limbs

The quality and functionality of replacement limbs has advanced significantly over the past several decades, culminating in a recent “explosion” of new control techniques driven by military injuries and diabetic amputations.⁸¹ Prosthetic limbs were once limited to unwieldy and poorly functioning replacements constructed from wood and metal.⁸² Modern manufacturing processes improved these crude devices, but they were still quite limited due to the fact that the wearer had to use an awkward system of pulleys and levers to operate the prosthetic.⁸³ The addition of motors did not help due to the fact that the wearer had to consciously operate each motor individually.⁸⁴ Robotic prosthetics are now approaching levels of human functionality; most importantly, prosthetics users may now control their limbs through thought alone.⁸⁵

Currently, some of the most advanced prosthetics use a technique called targeted muscle reinnervation, also known as a myoelectric interface.⁸⁶ One example of an advanced myoelectric prosthetic, the so-called “Luke Arm,” features eighteen points of movement and weighs only

78. *Id.* (“Implants like these could also control prosthetic limbs more precisely because they relay signals from carefully chosen neurons, rather than having software calculate a signal from recordings of many different cells.”).

79. See Laura Mgrdichian, *Carbon Nanotube-Coated Electrodes Improve Brain Readouts*, PHYSORG.COM, Aug. 12, 2008, <http://www.physorg.com/news137768659.html> (describing the positive results of a recent experiment).

80. See Colin Barras, *Computer Circuit Built from Brain Cells*, NEW SCIENTIST, Oct. 23, 2008, <http://www.newscientist.com/article/dn15019> (explaining how scientists constructed a working circuit from human neurons).

81. See Defense Sciences Office, *Revolutionizing Prosthetics*, http://www.darpa.mil/dso/thrusts/bio/restbio_tech/revprost/index.htm (last visited Mar. 27, 2010) (outlining DARPA’s project to develop a human-arm-equivalent robotic prosthesis, including sensory feedback, in four years).

82. Kim M. Norton, *A Brief History of Prosthetics*, INMOTION, Nov.–Dec. 2007, available at http://www.amputee-coalition.org/inmotion/nov_dec_07/history_prosthetics.html.

83. *Id.*

84. Pam Belluck, *In New Procedure, Artificial Arm Listens to Brain*, N.Y. TIMES, Feb. 11, 2009, at A1.

85. *Id.*

86. See Chan, *supra* note 58, at 122–23 (describing the history of myoelectric prostheses and the science behind their function).

3.6 kilograms, about the same weight as a real human arm.⁸⁷ In addition to a traditional control system with buttons and levers, doctors can install the arm by rerouting the nerves that used to go to the patient's arm into muscles in her chest.⁸⁸ Doctors then attach these nerves to the prosthetic.⁸⁹ Electrical impulses from the brain that would have controlled the patient's actual but missing arm are thus rerouted to the robotic arm, which is capable of performing many everyday tasks.⁹⁰ A soldier who received the device after losing his left arm in Iraq remarked that "[t]he difference is I'm not really thinking about it. . . . I kind of just do it."⁹¹ The soldier has DARPA to thank for providing a large portion of the funding for the Luke Arm.⁹² The researchers working on the Luke Arm have also developed methods to provide sensory feedback to the user.⁹³ After scientists are able to improve the interface further, advanced prosthetics like the Luke Arm are probably not far from becoming more articulate and much stronger than the arm of an ordinary human. One artificial arm currently under development demonstrates how such devices can be superior to human arms in some ways—it can lift weights most people have trouble with and only tires when its batteries run out.⁹⁴

4. New Horizons: Nanotechnology and Extension of the Senses

The possible uses of BCI go beyond restoration and enhancement of existing human functions; it is possible for a BCI to literally add new functions. Scientists are working on devices that can create new senses.⁹⁵ For example, Intel is developing a robotic hand that can sense objects before it touches them by using magnetic fields in a way that mimics the sensory

87. Sarah Adee, *Dean Kamen's "Luke Arm" Prosthesis Readies for Clinical Trials*, IEEE SPECTRUM, Feb. 2008, <http://spectrum.ieee.org/biomedical/bionics/dean-kamens-luke-arm-prosthesis-readies-for-clinical-trials>. The device is dubbed the "Luke Arm" to reference the fact that modern prostheses are approaching the sophistication of Luke Skywalker's robotic hand in the movie *The Empire Strikes Back*. *Id.*

88. *See* Chan, *supra* note 58, at 122–23 (describing the myoelectric procedure).

