Good, Better, Best: The Human Quest for Enhancement

Summary Report of an Invitational Workshop
Convened by the Scientific Freedom, Responsibility and Law Program
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Executive Summary

Human enhancement research and technologies offer many unprecedented opportunities and just as many unforeseen challenges to society's view of human performance. This report is an effort to identify those opportunities and challenges as deliberations on human enhancement move forward.

Human enhancement (HE) is the concept of applying science and technologies to expand cognitive and physical human capacities. In some ways HE is a very familiar phenomenon utilizing common methods like surgical techniques and pharmaceuticals to accomplish control of human function. In others, emerging technologies offer individuals new ways to improve human function. Stem cell research, gene therapy, pharmaceuticals, cybernetics, prosthetics, nanotechnology, and computer science are just few of the technologies that may contribute to HE.

Not only are HE technologies diverse, the mechanisms driving HE development also vary. One major driver is the increasing convergence in HE related technologies. Technology convergence is a framework used to describe how a number of science and technology fields are developing rapidly and informing each other – further accelerating their development. Another HE driver is the global market place, where efforts to achieve economic superiority are in many ways a quest for technological superiority. An additional driver of HE development is the consumer, as reflected in the life style choices that create demand.

Although convergence, economic competition, and consumer demand push in the direction of rapid HE development, ethical, legal and policy concerns pull in the direction of a more cautious approach. Advances in HE should be weighed against the effort needed to develop mechanisms for assessing the quality and safety of HE products, to consider the ethical and social impacts, and to define public policy objectives and design appropriate regulatory structures.

This report examines some of the aforementioned forces at work in HE development. Examination of public opinion polls and discussions of human nature reveal that the U.S. public has a complex view of role of HE technologies. For example, polls indicate that personal interest in or aversion to using HE technologies depends on one's perceived social status, and how HE would affect his/her competitive advantage. In addition to issues of equity and access, fundamental conceptions of what it means to be human underscore the arguments for and against HE. On one end of the spectrum, human nature includes a "natural" human instinct to improve oneself and develop technology. On the other end, it is through the "natural" human form that we perceive ourselves and others and experience the world. Thus, radical transformations in performance of the body risk undermining our identity and dignity as human beings. These polarized views are common to the HE debate and have made consensus building in the U.S. extremely difficult.

The report concludes with participant recommendations of next steps AAAS might consider in its role as an association committed to "advancing science, serving society." Recommendations include: refining key terms the debate, facilitating discussion between stakeholders in the debate, developing HE technology forecasts, and providing input on potential policy guidelines for HE research, among others.

Introduction

On June 1-2, 2006, the Scientific Freedom, Responsibility and Law Program of the American Association for the Advancement of Science (AAAS) convened a workshop in Washington, DC on human enhancement research and technology. This two-day invitational meeting brought together an interdisciplinary group of experts to explore cutting-edge research and emerging technologies that have the potential to contribute to the enhancement of human physical and mental abilities. The gathering was designed to allow attendees from a range of philosophical, cultural, and political views to brainstorm on the impact such research and technologies might have on society, and to reflect on possible next steps to address some of those perceived impacts. This report is a summary of the group's deliberations. The first section is an overview of what constitutes human enhancement (HE). The second part examines the possible impact of HE on different sectors of society. The final section identifies potential next steps AAAS might take in the emerging debates on HE.

What is Human Enhancement?

HE is about applying science and technologies to expand human capacities. Developments in fields as diverse as sports medicine, surgery, stem cell research, gene therapy, pharmaceuticals, cybernetics, prosthetics, nanotechnology, and computer science may contribute to HE. One major factor driving HE development is the convergence of four research areas: nanotechnology, biotechnology, information technology, and cognitive science (NBIC).

NBIC convergence is a framework used to describe how those fields are developing rapidly and informing each other – further accelerating their development. For example, information technology contributes to biotechnology with developments such as biochips that speed up data gathering and analysis. "Another [example] is cognitive science, which can help computer scientists develop software inspired by a growing understanding of the neural architecture and algorithms actually employed by the human brain."[1] Similar intersections are appearing throughout the science and engineering disciplines.

Since both HE and NBIC refer to multi-disciplinary science and technology collaborations, the two terms are often used interchangeably. For the purposes of this report, however, HE refers to a specific subset of applications of NBIC sciences that affect the performance of the human body.

The line between therapy or restoration and enhancement is another piece of ongoing debates about HE. After noting at the workshop that the line between therapy and enhancement is particularly faint and subjective, Zack Lynch, managing director of NeuroInsights, recommended the term "enablement" as a replacement for the current buzz-word "enhancement." He believes the term enhancement is already politically charged in both its meaning and use among science policy players. He sees no hard line between "therapy" and "enhancement"; instead, there is a range of capacities already in normal distribution among the population, and enablement refers to maximizing each person's latent potential. While these

[1] Roco, M.C. and Bainbridge, W.S., *Converging Technologies for Improving Human Performance*, NSF/DOC Sponsored Report; http://wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf (June 2002).

arguments are explored in greater detail later in this essay, this report will utilize the more familiar term of "enhancement."

As a species, we share certain basic characteristics and physiological features, such as a particular auditory range, olfactory range, visual spectrum, range of height, reflex speed, etc. Despite the range of abilities and disabilities within a particular feature, for the most part, the distribution of a trait is "normal,"[2] with most individuals clumped in the middle of the distribution curve with some outliers.[3] For example, normal vision is somewhere in the vicinity of 20/20.[4] However, a person may be completely blind, partially blind, color blind, require eyewear, possess better than average vision, or have exceptional night vision. While all these capabilities lie within the normal distribution range, they are not the mode – the most commonly occurring in the population. Depending on one's context or experience, what is considered average or normal may vary. Medicine is considered to be the route by which a person might normalize a feature like sight. Surgeries to remove cataracts and the use of corrective eyewear are two examples of medical applications of technology.

LASIK (Laser In-Situ Keratomileusis) eye surgery is a treatment that can improve vision for many now using eyeglasses or contact lenses. It can also improve vision in individuals beyond 20/20, as was the case in the highly publicized surgery performed on golf pro, Tiger Woods. Woods had the surgery in 1999, following a period where he had lost 16 straight tournaments. After the surgery, he had 20/15 vision and won 7 of his next 10 events.[5] Since it is possible to have naturally occurring better than 20/20 vision, is this an enhancement, or merely a case of atypical vision? Woods underwent what is now a relatively common procedure. His competitors have access to the same treatment. He chose to invest in better sight, while his competitors may have chosen to invest in better golf clubs. Both are enhancements in their own way.

