



Towards Our Neuro-Future: Challenges, Risks and Opportunities

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- A nano-biomimetic implant embedded in the surgeon's brain insures her ability to practice after a serious degenerative disease.
- Neuro-biomarkers now linked to genetics, lifestyle and diet have created a new understanding of how to prevent certain diseases leading to personalized medicine.
- Brain Mind based learning has opened up a new global awareness about education and training, helping millions to develop skills and find productive jobs.
- Courts of law, governments and corporations extensive use of MRI scans to determine job brain fit, establish innocence and validate truthfulness pose troubling social and ethical issues.
- Certain governments to offset depopulation and encourage global competitiveness subsidize neuro-health enhancement policies for children and adults.
- Quants--Micro-societies of cognitively enhanced humans now dominate certain global industries, governments and even non-state actors such as stock, energy trading and terrorist organizations rely on neuroscience.
- Mental disease, trauma and dementia have been reduced by 60% over the past 20 years due to neuroscience breakthroughs.

Our neuro-future is fast approaching. These headlines from our possible future attempt to capture the neuroscience scenarios that may impact society. Each headline is a forecast of sorts pointing to an emerging future not so far in the distance, this futurist would venture to predict.

Neuroscience, the science of the brain mind and the understanding of consciousness itself, is in its infancy. The last century we have spent on behavior, genetics and biology. We know so little about what affects so much of our reality—the brain. Exciting new developments that may redefine ourselves, such as the plasticity of the brain, the nature of intelligence, the nature of consciousness, what is the mind, how people learn and the function and the life of the brain may unlock unknown benefits for humanity in the future on a scale that cannot be fully appreciated today. Clearly

this field will contribute to a new understanding about our minds, about intelligence and this could help to enrich our lives in the future.

New technologies such as MRI scanning, genomics, synthetic biology, nanotechnology, robotics and information technology when combined with neuroscience point to a future where our capacity for innovation maybe boundless. If we include quantum mechanics in this mix, then we have just upped the ante for imaginative and potentially important scientific discovery. The convergence of these other technologies with neurotech will offer powerful tool sets and systems for discovery, innovation and invention that will transform modernity. Neuroscience will touch and change media, education, law, security, defense, medicine, biology and communications in profound ways, mostly unimagined. This informative book expands on the wide impact coming in the future brought by neuroscience.

The world of 2020's law, policies, business medicine and science will be influenced by insights generated by neuroscience. Every human endeavor, from marriage, work and education even warfare shall be shaped by what neuroscience brings. What neuroscience will bring to society will likely be perspectives and tools that can, as with most science, be used for the social good and for social ill, even the oppression of rights and freedoms. We should all beware. As toolmakers, humans have an uncanny capacity for innovations that can bring benefit and risk. Neuroscience will shape an intriguing future that this book explores of which there will be a myriad of spectacular benefits and as many daunting risks.

It maybe difficult to forecast, as some would argue, that neuroscience is just emerging and too immature a science to accurately extrapolate such forecasts. This futurist disagrees. Predicting the future may be preventive for shaping the potential direction of neuroscience and better mitigating risk. We must as scientists apply an extrapolative forecast for what social influences neuroscience may bring to changing society and changing the human brain—positive and negative.

Simply put, neuroscience will change everything. Neuroscience will bring a transformation in the information, behavior and likely the laws and values that are the foundation of our society. All will be challenged in a comprehensive way not fully appreciated at this early point in time. We are not prepared as a society for the accelerated exponential neuro-technologies that are coming faster than most of the scientific as well as the public realize. As the social, ethical and legal communities often lag the science, this book has as a mission, and rightly so, to help prepare us by examining the issues and challenges that may confront us in the neuro-future.

Will we need to classify enhanced people as Transhumans? What makes up a human versus a non-human? What are the ethics of cybernetic replacement and augmentation of humans and super human capacities? What laws should guide enhanced humans? Is it fair for individuals with enhanced cognitive, physical and emotional capabilities to gain favor in employment over non-enhanced individuals? How do we determine who gets access to neuro-enhancement for medical or

performance reasons? These questions raise serious social, ethical and legal issues that advances in neuroscience will bring.

Neuroscience will likely bring a diagnostic and operational tool set that will not just enlighten us about what we may learn or understand about cognition and the brain but how we may enhance, alter and shape the brain and even the mind. The augmentation of consciousness itself may be a possible outcome. Are we ready as a society to not just therapeutically heal the ill but enhance the healthy? What new cognitive enhancements will be possible? Are there new dimensions of consciousness and learning yet to be explored that only through neuro-enhancement we may uncover? How might these advances in enhanced intelligence, memory, speed and consciousness create two tiered global societies of those enhanced and those not? What new conflicts will these two different cultures bring to our world? How might neuroscience create a new balance of power on the planet?