89. *Id.* at 122.

90. *Id.* at 122–23.

91. Belluck, *supra* note 84.

92. Adee, *supra* note 87.

93. Belluck, *supra* note 84.

94. Kate Foster, *Scotland Joins Arms Race with Superhuman Strength*, SCOTSMAN.COM, Jan. 6, 2008, <http://news.scotsman.com/scitech/Scotland-joins-arms-race-with.3644501.jp> ("The i-Limb system is better than a human arm. It is faster and can lift heavier weights than a human arm. It also looks good, has smooth movement, and operates with less noise than existing prosthetic arms." (internal quotation marks omitted)).

95. Chan, *supra* note 58, at 118 (noting that the possibilities "will be limited only by the plasticity of the brain and its ability to adapt to strange new body parts").

perception of sharks.⁹⁶ Cortical implants will one day allow users to see beyond the currently visible spectrum of light.⁹⁷ Professor Kevin Warwick was able to use a neuroelectric device implanted into the median nerve of his wrist to guide himself around a room blindfolded, using only the electrical feedback from an ultrasonic range-finding sensor mounted on his hat.⁹⁸ NASA even has a research subcommittee called the Extension of the Human Senses Group.⁹⁹

Nanotechnology, the manipulation of matter at the scale of billionths of meters, may enable the most radical enhancement technology.¹⁰⁰ Some examples of nanotechnology enhancements include “roboblood” (the total replacement of all red and white blood cells with billions of nanobots), direct replacement of individual neurons, and highly integrated BCI capable of projecting full-immersion virtual reality from within the nervous system.¹⁰¹ While these possibilities may seem like science fiction, they are likely to become reality within the next few decades, since the pace of technological progress is much faster now than it has ever been.¹⁰²

C. THE FUTURE IS CLOSER THAN YOU THINK:
THE LAW OF ACCELERATING RETURNS

The pace of modern scientific research is staggering; one researcher noted in 1965 that “more has happened to man in terms of technicological [sic] advance, life control, death control, communication, etcetera, in the last 100 years than happened in *all of prior recorded time put together*.”¹⁰³ All the above technologies benefit from what prominent inventor and computer scientist Ray Kurzweil termed the “Law of Accelerating Returns,” which describes the exponentially accelerating pace of technological development.¹⁰⁴ Presently, computers double in price performance about

96. Posting of Joshua Fruhlinger to Engadget, Intel Shows Off Robotic Hand with ‘Pre Touch’ Object Conformation, <http://www.engadget.com/2008/06/12/intel-shows-off-robotic-hand-with-pre-touch-object-conformatio/> (June 12, 2008, 9:43 EST).

97. See Kotler, *supra* note 8 (describing how cortical implants could increase human vision beyond natural capabilities).

98. See Chan, *supra* note 58, at 132–33 (describing Warwick’s experiment in extending human senses).

99. McGee, *supra* note 48, at 85.

100. See RAY KURZWEIL, *THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY* 226–27 (2005) (defining nanotechnology).

101. *Id.* at 253–55.

102. Belding H. Scribner, Ethical Problems of Using Artificial Organs To Sustain Human Life (Apr. 1964), in SCHMECK, *supra* note 52, at 208, 213.

103. *Id.* (emphasis added). Schmeck, Jr., referencing technological advancement, remarked that “[t]hese new possibilities, in turn, sometimes transform the impossible into the conceivable, the conceivable into the routine.” SCHMECK, *supra* note 52, at 196.

104. KURZWEIL, *supra* note 100, at 35.

every year.¹⁰⁵ Since modern prosthetics and implants often have microprocessors built in, these technologies directly benefit from the accelerated development, increased miniaturization, and decreased cost of computers.¹⁰⁶

The exponential growth of computational performance has profound implications for any field integrated with information technology.¹⁰⁷ This process transformed medical neuroscience laboratories over the past few decades, as every exponential increase in the availability of computing power corresponds to a similar increase in scientists' ability to develop even more advanced neuroscience technology.¹⁰⁸ This is because the design systems used to develop new technologies are also increasing exponentially in power and capability.¹⁰⁹ For example, the resolution of the brain-scanning technologies vital to BCI development has been improving substantially.¹¹⁰

As the pace of technological innovation continues to accelerate, it is only a matter of time before we move from constructing devices that let the blind see to devices that will enable the human eye to see in infrared and zoom to microscopic close-ups or eagle's-eye distances.¹¹¹ Cybernetic-enhancement technologies such as these are likely to enter the marketplace within the next few decades.¹¹² The legal and ethical considerations