Whether the technology appears to be right around the corner or decades into the future, it is important to reflect on the implications of this class of technologies. Scientists will be challenged to define new disciplines of research, to train the next generation of scientist to pick up where others have left off, to ensure research is done ethically and rigorously, and to report it accurately. Ethicists will be called on to help society reflect on the impact of these new technologies on our values and culture. Policy makers will be tasked with balancing regulation and facilitation of these new technologies in the best interests of the constituents they represent. Business leaders have the role of turning scientific research into useful products. The next section focuses on the business of HE.

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[2] For this report, we use the term "normal" in the sense of statistical distribution within a population, without implying a subjective judgment on any physical trait or behavior.

[3] Marsh, J. L., "To Cut or Not to Cut?" in E. Parens (ed.), *Surgically Shaping Children*, (Baltimore: John Hopkins University Press, 2006), p.123.

[4] Subject to the affect of age, behavior, diet, etc.

[5] Saletan, W., "The Beam In Your Eye: If Steroids are Cheating, Why Isn't Lasik?", *Slate.com*; http://www.slate.com/id/2116858/ (April 2005).

The Business of Enhancement

Pharmaceutical companies, universities, and governments from around the world are pouring millions into human enhancement research and technology. According to James Canton, business consultant and CEO of the Institute for Global Futures, human enhancement is already in the commercial sector. Canton's team analyzes business patterns and market trends, helping companies innovate and adapt to looming market transformations.

HE technologies related to health enhancement are a hot topic. According to Canton, health enhancement research can be divided into three major domains: therapeutic, augmentation, and designed evolution. Therapeutic enhancement refers to interventions that compensate for some deficiency. Enhancement through augmentation entails intervention where no such deficiency exists. Designed evolution is used to describe a class of technologies that promulgate enhancement in successive generations.

Canton has identified several market pressures leading to rapid development of HE technologies: 1) global competitiveness; 2) brain drain/depopulation economics; 3) national security concerns; and 4) quality of life/consumer life-style demands. Sustaining and exceeding past gross domestic product (GDP) growth figures is a large indicator of a nation's competitive performance; the creation of new industries and product innovations fuel GDP growth. Economics teaches us that one can increase the amount of goods and services produced in a given economy (output or GDP) by increasing the technologies available in a given market (total factor productivity),[6] increasing the physical infrastructure available (capital), or improving the skills and population of the workforce (labor). More research on HE is one way to increase all three components of the productivity equation, and, in particular, ameliorate some population workforce shortages projected in coming years. Maintaining U.S. competitive advantage in the world market requires the interaction of several of the factors described above.

"Innovation company flight" refers to the tendency of novel market-making companies to relocate to countries and social climates more welcoming to the goods they produce. Canton states that in the past, the U.S. has been a popular destination for high technology development. In recent years, however, countries like China, India, and Japan have become popular technology innovation destinations, challenging America's position in this area. Part of the reason for this shift in favor of many of those Eastern nations is the more permissive regulatory climate. Canton illustrated this point in the case of the pharmaceutical industry. A significant increase in drug development has shifted to China, where it is more cost-effective to do drug testing. With more companies shifting overseas, the U.S. could quickly lose the technology superiority it has enjoyed in the past.

Social scientists and economists have been warning society about the looming "brain drain" caused by the baby boomers' retirement and inadequate population replacement to reconstitute the workforce after this mass exodus.[7] "While older employees do tend to be higher paid and can incur higher health care costs, employers are realizing that there is a trade-off in

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[6] Law, M. T., "Improvements in technology – the invention of the internal combustion engine, the introduction of electricity, of semiconductors – clearly increase total factor productivity"; http://www.fraserinstitute.ca/admin/books/files/Prdctvty.pdf (2000); "Productivity and Economic Performance: An Overview of the Issues," *Public Policy Sources* (2000), vol. 37.

[7] Boyd, C., "Boomers' exit spells work-force shortage," *Orlando Sentinel* (October 2006), p. A1.

losing that knowledge from the organization," according to executive consultant Emmett Seaborn.[8] Enhancement technologies could play a roll in keeping baby boomers working longer by improving their physical and mental health beyond what would be expected at their age.

Market demand is another economic factor driving the human enhancement technology revolution. Consumers of the modern age have demonstrated an interest in medical technologies and personal computers based on their consumption of pharmaceuticals and handheld devices. "Surveys show that baby boomers are the key drivers of enhancement. They also have the money to afford enhancement. They will be the main consumer of drugs that will improve the quality of life…." Canton claims, "The marketplace will determine what consumers will be willing to pay to get their memory back, to have the vitality of a much younger person."

But optimism over the potential business gains from HE research and development are tempered by just as many investment concerns. Several HE research areas have unclear regulatory guidelines, and such uncertainty makes investors wary about heavy investment without knowledge of the direction regulation might take.

Investor hesitation can be seen in the case of nanotechnology in response to environmental and health concerns. The Science Committee of the U.S. House of Representatives held a hearing on September 1, 2006 on the impact of nanotechnology byproducts on the environment and the health of industrial workers. In the hearing, then Chairman Sherwood Boehlert (R-NY) said, "the nanotechnology industry, which has enormous economic potential, will be stymied if the risks of nanotechnology are not clearly addressed and understood."[9] This statement was supported by findings presented by Matthew Nordan, Vice President of Lux Research. Lux Research has found that "some Fortune 500 companies, [venture-capital funders, and insurers] are already backing out of nanotechnology research because of real and perceived risks of nanomaterials and uncertainties over how they would be regulated."[10]

Moving Towards Longer Lives

Many of the aforementioned healthcare and workforce issues are part of the larger issue of longevity. Longevity refers not only to extending an individual's age, but also retaining physical and mental capacities in old age. The average life span in the U.S. is 77 years. This is already a leap from a life expectancy of 47 years in the 1900's.[11] Just as society has adjusted to the ensuing social shifts with this increase in life expectancy, Robert Butler, President of the International Longevity Center, sees no reason that it can not continue to adapt in the face of further life extension. Butler's presentation delved further into the economics of longevity and its impact on society. He covered several issues surrounding the topic of longevity – working longer, paying for healthcare, intergenerational conflict, concerns about creativity languishing, and the feasibility of various routes to longevity.

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[8] Pasha, S., "Corporations woo baby boomers," CNN Money.com; http://money.cnn.com/2005/09/29/news/fortune500/babyboomers_companies/ (September 30, 2005).
[9] Service, R.F., "Priorities Needed for Nano-Risk Research and Development," *Science* (October 6, 2006) 314: 45.
[10] *Ibid*
[11] "Life Expectancy," *Scientific American*; http://www.sciam.com/print_version.cfm?articleID=000931E9-350F-1CE5-93F6809EC5880000 (May 2002).

