

THEME 3



TECHNOLOGY:

Changing Relationships Between Humans and Machines

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GETTING STARTED 1

To begin thinking about the topic of how technology affects us, do the following activity with a small group.

1. Brainstorm a short list of five to ten inventions from any time in history. For this exercise, choose inventions such as electric lighting, rather than discoveries such as electricity. Here are a few ideas to get you started:

written language

clay pottery

the wheel

the plow

the airplane	the refrigerator
the firepit	the printing press
the loom	television

2. Choose one or two inventions from your list to present to the class. For each, try to imagine how people living at the time of the invention would have responded to the new way of doing things. Make a list of their possible objections to it and also their reasons for adopting it.
3. When you tell your class about the inventions your group has chosen, have one member of your group be the secretary and take notes on the board.

GETTING STARTED 2

For homework, do an Internet search on the author(s) of each article in this Theme. In class, share what you found.



Introduction to the Theme

Innovation has been part of human history since our beginnings, and each new way of doing things has had both its supporters and its detractors. Today, as throughout history, some of us welcome innovations in technology for the benefits they will bring, while others are reluctant to accept new ideas because of the damage they may do. The first two articles in this Theme briefly set out some of the gains and losses that come with the adoption of new technologies.

It can be argued that working with new tools—for example, the car—have actually changed us physically, mentally, and emotionally. Some think this is true of the devices we use to acquire information today, such as cell phones and computers. Using new technology may actually change the way we think or lead us to new addictions. At the same time, these devices may be just what we need to keep pace with a flood of information. The next three articles discuss the interaction between the new information technology and the human mind.

In fact, some people even question what it means to be human in this age of rapidly advancing technology. As robots take on more human tasks, such as care-giving and making military decisions, and humans take on more replacement parts, such as artificial organs and neural implants in our brains, one may wonder if robots are becoming more like humans or humans are becoming more like robots. The last three articles examine the relationships between humans and robots.

Framing Articles: Pros and Cons of Adopting New Technologies

Technology, Progress, and Freedom

Edward W. Younkins

January 2000

The Freeman, Volume 50, Issue 1

<http://www.thefreemanonline.org/featured/technology-progress-and-freedom/>

Technology represents man's attempt to make life easier. Technological advances improve people's standard of living, increase leisure time, help eliminate poverty, and lead to a greater variety of products. Progress allows people more time to spend on higher-level concerns such as character development, love, religion, and the perfection of one's soul.

If people resisted technological change, they would be expressing their satisfaction with existing levels of disease, hunger, and privation. In addition, without experimentation and change, human existence would be boring; human fulfillment is dependent on novelty, surprise, and creativity.

An innovative idea from one man not only contributes to the progress of others, but also creates conditions permitting people to advance even further. Ideas interact in unexpected ways, and innovations are frequently used in unforeseen applications. Technological progress involves a series of stages consisting of experimentation, competition, errors, and feedback.

The Problem of Technology

Peter Augustine Lawler

Summer 2005

Perspectives on Political Science, Volume 34, Number 3

Technology is a problem because we cannot do without it and our use of it clearly makes us both better and worse. Human beings are—among other things—technological or tool-making animals. We use our brains and our freedom to transform nature, and in doing so we transform ourselves. We also have a perverse capacity to make ourselves unhappy and a singular pride in our misery. We are both proud of and wish to free ourselves from the burdens of our technological success. So we find it almost impossible to judge how much and what kind of technology would be best for us. In principle, we should be free to accept or reject various technological developments. Technology, after all, is supposed to be means for the pursuit of whatever ends we choose. But, in truth, it might be our destiny to be moved along by impersonal and unlimited technological progress. We do not have much evidence of significant numbers of human beings resisting technological changes for long periods of time. (The peaceful and admirable Amish, for example, are a very small exception to a general rule.)

Technology and the Mind

Addicted to Phones?

April Frawley Birdwell

January 18, 2007

University of Florida News: Health, Research, Technology

<http://news.ufl.edu/2007/01/18/cell-addiction/>

"Turn off your cell phones and pagers."

For most people, heeding these warnings in hospitals or at the movies is as simple as pressing a button. But for a growing number of people across the globe, the idea of being out of touch, even just for a 90-minute movie, is enough to induce anxiety, says
5 a University of Florida psychologist who studies addictions to the Internet and other technologies.

Although cellular phones and personal digital assistants such as the BlackBerry were created to make modern life more convenient, they're actually beginning to interfere in the lives of users who don't know when to turn them off, says Lisa Merlo, an assistant
10 professor of psychiatry in the UF College of Medicine.

"It's not so much talking on the phone that's typically the problem although that can have consequences too," Merlo said. "(It's) this need to be connected, to know what's going on and be available to other people. That's one of the hallmarks of cell phone addiction."

15 Unlike addictions to alcohol, drugs or even gambling, it can be hard to pinpoint problematic cell phone use. Almost everyone has a cell phone and uses it regularly. But if someone can't get through dinner without sending text messages or furiously typing on a personal digital assistant during a meeting, it may be time to take a step back, Merlo said.