105. *Id.* at 56. Kurzweil examines many measures of computational ability, including the dimensions of elements on a chip and the price per bit of memory and hard-disk storage. *Id.* One humbling example of the sheer scale of this proposition is computer-hardware manufacturer NVIDIA's recent release of a graphics card boasting almost a teraflop (one trillion floating point instructions per second) of processing power at a price under six hundred dollars. Posting of Bryan Gardiner to Tech Biz, Supercomputing Power Hits the Desktop, Minus the Software, http://www.wired.com/techbiz/it/news/2008/06/gpu_power (June 20, 2008). Eleven years ago, the U.S. Government spent about thirty-three million dollars to build a supercomputer with a similar processing capability of one teraflop. *Id.*

106. See NAT'L RESEARCH COUNCIL, *supra* note 59, at 90 ("The elaboration of foundational concepts for cognitive and robotic prostheses . . . happily dovetail with progress in the miniaturization of computing devices.").

107. KURZWEIL, *supra* note 100, at 35–36 (demonstrating how any field closely associated with information technology benefits from the increase in computing price performance).

108. *Id.*

109. *Id.*

110. *Id.* at 162. Kurzweil mentions one scanning camera under development with a spatial resolution high enough to resolve individual neurons. *Id.* This camera also has a millisecond temporal resolution, "which is sufficient to record the firing of each neuron." *Id.*; see also Greely, *supra* note 12, at 612–13 (describing recent advances in brain-scanning technology, such as functional-magnetic-resistance imaging).

111. This is, more or less, exactly what DARPA envisions for U.S. soldiers. White, *supra* note 64, at 180; see also HUGHES, *supra* note 9, at 18 (explaining the likely development of bionic eyes that can see beyond the currently visible spectrum of light).

112. See Walter Glannon, *Introduction to DEFINING RIGHT AND WRONG IN BRAIN SCIENCE*, *supra* note 12, at xiii, xvii (describing how cybernetic enhancement is the likely direction of neuroscience research; "neuroscience and technological medicine will likely transform cyborgs—integrated complexes that are part human and part machine—from imagination to reality").

surrounding disability must therefore adapt to stay relevant.¹¹³

III. RETHINKING DISABILITY LAW

A. RESTORATION VERSUS ENHANCEMENT: THE PROBLEM OF THE BETTER ABLED

There is no question that modern science will develop cybernetic-enhancement technologies; these technologies are either already on the way or are already here.¹¹⁴ The question policymakers now struggle with is the normative question—the *should*. A question central to the debates around human enhancement is how to determine whether a particular technology is restoring human function or enhancing that function. Scholars are conflicted over where to draw the threshold line between restoration and enhancement¹¹⁵—or whether to draw the line at all.¹¹⁶ The fact that most restorative technologies are “dual-use,” having at least the potential for enhancement, complicates the problem.¹¹⁷ Technologies that scientists initially developed for therapeutic reasons often find their way into enhancement uses as well.¹¹⁸

Many are predicting that the 21st century will be the century of neuroscience. Humanity’s ability to alter its own brain function might well shape history as powerfully as the development of metallurgy in the Iron Age, mechanization in the Industrial Revolution, or genetics in the second half of the twentieth century.

Farah et al., *supra* note 29, at 289; *see also* Martha J. Farah, *Emerging Ethical Issues in Neuroscience*, 5 NATURE NEUROSCIENCE 1123, 1125 (2002) (“Nanotechnology and neural prostheses might eventually create a breed of enhanced human cyborgs.”).

113. *See* Scribner, *supra* note 102, at 213 (noting the importance of updating our ethics in light of advances in modern science).

114. *See supra* Part II.B (describing recent developments in cybernetic technologies).

115. *See* Farah, *supra* note 112, at 1125 (describing complications in the ethical analysis of human enhancement); Maxwell J. Mehlman, *The Law of Above Averages: Leveling the New Genetic Enhancement Playing Field*, 85 IOWA L. REV. 517, 540–54 (2000) (offering a bleak view of what a society where genetic enhancement is commonplace might look like); Shapiro, *supra* note 19, at 778 (examining the treatment-versus-enhancement problem in the context of genetics and our conception of equality); R. George Wright, *Personhood 2.0: Enhanced and Unenhanced Persons and the Equal Protection of the Laws*, 23 QUINNIPIAC L. REV. 1047, 1050–51 (2005) (describing the difference between therapy and enhancement). Wright introduces the problem through the recent medical practice of injecting abnormally short children with human-growth hormone. *Id.* If used, say, by a basketball-loving dad to make his normal child taller, most people would view it as enhancement. *See id.* (noting the difficulty of defining the use of human-growth hormone as always therapeutic or always an enhancement).