Pushing back the retirement age to keep baby boomers working longer is inevitable, according to Butler, and the public and private sectors must devote funds and human resources to deal with its consequences. He does not believe that an older working population will lead to stagnation of the economy. To the contrary, he holds that health and longevity will create wealth. Instead of languishing in retirement homes as an unutilized resource, the healthy elderly can be productively engaged in society, even if only volunteering.

Butler also reflected on the associated cost of health care in a longer living population. Economic forecasts anticipate social security and other retirement plans will be insufficient to cope with the medical costs and needs of the next wave of elderly patients. Butler proposed that the U.S. create an Aging Initiative and divert 1% of Medicare expenditures, or approximately $3 billion a year, to investment in longevity research. He admitted that, based on his experience as a former director of the National Institute on Aging of the National Institutes of Health, the government is highly unlikely to approve this plan in the current political and fiscal climate.

Intergenerational conflicts between the old and young are another anticipated difficulty associated with increased longevity. Francis Fukyama has highlighted these conflicts in his book, *Our Post Human Future.* He writes that social unrest will occur when young workers enter the job market to find older workers unwilling to retire.[12] Additionally, the focus on longer life-spans is likely to break down the family structure and diminish interest in reproduction, thus lowering birthrates.[13] Butler responded forcefully to these concerns. He believes the idea of a looming intergenerational conflict was constructed in the press, and the torch has since been carried by supporters citing anecdotal, but little scientific evidence. He also noted that a number of polls suggest that younger workers support social security and other resources for the elderly, with no evidence of any festering intergenerational frustrations. With respect to birthrate, there are a number of factors that influence birthrates in addition to longevity, and research is needed to determine what degree of influence is associated with longer life span.

Another issue prompting concern about significant increases in life span is the possibility of creativity languishing. The common assumption is that the older an individual is, the less flexible and more set in his ways he becomes. Butler stated there is no scientific proof supporting this hypothesis, and believes that HE technologies that help sustain or improve mental and physical acuity can actually foster even more creativity by older generations.

Citing the work of others, Butler reported that of all the routes to longevity being explored, gene therapies, particularly germline manipulations, seem to be the most promising. Germline therapies, or modifications that can be inherited by future generations, could, according to Butler, spare later generations from the cost and health concerns present generations face. Butler presented findings from several different scientific disciplines that all point to the role of genetics in longevity. There are significant life expectancy differences between the genders. Females routinely outlive their male counterparts; this may suggest the X chromosome itself may be a longevity factor. Genetic factors for longevity are found in the family gene pool. Long living individuals tend to have long living relatives. In the case of identical twins, there is research showing a 25% correlation in the heritability of longevity. Research on centenarians points to a possible relationship between longevity and a number of gene variants. For example,

[12] Fukyama, F., *Our Post Human Future* (New York: Farrar, Straus and Giroux, 2002).
[13] The President's Council on Bioethics, *Taking Care: Ethical Caregiving in Our Aging Society* (Washington, DC, September 2005).

HLA-DR is a gene polymorphism associated with improved immune function. This variation is often found among Okinawa-Japanese centenarians, a group found to be especially long lived.

Andrzej Bartke and Michael Rose each described how research on genetic traits in laboratory animals may impact human longevity research. Bartke is a professor at Southern Illinois University specializing in geriatric medicine. His research explores the relationship between certain genetic mutations associated with dwarfism and longer life-spans. His research demonstrates that dwarf mice and mice with genetically suppressed growth hormone expression both live longer and have longer "healthspans" than normal mice. In fact, research on the aging of these diminutive mice provides evidence that: cognitive function (learning and memory) are maintained, aging of the immune system is delayed, incidence of cancer is reduced, fatal diseases develop later in life, aging of collagen and joint cartilage is delayed, as is development of osteoarthrosis. This enhanced life cycle is due, in part, to the fact that these smaller mice had altered metabolic control compared to their larger, species counterparts. For example, Bartke's dwarf mice retain insulin sensitivity in old age. This feature contributes lower incidents of obesity, diabetes, and coronary artery disease. Enhanced insulin sensitivity is one of the most prominent metabolic features of humans with exceptional longevity such as centenarians. Bartke hopes genetic information garnered from dwarf mice will help researches isolate and later replicate life-extension in humans.

Michael Rose, a professor of Ecology and Evolutionary Biology at the University of California at Irvine, presented several other avenues of life-extension, but cautioned that controls instituted in a lab are not reflective of realistic life choices a typical person might make. Rose's research uses various breeding techniques and caloric restriction to suppress aging by combining genetic inheritance with environmental factors to affect life extension. An organism's life cycle is influenced by the onset of reproduction. When reproductive maturity is delayed, then an organism enters a developmental stasis, arresting the aging process. Rose believes both the means and side-effects of delaying reproduction in humans are so unappealing as to be a non-option. For example, caloric restriction, at the point that such a practice would impacting aging, would be physically and psychologically akin to long-term starvation. Physical weakness, emotional strain, lowered sex drive, etc. are just few of the likely side-effects. With respect to genetic means of life-extension, Rose theorizes that there is no one, genetic factor to control aging, but rather hundreds of factors, each of which affects one small aspect of aging. He argues that longevity research is not a quest for an anti-aging magic bullet, but rather a complex system that can only be impacted gradually. Rose credits this complexity as the reason future life-extension research will only result in small increases in life-span and health-span.

The debate surrounding longevity epitomizes the complexity of values and issues at stake in HE. Everyone ages, and at some point must struggle with difficult health care decisions. Heart disease, Alzheimer's disease, etc. are medically detectable conditions. But they are also "normal" conditions, or conditions almost universally associated with the aging process. By treating one condition, doctors only stem a small trickle in a flood of ongoing physical and mental deterioration. Questions of resource allocation, quality of care, government/community obligation, and cultural identity must be addressed in public policy planning connected to longevity.

Emerging Neurotechnologies for Cognitive Enablement[14]

Zack Lynch, managing director of the neurotechnology market research and advisory group, NeuroInsights, discussed neuroscience technologies and how they could someday alleviate one of the main difficulties of longevity – neurodegeneration. A number of disorders and diseases have a neurological component: addiction, anxiety and attention disorders, obesity, chronic pain, depression, hearing loss, Alzheimer's, epilepsy, schizophrenia and psychosis, stroke, Parkinson's disease, among others. Currently, about 1.5 billion people world-wide suffer from such diseases. According to Lynch, current estimated costs of brain related illness in the U.S. is $548 billion dollars, while the European Union spends $350 billion a year on similar neurologically based illnesses. With future generations conceivably living even longer, demand for similar treatments will only increase.