There are vast social, ethical and legal issues that we must prepare to deal with and that will be ushered in as neuroscience's impact on society and individuals emerges. Who will control the tools of neuroscience? Who will get access to my Cognitive Personality Analysis? How will cognitive evaluations be used and by whom in society towards what aim? How will the selection process for jobs, relationships and health care be shaped by the ethics and social responsibility of neuroscience innovations?

And what of minds? Neuroscience will also guide not just the exploration of the human mind but will guide the invention of new minds--synthetic minds. The neurological models once understood about humans will lead to designing new minds, neuro-memetic models. These models will rejuvenate the human mind, but also to create new minds for virtual cyberspace entities and mobile autonomous robotics. The ethical and legal issues raised by creating synthetic minds, be they wet minds (with artificial life components) or virtual minds (with digital or qubit components) stretches the imagination. We must be ready when science brings these scenarios into reality.

The long path to creating AI's, artificial intelligence may finally be realized by understanding neuroscience. As humans have advanced reasoning, to try and understand, imitate and synthesize human brains to create new brains is a logical research path. The biomemetic path, to learn from and imitate nature is a reasonable course. AI's will be prevalent in the society of 2020. The issues we will review in this book set the stage for what types of brains we develop. How will our New Brains influence society?

The long-range scenarios that this forecast portends assumes a social responsibility and ethical compass that we have yet to establish rules for; let alone have we considered a framework to understand what the potential for positive and negative effects on society maybe. We have much work to do as scientists, lawyers, health

care providers and policy makers to prepare for the neuro-future coming at breakneck speeds.

Neuroscience faces a double-edged sword of benefits, insights, innovations and ethical risks. In this book the reader will find a plethora of issues and innovations that will likely describe the emerging Neuro-Future. There is much food for thought as the reader grapples with speculation, philosophy and this emerging science. Much has not been written and the field is evolving quickly but also the tools, such as fMRI's are evolving as well.

Other allied sciences, such as genetics, as we have seen alter society by the use of tools. Inexpensive consumer genetic tests when available to determine neuroscience evaluations of individual cognitive potential and predictive analytics based on genomics, will bring our neuro-future closer. Just the emergence of neuro-informatics as a field will bring issues of privacy and law to new levels of importance. Mashups of neuro, nano and genomic tools will provide choices and challenges will be vexing for future decision makers and scientists.

The post-neuro society will be a very different society. To characterize the future as one that shall be shaped by important discoveries in neuroscience, would be a understatement But I would go further: I think that neuroscience may offer a fundamental new understanding of human beings and perhaps civilization itself, and that this new understanding will transform civilization mostly for the better. In this way, neuroscience may be a sublime disruptive force in the sheer innovative impact it shall have on society. This will not occur immediately and not without risk and even threat. Best we prepare now. This book can further this preparation of the social issues at hand and those emerging.

Meeting Grand Challenges: Preventing Brain Illnesses

Every 90 seconds someone develops Alzheimers. The fastest-growing segment of the American population is over 85 and dementia afflicts one in two. It is estimated that 13.5 million Americans will be stricken with Alzheimer's by 2050. World wide these numbers are increasing dramatically.

Attention disorders are rising in the population. One in four American's suffer from mental disease. Over 13% of children have developmental diseases in the US.

Serious mental illness is associated with an annual loss of earnings in the US totaling \$193.2 billion. The loss of productivity extrapolated over ten to twenty years could be staggering, have more impact then a war, if this is not addressed.

Brain illnesses, be they from trauma, mental illness or dementia, is clearly on a trajectory of near epidemic proportions over the next few decades. The need to prevent or cure brain illness should be global priority. This quest lies at the heart of what social good neuroscience can offer society in the near term. It could not be overstated that the healing of the brain will lead to an entirely new paradigm for health care: personalized cognitive medicine.

The lack of replacements in the workforce, depopulation due to low fertility and low immigration if not kept pace with productivity demands will limit the US and other industrial societies and affect prosperity, security and sustainability. Older workers will need to work longer. We will need to refresh their brains to keep pace with driving the GDP an insuring in fruitful tomorrow.

Health care is moving towards personalization but the breakthroughs in genomics have not kept pace with the needs. Health care is still costly and little of the practice focuses on prevention. Brain diseases are on the rise and we must work towards prevention on a global scale.

Few discoveries in the 21st century will offer more benefits to humanity than neuroscience. From breakthroughs in medicine and education to social science, philosophy, biology and physics—neuroscience unlocked may hold treasures that will vastly increase human understanding. In this context neuroscience is not solely a new science alone or an end game but an evolutionary tool to understanding the human brain mind and its creations—society, culture and civilization.