116. *See generally* Isabel Karpin & Roxanne Mykitiuk, *Going Out on a Limb: Prosthetics, Normalcy and Disputing the Therapy/Enhancement Distinction*, 16 MED. L. REV. 413 (2008) (criticizing the distinction between therapy and enhancement as untenable).

117. *See* Greely, *supra* note 10, at 90 (emphasizing how many restorative technologies will likely become enhancement technologies).

118. *Id.*

An analogy to the establishment and growing popularity of cosmetic surgery illustrates the restoration–enhancement problem.¹¹⁹ When a patient undergoes nose-reconstruction surgery after a car accident, plastic surgery is restorative and acceptable.¹²⁰ However, when a patient undergoes nose-reconstruction surgery to improve the appearance of his otherwise healthy nose, plastic surgery is enhancement and somewhat controversial.¹²¹ Sports law further illustrates the blurriness of this distinction. For example, in baseball, enhancements such as nutrition, psychological training, tendon-tightening surgery, and high-tech gear are fine, but steroids are not.¹²²

If taken broadly, all technology has the potential for human enhancement.¹²³ From the first cavemen who discovered fire to the advent of the modern education system, humanity has used technology to enhance itself.¹²⁴ In that sense, humanity is dependent upon its tools.¹²⁵ The difference today is that we face the prospect of merging with our tools rather than simply using them, a development that is likely to occur within the next few decades as the distinction between restoration and enhancement continues to blur.

*B. PARADIGM SHIFT: WHY WIDESPREAD CYBERNETIC
ENHANCEMENT IS A LIKELY SCENARIO*

Eventually, common cybernetic devices will be capable of enhancing human function beyond the baseline level rather than restoring human function to that level.¹²⁶ Given the blinding speed with which people accept and adapt to new technology,¹²⁷ it is not difficult to envision a future where cybernetic upgrades are commonplace. It is easy to see how a robotic arm could be better than a human one: greater freedom of movement in joints, additional degrees of articulation, and vastly increased strength. Neural prostheses will enable us to connect our brains directly to the Internet and

119. *See id.* at 89 (examining the complications of human enhancement through the context of cosmetic surgery).

120. *Id.*

121. *Id.*

122. *See* Greely, *supra* note 10, at 89 (discussing the controversy).

123. *See id.* at 88 (describing the inherent potential of any technology for human enhancement).

124. *Id.*

125. *Id.*

126. *See supra* Part II.B (describing recent advances in cybernetic technology).

127. KURZWEIL, *supra* note 100, at 48–50 (explaining the increase in the rate of “paradigm shift” with each new generation of technology). While Americans took over fifty years from the invention of the telephone to adopt its use at significant levels (i.e., use by one quarter of the American population), they only took ten years to adopt the cell phone. *Id.* Kurzweil observes that the rate of paradigm shift is doubling about every decade: “At this rate, technological progress in the twenty-first century will be equivalent . . . to two hundred centuries of progress (at the rate of progress in 2000).” *Id.*

communicate via thought.¹²⁸ As enhancements become more common, they may seem as necessary to everyday life as cell phones seem to us today. Recall that cell phones basically did not exist in their current form twenty years ago. Now, it is almost unthinkable to operate in this country without one.

The development of enhancement technology will probably lead to a similar phenomenon, with widespread use leading to the enhanced majority viewing the unenhanced as disabled:

In time, the attitude could become ingrained that in order to be successful in life one has to submit one's body to all manner of enhancing interventions available. As a result, attitudes towards conventional human abilities could change quite negatively. *Average abilities could become almost akin to defects, in need of elimination.* People could become afraid that their bodies and skills are fundamentally inadequate. As a result, enhancement interventions could trigger a process of medicalization of thus far absolutely ordinary functioning human abilities and normal physical appearances.¹²⁹

Arguably, we have already started down this path. Our lives are increasingly medicalized; the number of artificial body parts implanted in patients continues to increase.¹³⁰ A patient undergoing restorative surgery might ask for enhancement instead: if the doctor is using lasers to correct her vision to the baseline of 20/20, why not go for 20/15, or even 20/8? People are increasingly ready and willing to go "under the knife" in order to enhance the appearance of their bodies.¹³¹ Cosmetic-enhancement procedures are well established and immensely popular.¹³²