This demand has encouraged companies and even governments to invest in neuroscience research and technology. Lynch reported that approximately 400 companies are currently involved in the $110 billion neurotech industry, and that the number of neurotech patents is rising sharply. About $5 billion worth of public funding per year goes towards understanding brain function in addition to the investment by the Department of Defense in neurotechnological research. Major regional clusters of neurotechnological development "hotspots" are springing up all around the world, in cities like San Francisco, Boston, Shanghai, Stockholm, and London, and several in India. Lynch added that the industry is "poised for rapid growth," echoing the projection of many others that increased human longevity will lead to more individuals afflicted with neurological or psychological illnesses.

Lynch noted that converging technologies have already improved neurological diagnosis and treatment. NBIC technology will continue to revolutionize the potential of neurotechnology. Advances in bio-chips and brain imaging techniques will enable far better views inside the brain, while an increased understanding of DNA – particularly in the wake of the Human Genome Project– will facilitate examination of the brain on a cell-by-cell basis.

Neuro-enabling technologies are targeted towards helping to sustaining the work force longer by coping with psychosocial disorders, treating neurologically based disease and injuries, and correcting various impairments. Lynch subdivided enablement into three categories: cognition, emotion, and sensation. "Cognition" was used to refer to such matters as learning, rationality, and memory. Lynch mentioned 40 "cogniceuticals" currently undergoing trials, discussed neuroprosthetics like prosthetic hippocampuses, and described an external magnetic form of neurostimulation. Lynch's second category, "emotional enablement," refers to the alteration of such feelings as arousal and empathy. According to Lynch, neurotechnology associated with emotional enablement includes 100 "emoticeuticals" currently in trials, and implanted neurostimulators for treatment of depression and obsessive compulsive disorder. Lynch's final category, "sensation," includes such things as pain reduction and stamina improvement, which Lynch said could be controlled by "sensoceuticals."

Lynch cautioned that neurotechnological improvements would pose many ethical and legal challenges to society. Neurotechnologies that can improve learning pose serious social justice questions if technologies are only accessible to the few able to afford them. Devices and pharmaceuticals that affect emotion and thought challenge our notions of identity and personal

[14] Section written by Eitan Bernstein, with added text by Enita Williams

responsibility. By shifting how we experience the world, neurotechnology capable of altering sensations could impact how humans interact and communicate with each other. While acknowledging these challenges, Lynch predicted that, should the technology prove safe and effective, the appeal of having the ultimate competitive advantage will ensure a huge demand.

Social and Ethical Implications of HE

A panel presentation further delved into the social and ethical implications of HE technologies, and Braden Allenby, Max Mehlman, and Richard Hayes each provided a perspective on some of the key issues. Allenby, a professor of Civil and Environmental Engineering at Arizona State University, applied a systems analysis to human enhancement technologies to examine how HE, as well as similarly transformative technologies, have changed the landscape of the physical environment and the individual body. Equality and access were the key issues Max Mehlman, a Professor of Bioethics and Law at Case Western Reserve University, analyzed in his presentation. One of the policy issues he challenged attendees to consider was whether or not there are groups of individuals that deserve priority access to HE technologies based on their careers, skills, etc? Richard Hayes of the Center for Genetics and Society focused on the profound social risks associated with HE technologies. He said that since these technologies have the potential to undermine the shared human nature that sustains human society, decisions about their development and use should be made within a strong precautionary framework.

For millions of years, the organisms of Earth have been evolutionary shaped by ecological forces. Modern humans are the only creatures able to substantially impact the biological system in which they live. Allenby pointed out that "human intentionality is being extended to unprecedented scales." This is easily seen within the framework of NBIC technologies. Nanotechnology is the means for manipulating the environment at the molecular level. Through modern biotechnology, humans endeavor to direct their own evolution. Information technology and cognitive science are both exploring ways to increase the speed and range of information a person can assess, whether by artificial computing or expanding cognitive capacity.

We have turned to social institutions for guidance about whether or not to accept technologies, how to live with them, and what limits, if any, there should be. In the face of these radical technology shifts, our social institutions have been greatly challenged. Allenby believes the impact of HE technologies already exceeds the controls possible through modern institutions. "We don't even know if we *can* 'manage' these [technological] systems," he cautioned. Citing the examples of the European opposition to genetically modified organisms (GMOs), and the U.S. government's limited financial support of embryonic stem cell research, Allenby claims that such reactions have not stopped the technologies, but "merely shifted their center of gravity."

The dilemma of HE technologies goes even deeper than institutions. HE development is progressing so rapidly and with such wide-ranging ramifications, Allenby argues that our ontologies and cultural constructs, even our language, cannot keep pace. Mutually exclusive ontologies make communication about these technologies even more difficult, if not impossible. How do you define 'human'? "Everyone will answer from a particular sense of being and structure," he argued. Even traditional belief systems are failing to address the subtleties

associated with these technologies. Language is another area flagging in the race to keep pace with HE technologies. In today's environment, new phenomena are christened not by the scientists and scholars at the site of the discovery, but by the media, with its borrowed concepts from fiction and popular-culture. When attempting to describe the possibility of certain artificial human parts or genetic enhancements, common references include "X-Men" and "The Bionic Man."[15]

Allenby also presented the inverse to this equation – de-enhancement and weaponization. De-enhancement, or intentionally diminishing the range of one's normal abilities for any purpose, especially as an offensive weapon, is another important concern. If HE technology can create a super-baby and cure debilitating diseases, it seems logical that HE could deprive a child in specific ways and create newer, more debilitating diseases.[16] If concerns exist about the ability of current institutions to constrain positive human enhancement, then there is also the very real possibility of facing similar concerns about the darker side of human enhancement.