This book, a breakthrough in scope and imagination describes the enormity of what neuroscience may bring to our world. It covers a wide range of social, scientific and ethical issues that should be debated so we may better shape the future of this field. Much of the future of neuroscience is becoming, like the human condition. We too are a work in progress. As we face grand challenges that threaten our very sustainability on the planet, neuroscience and a truly better even smarter way to use the brain mind may emerge. This maybe the most exciting potential future that neuroscience can contribute to: a deeper cognitive understanding; a smarter way to meet the grand challenges of our time. We may better understand how to unlock intelligence from the mind.

Einstein was said to have postulated that our brains were massively underutilized by as much as 90%. That is a significant waste of intelligence if indeed he was accurate. Imagine a world where human beings use even 50-70% of their brainpower? What could we do? What challenges could we face and solve? This book brings us closer to realizing this future by the assemblage of thought leaders that offer a wide array of chapters and topics. This book brings us closer to realizing the issues and promise of neuroscience to better the world.

The challenges facing our world from energy, security, war, hunger and climate to employment and innovation all require one fundamental factor that is in short supply—brain power. This is the specialized intelligence to sort out the enormous complex challenges that face our world. I have often spoken about the sheer complexity of the problems we face on the planet and the need to increase our intelligence quotient to solve them.

Likely the future will not be less but infinitely more complex and require perhaps a different type of intelligence, one that is augmented to unleash hidden potentials for

more complex problem solving that the future will demand. A mind that can process at speeds and with a depth of knowledge that can correlate a unique creative Deep Intelligence, capable of managing massive complex problems, such as we face today on the planet and in the sciences. Neuroscience may show us the way to envision new solutions to vexing problems that threaten our very existence and way of life. This forecast is not a grandiose as it sounds as few would argue that the challenges of world today are being properly met to insure in a viable and sustainable future for humanity. Advancing, expanding and developing minds, via education, training and science—both the healing of and enhancement of intelligence, will be the largest industry in the 21st and 22nd centuries. Today's humble beginnings of neuroscience is tomorrow's brain mind science of cognitive and health enhancement. Will smarter brains make for a better world?

Ethical Issues Abound

Human cognitive performance enhancement gives people new choices and with these choices may come greater productivity, creativity and prosperity. Smarter people make better more informed and more intelligent decisions—or so we think. Neuroscience as an evolutionary discipline may influence whole societies who desire to neuro-enhance their populations to make them cognitively resilient for the future.

Who gets enhanced? Who doesn't? What happens when some societies are smarter? Many ethical and social issues will emerge as neuroscience delivers innovations that can with efficacy demonstrate results such as increased intelligence, memory enhancements or speed of cognition, to name a few.

It is possible that neuro wars will break out in our future. Neuro wars would be fought between powers; beyond the traditional borders of territory or geography. The neuro wars would be fought between minds and groups of minds; over the neuro landscape of virtual spaces where there are only minds. To envision this future is strange indeed but maybe coming.

The neuroscientist's ability to map the brain and create an accepted paradigm of brain mind science touches a vast landscape of ethical and social issues that concern us about this field. Who will get access to this technology and for what purpose? What are the legal rights of the individual and the responsibility of the state? Too often the new science or technology far outpaces a thoughtful analysis about the social implications of the new science. We have seen this in biotechnology and nanotechnology in the past. Pandora's box once open cannot be easily closed as we have learned.

Neuroscience may fall into a separate special category due to the individual not the state's ownership and control of ones brain and mind. Is not the mind a private space, owned by the individual? This demands a keen debate. The intrusive nature of aggressive or hostile neuroscience as a weapon for propaganda, media manipulation or even blatant mind control should not be tolerated in free societies.

The destructive power of neuroscience to potentially control or influence individuals or the masses to take actions or embrace beliefs that are not of their choice cannot be condoned by modern law abiding states.

We would recognize that rogue states who have a history of suppressive control, offer little human rights and where oppression is the norm in the culture, will welcome neuroscience in the future as a way to control the masses. We must be vigilant and watch carefully as this parallel phenomena emerges along side of the more positive outcomes we anticipate for neuroscience. Protecting from the proliferation of WNMD, weapons of neuro mass destruction would be a prudent foresight. As we progress to heal, learn and explore with neuroscience we cannot ignore that there are those who will seek to exploit this field for other reasons less than noble if not oppressive.

Ethical uses of neuroscience are explored in this book with an eye towards the common good and with a scientist's concern for the public's welfare. The social implications of neuroscience will be expanded upon and even some of the choices ushered in by developments in the neuro-future may surprise some. Neuroscience will look very different in ten years than it will from today. What we are learning about the brain mind for the most will be productive and bring hope to many.