As technology continues to advance, people will become more willing to undergo surgical procedures to enhance the function as well as the form of their bodies.¹³³ Another likely path toward more widespread enhancement is the U.S. military, which seemingly has no qualms about human enhancement.¹³⁴ The military could require and pay for cybernetic upgrades

128. Wright, *supra* note 115, at 1053–54.

129. Gordijn, *supra* note 7, at 730 (emphasis added).

130. See *supra* Part II.B (examining various parts of the human body that medical science has successfully replaced with mechanical devices).

131. See Jacqueline A. Gilbert, Lookism, Workplace Bias, and the Plastic Surgery Explosion, <http://www.diversitybusiness.com/news/diversity.magazine/99200819.asp> (last visited Mar. 27, 2010) (noting that from 1997 to 2005, "the number of non-surgical cosmetic treatments has risen 764 percent").

132. *Id.*

133. See Gordijn, *supra* note 7, at 730 (analyzing a scenario in which enhancement technologies could become commonplace).

134. Michael Sokolove, *The Scold*, N.Y. TIMES, Jan. 7, 2007, available at <http://www.nytimes.com/2007/01/07/magazine/07Antidoping.t.html> ("My measure of success for this is that the [International Olympic Committee] bans everything that we do." (quoting the head of DARPA's "metabolically enhanced soldier project")).

for its soldiers. When these enhanced soldiers become civilians and begin outperforming their neighbors, their neighbors will likely desire the enhancements as well.

Although individual governments may decide to ban enhancement technologies due to their potential for abuse, such a ban in one country would likely succeed only to increase medical tourism, where would-be upgraders move to states where enhancement is legal.¹³⁵ Bans may not happen at all in many countries, if the transhumanist movement is successful in advocating for the significant extension of human capabilities through enhancement technology.¹³⁶

Businesses and individuals are already considering real-world applications of cybernetic-enhancement technologies. One company proposed a concept for an implantable cell phone, which consists of a thin film under the skin of the forearm, powered by the user's blood.¹³⁷ Additionally, design studios are already considering the aesthetics of producing mind-controlled prosthetics as concept pieces.¹³⁸

Some people have already chosen to upgrade. One example of a non-disabled human who underwent cybernetic enhancement is Professor Kevin Warwick.¹³⁹ In 2002, doctors implanted electrodes into Warwick's arm.¹⁴⁰ These electrodes interfaced directly with the median nerve in his wrist, allowing him to control a robotic arm and navigate blindfolded using an ultrasound device.¹⁴¹ Another example involves an artist who lost an eye in a car accident and is working with researchers to construct a cybernetic replacement that will be capable of recording his visual experience during every waking hour.¹⁴²

The profound changes that enhancement technology brings will require significant reevaluation of our conception of the body.¹⁴³ They will

135. See Greely, *supra* note 10, at 107–08 (explaining how outlawing enhancement procedures in one country would likely lead to increased “enhancement touris[m]” to other countries).

136. See Humanity+, *supra* note 22 (describing the goals of the organization).

137. Lisa Zyga, *Electronic Tattoo Display Runs on Blood*, PHYSORG.COM, Feb. 21, 2008, <http://www.physorg.com/news122819670.html>.

138. PlayMeDesign, *Immaculate*, <http://playmedesign.carousel.no/graphics/immaculate/> (Jan. 26, 2009).

139. See KEVIN WARWICK, I, *CYBORG* 42–45 (2004) (examining the author's experiences with cybernetically upgrading himself).

140. *Id.* at 207–16 (describing the procedure).

141. *Id.* at 183, 263–66 (describing how the arm functions).

142. Joel Garreau, *The Eye of a Dream Beheld: A Crash Victim's Hope and a Techie Response*, WASH. POST, Jan. 22, 2009, at C1.

143. Gordijn, *supra* note 7, at 729 (discussing the concept of the posthuman body in the context of human-enhancement technologies).

also pose significant problems for our closely held egalitarian values.¹⁴⁴ The plausibility of widespread cybernetic-enhancement highlights the nature of disability as a social construct.