How people respond to being separated from their cell phones or PDAs is another
20 clue. Frequent users often become anxious when they are forced to turn off the phone or if they forget it at home, so much so that they can't enjoy whatever they're doing, Merlo added. Often, cell phone "addicts" compulsively check their phones for voicemails and text messages, she said.

"When (cell phone overuse) really becomes problematic for a lot of people is if they
25 have underlying anxiety or depression," she said. "This can really exacerbate it or (cause) their symptoms to manifest themselves."

For example, someone who already worries about what others think of them could become easily agitated if their phone calls or messages aren't returned right away.

"This is something that is going to affect them on a day-to-day basis," Merlo said.

30 The problem seems to be growing. A Japanese study revealed that children with cell phones often don't make friends with their less tech-savvy peers, a Hungarian study found that three-fourths of children had mobile phones and an Italian study showed that one quarter of adolescents owned multiple phones and many claimed to be somewhat addicted to them. A British study also recently found that 36 percent of college students
35 surveyed said they could not get by without cell phones. But this may be more a sign that students view cell phones as a modern necessity like a car, said David Sheffield, a psychologist who conducted the study at Staffordshire University in England.

"The most shocking figure was that 7 percent said the use of mobile phones had caused them to lose a relationship or a job," Sheffield said.

- 40 Although experts have pinpointed these problems in frequent cell phone users, studies have yet to show if a bad cell phone habit constitutes an actual addiction. Yet as with traditional addictions, excessive cell phone use is associated with certain hallmark patterns of behavior, including using something to feel good, building up a tolerance and needing more of it over time to get the same feeling, and going through
45 withdrawal if deprived of it, Merlo said.

- Cell phone users could start out with one phone and switch to newer models with more advanced features or PDAs that act like mini-computers over time to get the same feeling they had with their first phone, she said. Although withdrawal is typically considered a physical response that occurs when the body goes without a chemical, the anxiety cell
50 phone users feel without their phone could simply be another form of withdrawal.

"Those things lend toward the idea that maybe this is an addiction, but maybe it's manifesting in a little bit different way than you would think of a chemical substance," Merlo said.

- Addiction also causes changes in the brain, but scientists have yet to measure what
55 happens in the brains of cell phone users, she said. Even eating and other behaviors have been shown to produce the same effects in the brain as drugs and alcohol in some people, UF studies have shown.

- For frequent phoners who do think they have a problem or for parents of children obsessed with their cells, Merlo advises downgrading to a basic phone with fewer
60 features and setting limits about where and when to use the phone.

"Cell phones are a great technology," Merlo said. "They're useful in a lot of situations. (But) one of the most important things is making sure you have some cell phone free time in your day. It's OK to turn it off. Focus on family, homework, knowing that cell phone message will still be there."

Does the Internet Make You Dumber?

Nicholas Carr

June 5, 2010

Wall Street Journal

- The Roman philosopher Seneca may have put it best 2,000 years ago: "To be everywhere is to be nowhere." Today, the Internet grants us easy access to unprecedented amounts of information. But a growing body of scientific evidence suggests that the Net, with its constant distractions and interruptions, is also turning us into scattered and superficial
5 thinkers.

- The picture emerging from the research is deeply troubling, at least to anyone who values the depth, rather than just the velocity, of human thought. People who read text studded with links, the studies show, comprehend less than those who read traditional linear text. People who watch busy multimedia presentations remember
10 less than those who take in information in a more sedate and focused manner. People who are continually distracted by emails, alerts and other messages understand less than those who are able to concentrate. And people who juggle many tasks are less creative and less productive than those who do one thing at a time.

The common thread in these disabilities is the division of attention. The richness
15 of our thoughts, our memories and even our personalities hinges on our ability to
focus the mind and sustain concentration. Only when we pay deep attention to a
new piece of information are we able to associate it "meaningfully and systematically
with knowledge already well established in memory," writes the Nobel Prize-winning
neuroscientist Eric Kandel. Such associations are essential to mastering complex
20 concepts.

When we're constantly distracted and interrupted, as we tend to be online, our
brains are unable to forge the strong and expansive neural connections that give
depth and distinctiveness to our thinking. We become mere signal-processing units,
quickly shepherding disjointed bits of information into and then out of short-term
25 memory.

In an article published in *Science* last year, Patricia Greenfield, a leading
developmental psychologist, reviewed dozens of studies on how different media
technologies influence our cognitive abilities. Some of the studies indicated that
certain computer tasks, like playing video games, can enhance "visual literacy
30 skills," increasing the speed at which people can shift their focus among icons
and other images on screens. Other studies, however, found that such rapid shifts
in focus, even if performed adeptly, result in less rigorous and "more automatic"
thinking.