While Allenby related human enhancement endeavors to the greater cultural and ecological system, Mehlman focused on the impact of HE on equality and access. He began his analysis with the premise that individuals will pursue HE technologies for "self-fulfillment." Though this is intended as a very personal decision, it will inevitably spill over into the public domain because society has empowered the government to restrict people from using certain HE related technologies as a form of social protection. Restriction of access to certain pharmaceuticals is just one of the ways in which the government exercises its authority to restrict an area of HE. Society now has to decide if it wishes to redraw these boundaries in the face of emerging HE technologies. A lack of information on the critical issues surround HE makes this boundary identification even more difficult. There are tentative steps underway to correct this problem, such as the NIH funded Case Western Reserve University project to develop human subjects guidelines for genetic enhancement research. Such findings may provide a first step in thinking through the key issues that need to be addressed in the larger issues of HE regulation.[17]

Striking a socially acceptable balance between equity and access is another major concern precipitated by HE. Providing all members in a society equal opportunity to utilize technologies that offer better quality of life is one task of a democratic society. This ideal must be balanced against a rational evaluation of the resources available to create such equity. In a world of limited resources, and especially in light of the financial costs associated with HE technologies, full equality of access to HE simply is not economically feasible. More affluent members of society have the financial resources to gain access to HE technologies as soon as they become available, technologies that, in themselves, can increase the competitive advantage

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[15] Garreau, J., "The Next Generation: Biotechnology May Make Superhero Fantasy a Reality," *The Washington Post*, April 26, 2002, p. C1; "We Can Rebuild You," *Wired Magazine* (September 2002), pp. 54-55; Herbst, M., "The Real Bionic Man," Discoveryschool.com;

[16] Researchers studying DNA sequences incompatible with human life suggest the possibility of creating a "suicidal gene" that "could be attached to genetically modified organisms and activated to destroy them at a later date…." While this would be an extreme case of "de-enhancement," it is a striking reminder of the need to scrutinize the "darker side of enhancement" See Geddes, L., "The DNA So Dangerous It Does Not Exist," New Scientist, Vol. 2585, January 3, 2007, p.12

[17] "Law-Medicine Center Director Maxwell Mehlman is Principal Investigator on $772,500 NIH Grant," Case Western Reserve University (press release); http://www.law.case.edu/faculty/news_detail.asp?id=215&content_id=3 (April 26, 2006).

for a user. Concern about furthering the gap between the rich and the poor has some proposing restrictions of HE on grounds other than safety and effectiveness. On the other hand, there do seem to be priorities in access that might benefit society and that should be considered. Mehlman argues that we want our firefighters stronger, aircraft pilots with clearer sight, and our researchers smarter, yet we want our athletes to play fair. "Ideally we want some people to have enhancements," he said. Setting a socially acceptable criterion for determining who deserves priority access to HE is a difficult and complicated endeavor.

Mehlman believes there is something more than personal fulfillment at stake, because what one personally desires may create real world advantages over others. This is important, because the "illusion of equality," as Mehlman describes it, is critical to our social construct and easily compromised in the presence of significant differences in physical and mental abilities possible through HE. Mehlman proposes that society make enhancement as inexpensive as possible and as publicly available as possible. He reasons that since people do not earn their natural talent, fairness and equity demand the naturally gifted not to impede those who want greater ability from achieving it. Like Allenby, he also doubts attempts to ban HE would be successful. He suggests the best avenue to achieve wide-scale, affordable access to HE technologies would be to invest public funds at the research stage, because such investments could have substantial implications for the future costs of a technology.

Richard Hayes and colleagues have examined public opinion polls to gauge public understanding of the issues surrounding genetically based HE technologies. He holds that public opinion on HE is a continuum, not a nice, neat left-side versus right-side debate. On this continuum, some voices are louder than others, and Hayes worries that key constituencies are being left out of the debate. He noted that the lack of diversity at in community representation delegitimizes the entire HE discourse. His solution is to slow down the introduction of new HE technologies into the public domain, including, if necessary, through moratoria or explicit prohibitions. Such precaution will give citizens the time needed to understand and assess these new technologies and to make their opinions known, and will give legislative and regulatory bodies time to develop policies that truly reflect these opinions. He believes the potential risks that HE technologies pose to equality, equity, and human and civil rights warrant this caution. Hayes cited the Council of Europe's *Convention on Biomedicine and Human Rights,* negotiated in 1997, and Canada's *Assisted Human Reproduction Act,* approved by the Canadian Parliament in 2004, as models of democratic deliberation on these issues. Both measures allow important medical research to proceed, but prohibit genetic technologies that were viewed as unacceptable, such as human reproductive cloning and germline engineering. Hayes said it is imperative that socially responsible scientists take a lead role in affirming the need for measures to constrain the use of HE technologies widely judged to endanger human well-being.

This panel sparked considerable debate, with some attendees arguing that great caution with these technologies is important, while others asserting that society is very capable of adapting to the changes HE might bring. One attendee argued that while no one can predict the future, a number of indicators point to larger problems. Waiting until deployment may be too late. "Once the nuclear cat was out the bag, the world has spent the decades since trying to calm the beast of nuclear war. Similarly, once the HE enhancement door is fully thrown open, we have no idea what may step through, nor if we can ever close that door again." On the other side, many did not see the shifts involved in HE to be so dramatic, and argued that society has already

adjusted to any number of large-scale technological and social shifts, like the industrial revolution and longer life spans.

Athletic Enhancement

Athlete enhancement is one area in which HE technologies are now being applied, thus providing an opportunity to examine various impacts. First, the history of doping, or the use of performance enhancing methods (e.g., drugs, blood transfusions, gene transfer), in sports is extensive and found all over the world. Second, sports-related enhancement is much more publicized than other types of human enhancement. As a result, the public is much more engaged in discussions about impacts in this area. Finally, there are regulatory structures and standards in place for enhancement in sports.

Doping dates back to the 8th century B.C., when early Olympians ingested sheep testicles as a source of testosterone. From running to cycling, weightlifting to baseball, gymnastics to speed skating, few, if any, sports fields have avoided the practice of doping.

- 1988 Summer Olympics: Ben Johnson won the 100m dash, breaking the world record in the process. He was later stripped of the Gold medal when testing documented evidence of steroid use. Carl Lewis, the runner up, was then awarded the Gold medal until it was determined that he, too, tested positive for drug use.

- 1998 Tour de France: Team Festina was excluded from competition after a member of the coaching staff was found with a car full of doping agents. Six other teams withdrew in protest, some of which were themselves under suspicion for similar misconduct. Marco Pantani won the Tour de France that year, but was later stripped of the title and suspended for two years when he tested positive for drugs.

- 2006: The 2006 book *Game of Shadows* alleged extensive use of several types of steroids and growth hormones by baseball superstar Barry Bonds, and also named several other athletes as drug cheats.

- 2006 Tour de France: Winner Floyd Landis tested positive for abnormally elevated hormone levels. He faced trial before the U.S. Anti-Doping Agency (USADA) in May 2007, and if found guilty Landis would be forced to cede his Tour de France title to the runner up.

- 2007 Tour de France: Cyclist Alexandre Vinokourov tested positive for a blood transfusion in this year's Tour de France and was suspended from the race.