C. *THE ADA EMBODIES DISABILITY AND IS NOT EQUIPPED TO
HANDLE WIDESPREAD CYBERNETIC ENHANCEMENT*

1. Disability Is Best Defined as a Fluid Social Construct

Contemporary disability theory focuses on how society creates disability.¹⁴⁵ This analysis depends upon social norms of the body.¹⁴⁶ As one author explains:

We live in a world of norms. Each of us endeavors to be normal or else deliberately tries to avoid that state. . . . We rank our intelligence, our cholesterol level, our weight, height, sex drive, bodily dimensions along some conceptual line from subnormal to above-average. . . . There is probably no area of contemporary life in which some idea of a norm, mean, or average has not been calculated.¹⁴⁷

This process of normalization creates a situation where there is one “normal” type of body to have, and any type of body outside of that norm is disabled.¹⁴⁸ The social-constructivist approach to disability rejects the dichotomy between the terms disabled and non-disabled.¹⁴⁹ Disability-studies scholars argue that the nature of disability is a social construct that changes over time.¹⁵⁰ “[T]he object of disability studies is not the person using the wheelchair or the Deaf person but the set of social, historical, economic, and cultural processes that regulate and control the way we think about and think through the body.”¹⁵¹

144. See Shapiro, *supra* note 19, at 776–79 (discussing the difficult ethical questions related to equality that are posed by human enhancement); Wright, *supra* note 115, at 1053–56 (examining how widespread enhancement could create an increasingly stratified society).

145. See GERARD GOGGIN & CHRISTOPHER NEWELL, *DIGITAL DISABILITY: THE SOCIAL CONSTRUCTION OF DISABILITY IN NEW MEDIA* 148–49 (2003) (examining how the new information society functions to construct disability in new ways).

146. MAIRIAN CORKER & TOM SHAKESPEARE, *DISABILITY/POSTMODERNITY: EMBODYING DISABILITY THEORY*, at xii–xiii (2002) (setting out the basics of the social theory of disability).

147. LENNARD J. DAVIS, *ENFORCING NORMALCY: DISABILITY, DEAFNESS, AND THE BODY* 23 (1995).

148. *Id.* at 23–24.

149. See Lisa Eichhorn, *Applying the ADA to Mitigating Measures Cases: A Choice of Statutory Evils*, 31 ARIZ. ST. L.J. 1071, 1077–79 (1999) (describing disability as a “fluid, socially constructed concept”).

150. See DAVIS, *supra* note 147, at 2–4 (examining the nature of disability as a social construct).

151. *Id.* at 2.

Disability is thus context sensitive—certain disabilities disappear in certain contexts, such as being unable to tell that the sender of an e-mail is deaf.¹⁵² Many of today’s mentally challenged people would have been average, “able” humans one or two centuries ago.¹⁵³ Additionally, a dyslexic individual would have been able to function quite easily five hundred years ago when most people were illiterate; today, such an individual could easily be considered “disabled” in our primarily text-driven society. The ADA and its amendments do not reflect the nature of disability as a social construct. The problems with the ADA that cybernetic enhancement highlights fall into two major categories: mitigating factors and comparative discrimination.

2. Categorically Barring Mitigating Factors from Consideration Embodies Disability and Will Lead to Unusual and Unfair Results

By overturning the Supreme Court construction of the ADA as including “mitigating factors,” Congress emphasized its conception of the human body as solely its flesh-and-bone biological makeup. This approach forces the concept of disability into the bodies of the disabled, condemning amputees to permanent disability status and creating problems when healthy individuals choose to replace parts of their bodies with cybernetic devices. For example, if a woman chose to replace her right leg with an enhanced cybernetic limb, the limb would fall into the category of “prosthetics including limbs and devices” under the ADAAA.¹⁵⁴ Since the ADAAA bans such mitigating factors from consideration, this woman would be legally disabled, even though her new leg is actually better than the old one. She may now sue her employer for disability discrimination. This broad “prosthetics including limbs and devices” language would include any and all replacement body parts. What if everyone else at her company replaces their arms with cybernetic upgrades and she does not? Paradoxically, she would then become the only non-disabled employee, even though her colleagues all enjoy superior capabilities.

Categorically excluding mitigating measures also swallows the “substantially limiting” language of the ADA, leading to the nonsensical result that if an individual is able to control his disability to such an extent

152. *Id.* at 13 (“In the space of e-mail, for example, some disabilities disappear: the Deaf, for example, or people using wheelchairs or with other physical limitations, are not disabled.”). Indeed, the accelerating pace of technological change makes the nature of disability as a social construct easier to notice. For a discussion of how the ADA should apply to Internet use by the blind, see Katherine Rengel, Comment, *The Americans with Disabilities Act and Internet Accessibility for the Blind*, 25 J. MARSHALL J. COMPUTER & INFO. L. 543, 543–50 (2008) (discussing recent case law on Internet accessibility for the blind).