From education to medicine, security to biology, neuroscience will usher in a new understanding about our world and perhaps ourselves. This book, the first to expand on the full scope of possibilities of neuroscience is an excellent step forward into our Neuro-Future.

Towards the Neuro-Enhancement of Society

The neuro-enhancement of society--both the healing of the ill and the performance enhancing of the healthy-- is coming in a future that is fast approaching. States, non-state actors, corporations, individuals and institutions are some of the stakeholders in this evolution of society. Individuals are the essential stakeholder that should be at the center of the ethics and law debates. There are important social issues that will influence science, policy, law and ethics that we must as a society face that revolve around who gets access to neuroscience tools, data, research, processes and procedures. What kinds of research should we do and what should we not do? Are there risks to the genetic pool by genetically manipulating neuronal genes or by introducing artificial brain cells into human genetics?

The proliferation of neuroscience worldwide will be a challenge to manage. Today science proliferation among nations has been an issue given both the huge benefits and risks to society. Super computers abound. Biotech is commonly used for weapons and medicine. Systems biology is globally developed across twenty nations. The Internet makes the world of knowledge management and intellectual property accessible to all. A deeper concern about the ethics of neuroscience being used by rogue interests, dark global networks that may exploit neuroscience for profit or exploitation of populations shall become a global risk factor soon.

The convergence of other sciences: nano, bio, info and quantum with neuroscience may bring the most significant innovations to light. Advanced neuroscience may give us tomorrow's mobile autonomous robots, artificial intelligence next generation Web agents, medicines that trigger neuronal receptors, nano-genomic brain scanning to prevent disease, nano-neuro devices to restore senses. By approaching neuroscience as a component of other strategic sciences such as these indicated here, entirely new holistic breakthroughs may be possible in medicine, education, communications, robotics marketing and computing. It would not be overreaching to forecast important innovations that could transform our world brought by neuroscience. This is the hope.

Some of the drivers of the neuro-enhancement of society are all ready emerging: rising mental illness worldwide, depopulation, global competition, increased social complexity, massive amounts of information and rapidly advancing developments in the sciences. Just the fierce competition between nations and corporations for growth and the need for constant innovation, disruption and progress will be accelerated by neuroscience as it merges with management. The management and development of talent in organizations given the applied tools of neuroscience could bring a new era of Smart Productivity.

When considering the social and personal impact of neuroscience we must protect the privacy and freedom of the mind. The brain has always been a private place, perhaps one of the last domains of privacy that we have in a society inundated with 24/7 media, information, marketing, propaganda and digital everywhere connectivity. The non-medical ethical and social issues are of a profound concern to many examining the potential of this field. What is the fate of free societies in a future dominated by neuroscience without ethical and legal social controls? These are the social issues and eventually scientific and policy issues we will be grappling with in this book.

Neuroscience innovations will impact minds. The rights of individuals in free societies to their privacy and the protection of their cognitive self, their personal consciousness has never before been so at risk as perhaps it will as a result of advances in neuroscience. We have never had access to the cognitive tools to understand, influence and even alter minds at the scale that is coming--will we seek to alter minds? Will altering minds become the end game for rogue networks, organizations and governments who will seek to exploit the good of neuroscience? Or will neuroscience unlock the mysteries of the aging brain and bring health to the aged and quality of life? Are there not benefits as well as dangers to altering dysfunctional and diseased minds? Our complicated future of multiple scenarios awaits us just around the corner, sooner then anyone may realize where we may face both of these realities.

We must be aware of this potential threat in the future that is coming, without allowing this threat to impede discovery. The ethical compass that has served us well in the past should be applied here as shall be discussed. There is a dark side to neuroscience that transcends the neutrality of science that we should vigorously

debate as the ethics of neuroscience emerge as important as the discoveries. In a future scenario where wireless remote long range MRI, brain scans, neuro-pharmacology, nanobio-devices are everywhere we must increase our debates and protections of a world where neuroscience must flourish in providing social benefit over social ill and cognitive freedoms over cognitive manipulation, intrusion and attack. This will not happen without controls, first with science. The proliferation of neuroscience is coming. Can we guide the field with solid ethical and legal controls to allow its growth? We must. These are some of the challenges that will face us in the neuro-future.

This book provides the essential blueprint for reviewing and discussing the ethical, legal and scientific issues that will emerge from neuroscience. There is an inevitability that I sense is coming that neuroscience will offer; an awareness of how to develop human potential that has eluded science to date as well as an understanding of the brain—for science, medicine, human performance, health and learning that may offer a new era for humanity to better meet the challenges of the future.

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