Source: http://en.wikipedia.org/wiki/Sports_doping

In the course of sports history there have been a number of doping strategies used: hormones (testosterone), steroids, strychnine, amphetamines (speed), heroin, cocaine, caffeine, blood transfusions, etc. In more recent years, Erythropoietin (EPO), Insulin Growth Factor

(IGF), and even Viagra have been used to enhance strength and endurance. As different methods of enhancement are devised, so too have different testing methods evolved. Concerns about both safety and testing accuracy worry doping regulators in the wake of new enhancement technologies. Genetic doping is predicted to be the most likely avenue of athlete enhancement in coming years.[18]

Genetic doping is appealing because the effects would be longer term than mere chemical doping, and likely be undetectable by current methods. Anti-doping agencies around the world have geared up for this eventuality, issuing revised guidelines, researching better testing methods, extending the period in which they keep athletes' samples, and aggressively pursuing athletes testing positive for doping by stripping medals and imposing severe suspensions.[19]

Dr. John Hoberman, from the University of Texas at Austin, addressed the topic of enhancement in sports, pointing out particularly controversial cases and various methods of enhancement practiced inside and outside of the sports arena. His presentation focused on distinctions between acceptable enhancement in sports and those considered unacceptable.

He argued there are "parallel worlds of licit and illicit drug use," and institutional support for enhancement doping. While on the one hand, certain enhancement drugs are acceptable – caffeine, protein supplements, sugars – others (steroids) are deemed unacceptable for seemingly arbitrary reasons. Despite the social stigmas associated with various enhancements, he believes there is an "implicit tolerance of 'productive' enhancements." The presence of a Starbucks on nearly every corner in commercial areas is a powerful signal for the social acceptance of caffeine. The increasing frequency of Ritalin and Adderall abuse on college and high school campuses by students looking for an edge; Prozac use by stressed corporate executives; or Provigil abuse by truckers and pilots fighting fatigue are other examples of socially accepted enhancement. Within sports, steroids, stimulants, and blood boosters have only been "pseudo-regulated" in the past, though recent press and regulatory pressure have substantially increased testing.

When asked about what which sports show abuse most frequently, Hoberman replied that, "Professional cycling is drug soaked. Shot put, weightlifting, and major league baseball all have high occurrences of doping…The effects [of doping] are haphazard and unevenly distributed." He continued, "Until a few years ago, baseball didn't have a drug problem. The doping issue is not being reported on in other sports, yet. [However] there is a growing number of sports journalists who are now paying attention to this issue."

Why is society so passive about the sports doping phenomena? "It goes back to the need of the athlete to be a hero in our society. We have inherited this cultural need," contends Hoberman. There are also huge financial incentives – endorsement deals, prize winnings, team contracts, salaries, etc. on the line for competitive athletes. Although social pressure and financial incentives pull in one direction, health concerns and legal repercussions of doping pull in the other direction. Hoberman explained that, "safety is not what athletes are concerned with." The current rules, while they set thresholds for the presence of significantly abnormal quantities of chemicals in the blood, do not address the long-term impacts of these high but tolerated levels. In the long run, elevated levels of testosterone or the use of steroids can lead to sterility,

[18] Pincock, S., "Gene Doping At Torino?", *The Scientist*; http://www.the-scientist.com/news/display/23101/ (February 9, 2006).
[19] *Ibid*

depression, arrested bone development, heart attack, and stroke. Blood doping through EPO or blood transfusions can lead to kidney damage, heart attack, stroke, or metabolic shock. Hoberman challenged participants by asking whether we must have our heroes, regardless of the price? But if HE can be done safely, with minimal side-effects, he asked, is there a legitimate role for doping in sports?

Public Opinion

Decisions to accept or reject HE, to regulate or not regulate, are matters that will be fought in the court of public opinion. Public opinion is William Saletan's forte. As the Chief National Correspondent for Slate.com, Saletan has covered public reaction to any number of emerging technologies.

Polls that specifically addressed public attitudes towards enhancement were not available, so Saletan collected survey results on specific HE-related technologies to paint a picture. Among the polls he discussed was a 2004 survey sponsored by the Genetics and Public Policy Center of Johns Hopkins University on "Reproductive Genetic Testing: What America Thinks."[20] The survey revealed that a majority of Americans favor either banning (11%) or regulating (43%) prenatal genetic testing. Though conservative on this issue, most people do not favor the government making reproductive and medical decisions for them. Of those surveyed, 67% agreed with the statement, "Let people decide for themselves because the consequences are so personal," and 70% said they were concerned about government regulators invading private reproductive decisions.

Preimplantation genetic diagnosis (PGD) is a procedure that provides a genetic profile of a fertilized egg before it is implanted in the womb. PGD can produce information on the gender of the embryo, presence or absence of certain mutations that can cause genetic diseases, and, in some cases the capacity to state the probability of expressing certain physical or mental traits. Public opinion about the use of PGD varies depending on its described purpose.[21] For example, Americans are more likely to approve of PGD for sex selection than PGD for improving traits like intelligence and strength. Likewise, approval is higher for preventing or curing a fatal disease than it is for improving the physical characteristics children would inherit. About three-fourths (74%) of those surveyed by the Genetics and Public Policy Center approved of parents being offered PGD to make sure their baby does not have a serious genetic disease, 69% approved parents using PGD to make sure their baby would be a good match to donate his/her blood or tissue to a brother or sister who is sick and needs a transplant, and 60% approved parents using PGD to make sure their baby does not have a tendency to develop a disease like cancer when he/she is an adult. Similar results appear when considering genetic engineering, or the means of activating, deactivating, or introducing novel genes into an individual's DNA in order to produce specific traits. In a separate poll produced by Time/CNN in December 1993, 79% approved of the use of genetic engineering to cure a disease, 25% to improve a person's physical appearance, and 34% to increase a person's intelligence.[22]

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[20] The Genetics and Public Policy Center, "Reproductive Genetic Testing: What America Thinks"; http://www.dnapolicy.org/images/reportpdfs/ReproGenTestAmericaThinks.pdf (2004).
[21] *Ibid*
[22] The Genetics and Public Policy Center, "Detailed Survey Results, 1987 to May 2003"; http://www.genetics-and-

As with all surveys, framing of questions and context must be considered when interpreting results. Variations in questions help catch some of the subtleties surrounding enhancement and how these subtleties intersect with reproductive technology issues. For example, a survey conducted by the U.S. Conference of Catholic Bishops shows more opposition to embryonic stem cell research than other surveys, possibly in part because the survey did not include a phrase suggesting the embryonic stem cell research may "save lives" in questions on the topic.[23]

Polling results revealed that for the masses, there is a sense of fatalism about "crossing the line" with HE technologies. The Genetics and Public Policy Center survey found 75% of those surveyed agreed with the statement "reproductive genetic technology will inevitably lead to genetic enhancement and designer babies." In a related question, 70% of those surveyed agreed or strongly agreed that "the ability to control human reproduction will lead to treating children like products."