153. See DAVIS, *supra* note 147, at 2–4 (examining how the Industrial Revolution “created” disability in the 1800s).

154. ADA Amendments Act of 2008, Pub. L. No. 110-325, § 4, 122 Stat. 3553, 3556.

that it becomes an enhancement over ordinary human abilities, he may still bring suit under the ADA. The more of his body parts he chooses to replace with cybernetic upgrades, the more disabled he becomes. The ADAAA states that basic corrective lenses are the only mitigating factors courts can take into account.¹⁵⁵ Under the ADAAA, a nearsighted individual employing ordinary contacts is not disabled, but a blind individual with an advanced ocular prosthetic is.¹⁵⁶

3. The ADA Does Not Protect Unenhanced Individuals Against Comparative Discrimination

Nothing in the ADA provides protection from comparative discrimination, where enhanced individuals discriminate against an otherwise ordinary individual whom they consider “disabled” due to his lack of upgrades. The ADA simply does not contemplate the possibility that the majority of people may one day view ordinary human capabilities as disabilities. Given the likelihood of widespread cybernetic enhancement, it may not be long before an otherwise healthy but unenhanced individual files suit under the ADA for discrimination against him in favor of an enhanced individual.

Consider the following hypothetical. Potential employees *A* and *B* both apply for a job with Corporation. *A* has installed in his brain a prosthetic memory device that enables recording and retrieval of information with the accuracy and detail of a computer.¹⁵⁷ Such a device would be as common as today’s cell phone. *B* has made a personal choice not to install this device. All other qualifications are roughly equal. After learning of *A*’s implant and *B*’s lack of implant, the employer decides to hire *A*, the enhanced individual. Has actionable discrimination under the ADA occurred? The ADAAA’s changes to the “regarded as” prong are unclear on this point since they do not define impairment.

Now imagine that *B* works for a large company that always keeps its employees flush in the latest technology. The company’s new computer system only takes input from direct connection via a head-jack BCI. The company requires and pays for head-jack implants for all its employees. *B* refuses. Although *B* is still useful to the company, the other employees ridicule him, calling him “obsolete” and “defective.” The company refuses to make reasonable accommodations to allow *B* to use the computer system. Does *B* have a valid Title I ADA claim? It appears that under the ADAAA, *B* is trapped. He cannot successfully claim disability under the first or second

155. *Id.*

156. *See id.* (stating that “ordinary eyeglasses or contact lenses” are excluded from the list of mitigating circumstances).

157. *See Don’t Leave Your Memory at Home, supra* note 67, at 26 (explaining how such a memory device could function).

prongs because the court cannot take the head-jacks into account in its analysis. They are a “mitigating factor,” and nothing in the ADA provides for the consideration of “mitigating factors.” Without this consideration, in the eyes of the law *B* is the same as his workmates. The court may also reason that he does not have an impairment. The third prong does not help him either. Even if the court broadly interprets “impairment” to include ordinary human function, his employer need not make reasonable accommodations.¹⁵⁸

The ADAAA is not without its strong points. The focus on the employer’s treatment of the claimant rather than whether the individual is disabled is a step in the right direction.¹⁵⁹ The ADAAA states that “the primary object of attention in cases brought under the ADA should be whether entities covered under the ADA have complied with their obligations . . . the question of whether an individual’s impairment is a disability under the ADA should not demand extensive analysis.”¹⁶⁰ Despite this language, courts still must answer in every case the threshold question of whether the claimant is disabled.

Disability is in constant flux and a concise definition is difficult to pin down. A better provision would focus simply on whether the employer has made a reasonable accommodation for the plaintiff’s unique body without mentioning disability at all. With the above considerations in mind, Congress should take action to preserve the relevance of the ADA.