The interests or characteristics of certain groups affected the answers provided. Among Blacks and Hispanics, there was greater approval for the use of PGD to improve traits such as intelligence and strength than among Whites. Also, the higher the income level, the lower the level of approval. Saletan pointed out that these results suggest that since Blacks and Hispanics are often among the poorest and least advantaged in society, they might have the most to gain from access to HE technology. Meanwhile, many Whites and the wealthy may view the technology as undermining the advantages they currently enjoy. With respect to age, an older individual is less likely to agree with the statement, "suffering is part of what makes us human," and is more likely to pursue medical and technological means to mitigate suffering. Even baseball fans have a stake in the HE debate. As Hoberman pointed out, the social need for heroes is a strong driver in society. This may explain why data from several surveys seem to indicate there is less concern about steroid use in baseball than one might expect. In general, baseball fans were less likely than others to believe that Barry Bonds should be punished. In a USA Today/CNN/Gallup poll, only 52% thought Bonds' record should be taken away.[24] In a Quinnipiac University poll, only 52% percent thought that baseball players who test positive should be banned from the Hall of Fame.[25] Only 30% of those surveyed in an ABC News/ESPN poll thought the federal government should create or enforce sports drug rules.[26] Gender also plays a role public opinion of HE related technologies. Based on information from the Genetics and Public Policy Center survey, men were more likely than women to support the application of genetic technologies. One hypothesis suggests women would be more cautious in their support of these technologies because they are frequently the

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society.org/analysis/opinion/detailed.html#1993time (June 2006).

[23] United States Conference of Catholic Bishops, "New Poll: Americans Continue To Oppose Funding Stem Cell Research That Destroys Human Embryos"; http://www.usccb.org/comm/archives/2006/06-109.shtml (May 2006).

[24] Nightengale, B., "Fans Conflicted About Bonds," USA Today.com; http://www.usatoday.com/sports/baseball/nl/giants/2006-03-13-bonds_x.htm (March 13, 2006).

[25] "Steroid Users Should Be Banned From Baseball, Fans Tell Quinnipiac University Poll; Keep Records, But Close The Door To Hall Of Fame," Quinnipiac University; http://www.quinnipiac.edu/x1295.xml?ReleaseID=595 (December 14, 2004).

[26] "Poll: Americans Support Punishment for Steroid Use," ABC News ESPN Sports; http://abcnews.go.com/Sports/PollVault/story?id=586653&page=1 (March 16, 2005).

ones making such reproductive decisions, and their bodies may be impacted by the intervention used.

The Case For and Against Enhancement - Hughes and Cohen

The debate over HE technology reflects differences in how one perceives human nature. In one sense, humans are driven to instinctively control and manipulate the world around them. Whether it is building fire, creating language, or engineering ships to traverse water and space, the course of human history has documented the species' unique drive to exceed its limitations. In another sense, much of this control and manipulation has been external to the body. While medicine has provided humans an increasing ability to repair and shape their bodies, it has typically offered corrective measures within the boundaries of what one might consider the normal spectrum. In large part, debates over HE technology reflect those contrasting views of "human nature." James Hughes, executive director of the World Transhumanist Association, and Eric Cohen, director of the Ethics and Public Policy Center, presented the case for and against HE as a function of different conceptions of human nature. Hughes argued that by denying the "natural" human instinct to improve oneself and develop technology, humans are denying their identity. Cohen countered with the argument that by radically transforming the human form, we change how we perceive and experience the world, and risk undermining our identity and dignity as human beings.

Hughes began his case by stating that the ethical considerations linked to human enhancement beg a differentiation between personhood and humanness. In Hughes's opinion, personhood exists when an individual is consciously aware of himself and has long-term goals or intentions. By this definition, one can be human and not a person (such as a brain dead individual), or a person but not human (such as an ape). The goal of a democracy is to protect an individual's right to express personhood, excel, and reach his/her fullest potential. As such, citizens have a fundamental right to technologic self-determination and control over their own lives and abilities.

Given this perspective of a democratic government's role and looming developments in HE, Hughes predicts that one of the three main axis of politics in the 21st century will be "bio-politics." With human enhancement come questions regarding such matters as the morality of extending life and the ethics of controlling the brain. These questions result in the creation of a wide and polarized "bio-political spectrum of thought." Hughes then went on to describe the different schools of bio-political thought beginning with bio-conservatives, who consist mainly of left-wing feminists, pro-disability extremists, and members of the religious right who oppose enhancement on theological grounds. The techno-progressive school believes that technology is a positive creation to which the public should have access, though only in a society that ensures equality, free choice, and democracy. Hughes also spoke on behalf of transhumanism, an intellectual and cultural movement that believes humans have the right to control their own affairs, and supports attempts to "transcend the limits of the human condition."

According to Hughes, a portion of the opposition to human enhancement stems from racist thinking. Hughes uses the term "racist" here in a non-traditional sense. He argues that historically, there is no denying that many progressive social movements promoting wide-scale unity have traditionally transformed "others" into "inferiors." Since he sees bio-politics as

uniting various political groups, and the bio-conservatives hold great sway in the debate, he anticipates that 'divergent' elements of the population will be quickly labeled inferior and slated for exclusion from the dialogue. For example, Hughes believes that most of society is terribly anxious about the potential for human-animal hybrids and the ramifications of such hybrids on existing social structures. Hughes believes this mode of thinking to be no different than the racist attitudes expressed repeatedly throughout history. "Does someone who has hair all over, like an animal, not count as a human because he has that one gene, like an animal?" Hughes asked. He acknowledged that one of his concerns regarding the future of human enhancement is that a new eugenics will emerge, one that attempts to control reproduction not in the name of health, but in the name of "humanness."

Hughes then presented a range of actions that are necessary to ensure the successful, healthy use of HE technology. He stressed the importance of promoting "techno-citizenship" and educating the global population on the science and technology behind enhancement. Techno-citizenship is a term Hughes uses to refer to the right and responsibility of every person to be informed about important technological developments and contribute to the governance of an increasingly technology intensive society. He also advocated several policy measures, including creating universal health care, abolishing the distinction between therapy and enhancement, and enacting laws that establish an individual's autonomy, reproduction, and cognitive ability as elements of one's personal life. By providing universal healthcare, the government can help alleviate some of the gross inequalities in medical care and also increase access to HE for many who would otherwise be excluded. Hughes also acknowledged concerns that unequal access to enhancement technology will exacerbate inequalities. Yet, he argued that the same concerns have historically applied to all new technologies, including penicillin and computers. Abolishing the distinction between therapy and enhancement also has important implications for healthcare and access to HE. Without such distinctions, medical insurance providers that wish to exclude certain expensive HE procedures and technologies from medical benefit coverage would be unable to do so. Similarly, laws explicitly protecting one's right to make autonomous reproductive, cognitive, etc., enhancement decisions prevent third parties from unduly restricting someone's access to HE technology. To address safety concerns, he recommended that the Food and Drug Administration (FDA) be expanded in order to regulate the testing and use of enhancement technologies.