IV. SUGGESTIONS FOR LEGISLATIVE ACTION

A. CONGRESS SHOULD REQUIRE EXISTING FEDERAL SCIENTIFIC PANELS TO CONSIDER THE ETHICAL AND MORAL IMPLICATIONS OF CYBERNETIC-ENHANCEMENT TECHNOLOGIES

Congress should consider cybernetic-enhancement technologies through some of the same processes and institutions Congress applies to other fields of advanced technology. Many of these institutions have directly considered the issue of human enhancement. For example, the President’s Council on Bioethics has been examining the ethical issues that human enhancement invokes, although its focus is almost entirely on genetic and pharmacological enhancement.¹⁶¹ Congress has also specifically addressed the possibility of nanotechnology dramatically enhancing human capabilities in

158. ADA Amendments Act § 6.

159. Larson, *supra* note 46, at 485.

160. ADA Amendments Act § 2.

161. See PRESIDENT’S COUNCIL ON BIOETHICS, *supra* note 13, at xv–xix (describing the purpose of the council).

the 21st Century Nano-Technology Research and Development Act, which created a series of ethics panels to analyze the relevant questions.¹⁶²

The President's Council on Bioethics should consider these issues. Although Congress could create a new panel, Congress should be wary of increasing bureaucracy in a field where the technology is moving faster than the law. The Council should include balanced representation from all sides of the debate and should make every effort to inform and involve the public.

B. CONGRESS SHOULD MODIFY THE ADA TO REDEFINE IMPAIRMENT AND CONDITIONALLY ALLOW FOR THE CONSIDERATION OF MITIGATING FACTORS

Since current legislation is not adequately flexible for future developments, Congress should consider amending the ADA to include language similar to the following:

Notwithstanding the provisions of Section 3(4)(E), courts must take into account a mitigating factor actually employed by the claimant when the mitigating factor is a prosthetic or implanted medical device that:

- (1) interfaces with the claimant's nervous system either directly or in such a way that operating the device is accomplished through thought alone; and
- (2) compensates for the claimant's impairment to such an extent that a reasonable person would consider the impairment completely eliminated or transformed into an advantage over ordinary human capabilities.

This provision would accomplish three important goals: (1) protect those individuals whose mitigating measures do not effectively control their disabilities; (2) provide flexibility to the ADA in the coming age of cybernetic-enhancement technologies that can effectively eliminate impairments or turn them into advantages; and (3) provide individuals with the option to choose not to employ mitigating factors while retaining their ADA-protected status.

The above statutory language could also serve to help equalize the distribution of enhancement technologies. Those who are able to afford better prostheses or implants would receive less protection under the ADA because of their more advanced (and more expensive) mitigating measures. Conditionally allowing for the consideration of mitigating factors creates incentives to develop and use more advanced prosthetics. For example, the military could avoid making continued disability payments to a retired soldier by paying for an advanced limb instead. The ADA should provide

162. 15 U.S.C. § 7501 (2006); see also Nigel M. de S. Cameron, *The NELSI Imperative: Nano Ethical, Legal and Social Issues, and Federal Policy Development*, 3 NANOTECHNOLOGY L. & BUS. 159, 161-62 (2006) (describing government treatment of ethical issues in the field of nanotechnology).

statutory incentives to cover advanced prostheses with insurance; for example, a guarantee that a sufficiently advanced device will bar an ADA claim by the recipient. Currently, the ADAAA discourages businesses from offering insurance coverage for advanced prosthetics, because no matter how good the prosthetic is, the individual is still disabled and the business is still exposed to liability under the ADA.¹⁶³

Finally, Congress should amend the ADA to clarify that an “impairment” may constitute an ordinary human capacity as well as damage to such capacity. This would provide the ADA with more flexibility once ordinary human capacities constitute actual or perceived disabilities. Further, the ADA should require reasonable accommodation under the “regarded as” prong when the discrimination is based on some implanted enhancement that the claimant lacks, thus providing a method for unenhanced claimants to obtain accommodations.

V. CONCLUSION

For the first time in history, we are faced with the prospect of significantly enhancing human capabilities through direct interfacing with technology. The ethical questions this possibility poses will require significant attention from our nation’s policymakers in the near future.

To make disability law workable in the twenty-first century and beyond, Congress must recognize that disability is a social construct that lies on a continuum. By eliminating from consideration all mitigating measures except basic corrective lenses, Congress reinforced the embodiment of disability. As it stands, the ADA will become increasingly irrelevant as the ability spectrum widens. Future amendments to the ADA should reflect a compromise between the Supreme Court’s ruling in *Sutton* and the provisions of the ADAAA.

Although the language should function adequately for now, Congress must begin considering the legal and ethical questions posed by cybernetic-enhancement technologies while the field is still in its infancy, or risk increased disability discrimination and social stratification.

163. ADA Amendments Act § 4(a).