Hughes further argued that a "yuck factor" associated with some elements of human enhancement prevent us from thinking critically about the technology, and instead lead us to rely on immediate, gut reactions that may not be fully rational. In addition, he insisted that efforts be taken to ensure that no "moral police" force is ever created to respond to human enhancement abilities. Hughes concluded by emphasizing that greed, racism, inequality, and ignorance are the key issues that require our attention in this debate, not human enhancement technology itself.

Cohen expressed skepticism in the public's assumed demand for enhancement technology. In Cohen's opinion, most individuals face too many truly significant problems to care very much about human enhancement technology. He also felt that true equality in access may be a great deal to expect of any technology, but the potential of HE to skew the natural lottery of traits for an individual will have deep cultural ramifications. Based on that concern, Cohen argued that society must look carefully at its goals for HE before the technology is widely accessible.

Echoing the view of Hughes, Cohen stressed that the threat of "inequality in access" is no more of a significant concern with enhancement technology than with any novel, expensive technology. Eventually, improvements in production and market forces lower prices. Cohen, however, did stress that a core principle of humanity is the belief in physical human equality, due merely to our common membership in the "human family." This "illusion of equality," described earlier by Mehlman, is pivotal to human cultural beliefs. This membership begins at conception, thus weeding out the "weak genetic fruit," as Cohen phrased it, and is a powerful move towards inequality and stands contrary to our inherent conception of what it means to be human.

Cohen criticized the argument that enhancement is "unnatural" because this view overlooks the fact that a great deal of human activity is uniquely human, inconsistent with many cycles found in nature, and arguably "not natural." One participant questioned whether Cohen's views on human enhancement were any different from the views of early skeptics on vaccines, antibiotics, and other hallmarks of scientific success. Cohen responded by emphasizing his support for medical progress, while cautioning that society must determine its objectives before a technology is developed and policy set. Cohen emphasized that both the ends and the means of "enhancement" must be adequately considered before the technology can be deemed beneficial. Another participant inquired about Cohen's opinion on government regulation of enhancement technology. In answer, Cohen stated that every situation must be handled on a case-by-base basis, and cited cloning experiments with Dolly the sheep as an example of what should be banned.

The latter portion of Cohen's presentation focused on whether the term "enhancement" was an appropriate label for the topic under discussion, and the moral significance of "nature." Though he does not view nature as an unbiased moral compass, he does argue that its boundaries do help us set basic standards of excellence and provide a sense of common membership in the human family. Cohen noted that he does not support pursuits in human enhancement due to his belief that humans will never be able to master such complex matters as human excellence. He argues that in order to engineer excellent humans, one must first understand the concept of human excellence. He noted that, if human excellence means standing among the ranks of Mozart and Shakespeare, then the likelihood of achieving human excellence via human enhancement is rather slim. The same is true if excellence is equated with virtuousness. Cohen maintained that current attempts at human enhancement aim not to make the perfect person but rather to improve a single trait, perhaps at the expense of balance within the whole. As an example, he presented the scenario of an individual who improves his memory yet, unable to forget any insult or inconvenience, leads to a miserable life as a result. "Even appearances," Cohen warned, "will end up being just an art show of the grotesque."

In response to this stance, another participant commented that a much firmer definition of nature should be set and maintained, and questioned Cohen's assertion that victims of trauma ought to be forced to keep their memories. Cohen replied by explaining that nature fills the roles of both a brutal, untamable presence and a beautiful force, and stressed that the amorality of nature must not be forgotten. He added that while our society needs more support for trauma victims, there remains a problematic element to transforming memories of horrible events into something less terrible. He concluded by warning that the happiness achieved by artificial means may never add up to the happiness earned through one's own initiative and success.

At the conclusion of both presentations, the discussion that followed illuminated one of the major challenges to sustaining a productive human enhancement dialogue. Participants felt that both sides had valid points, but the use of polarizing language and harsh criticisms of each other's positions made consensus building difficult, if not impossible. As one attendee observed, "the way you describe each other's positions makes them hard to bridge and discuss." Others agreed, yet acknowledged that the language and phrasing of both Hughes and Cohen were in many ways typical of human enhancement dialogue.

Participant Conclusions

During the closing session of the workshop, breakout groups were asked to consider the polarizing nature of HE dialogues. The groups were charged to identify shared values from both the conservative and progressive sides of the HE debate in an effort to parse out some common ground for future discussion. Shared values identified included: health, freedom, equity, diversity, solidarity/community, regulation/ access/distribution as they relates to social justice, shared concern over the commodification of children and the body, and the search for both the meaning of life and a meaningful life.

The groups were also asked to identify what factors would affect the development of human enhancement technologies, leading to the following list:

Economics of aging/longevity
Marketplace and corporate generated demand
Globalization
Religion (western and non-western)
R & D investment by government and industry
Patent and intellectually property law
FDA procedures
Therapeutic vs. enhancement distinctions
Medical procedures and standards
Trust in science/scientists' accountability
National security
Healthcare equity
Medicalization vs. normalization of physical and mental features
Safety and social/environmental impacts
Media coverage

Next Steps for AAAS

Meeting participants offered several suggestions for what AAAS might do as follow-on to this meeting.

1. Help refine HE terminology. Developing greater clarity about when and how "HE" should be used.

2. Bring scientists to the table with science-fiction writers and/or Hollywood producers. Many science-fiction writers and producers have already engaged in imaginative thought-experiments about what a world marked by extensive HE might look like. Feedback from such groups might help to flesh out interesting new dynamics to address.
3. Convene more interdisciplinary meetings on HE that reach out to a wide range of stakeholders, especially those whose views have historically been excluded from such discussion.
4. Contribute to better forecasting methods. For example, participants suggested the possibility of modeling HE convergence against past socio-technical convergences, such as the industrial revolution.
5. Use the Association's access to scientists across diverse disciplines to develop specific case studies on various HE technologies to identify technically realistic scenarios for public deliberation. Participants recognized that some areas will have a more developed dialogue and literature than others, but that each of the different areas should be examined independently.
6. Participate in efforts to assess potential policy guidelines in specific areas of HE research and technology.