In one experiment conducted at Cornell University, for example, half a class of
35 students was allowed to use Internet-connected laptops during a lecture, while the
other had to keep their computers shut. Those who browsed the Web performed
much worse on a subsequent test of how well they retained the lecture's content.
While it's hardly surprising that Web surfing would distract students, it should be a
note of caution to schools that are wiring their classrooms in hopes of improving
40 learning.

Ms. Greenfield concluded that "every medium develops some cognitive skills at the
expense of others." Our growing use of screen-based media, she said, has strengthened
visual-spatial intelligence, which can improve the ability to do jobs that involve
keeping track of lots of simultaneous signals, like air traffic control. But that has been
45 accompanied by "new weaknesses in higher-order cognitive processes," including
"abstract vocabulary, mindfulness, reflection, inductive problem solving, critical
thinking, and imagination." We're becoming, in a word, shallower.

In another experiment, recently conducted at Stanford University's Communication
Between Humans and Interactive Media Lab, a team of researchers gave various
50 cognitive tests to 49 people who do a lot of media multitasking and 52 people who
multitask much less frequently. The heavy multitaskers performed poorly on all the
tests. They were more easily distracted, had less control over their attention, and were
much less able to distinguish important information from trivia.

The researchers were surprised by the results. They had expected that the intensive
55 multitaskers would have gained some unique mental advantages from all their on-
screen juggling. But that wasn't the case. In fact, the heavy multitaskers weren't even
good at multitasking. They were considerably less adept at switching between tasks
than the more infrequent multitaskers. "Everything distracts them," observed Clifford
Nass, the professor who heads the Stanford lab.

60 Does the Internet Make You Smarter?

It would be one thing if the ill effects went away as soon as we turned off our computers and cellphones. But they don't. The cellular structure of the human brain, scientists have discovered, adapts readily to the tools we use, including those for finding, storing and sharing information. By changing our habits of mind, each new
65 technology strengthens certain neural pathways and weakens others. The cellular alterations continue to shape the way we think even when we're not using the technology.

The pioneering neuroscientist Michael Merzenich believes our brains are being "massively remodeled" by our ever-intensifying use of the Web and related
70 media. In the 1970s and 1980s, Mr. Merzenich, now a professor emeritus at the University of California in San Francisco, conducted a famous series of experiments on primate brains that revealed how extensively and quickly neural circuits change in response to experience. When, for example, Mr. Merzenich rearranged the nerves in a monkey's hand, the nerve cells in the animal's sensory cortex
75 quickly reorganized themselves to create a new "mental map" of the hand. In a conversation late last year, he said that he was profoundly worried about the cognitive consequences of the constant distractions and interruptions the Internet bombards us with. The long-term effect on the quality of our intellectual lives, he said, could be "deadly."

80 What we seem to be sacrificing in all our surfing and searching is our capacity to engage in the quieter, attentive modes of thought that underpin contemplation, reflection and introspection. The Web never encourages us to slow down. It keeps us in a state of perpetual mental locomotion.

It is revealing, and distressing, to compare the cognitive effects of the Internet with
85 those of an earlier information technology, the printed book. Whereas the Internet scatters our attention, the book focuses it. Unlike the screen, the page promotes contemplativeness.

Reading a long sequence of pages helps us develop a rare kind of mental discipline. The innate bias of the human brain, after all, is to be distracted. Our
90 predisposition is to be aware of as much of what's going on around us as possible. Our fast-paced, reflexive shifts in focus were once crucial to our survival. They reduced the odds that a predator would take us by surprise or that we'd overlook a nearby source of food.

To read a book is to practice an unnatural process of thought. It requires us to
95 place ourselves at what T. S. Eliot, in his poem "Four Quartets," called "the still point of the turning world." We have to forge or strengthen the neural links needed to counter our instinctive distractedness, thereby gaining greater control over our attention and our mind.

It is this control, this mental discipline, that we are at risk of losing as we spend ever
100 more time scanning and skimming online. If the slow progression of words across printed pages damped our craving to be inundated by mental stimulation, the Internet indulges it. It returns us to our native state of distractedness, while presenting us with far more distractions than our ancestors ever had to contend with.

Mind Over Mass Media

Steven Pinker

June 10, 2010

The New York Times

<http://www.nytimes.com/2010/06/11/opinion/11Pinker.html>

New forms of media have always caused moral panics: the printing press, newspapers, paperbacks and television were all once denounced as threats to their consumers' brainpower and moral fiber.

So too with electronic technologies. PowerPoint, we're told, is reducing discourse
5 to bullet points. Search engines lower our intelligence, encouraging us to skim on the surface of knowledge rather than dive to its depths. Twitter is shrinking our attention spans.

But such panics often fail basic reality checks. When comic books were accused of turning juveniles into delinquents in the 1950s, crime was falling to record lows, just
10 as the denunciations of video games in the 1990s coincided with the great American crime decline. The decades of television, transistor radios and rock videos were also decades in which I.Q. scores rose continuously.

For a reality check today, take the state of science, which demands high levels of brainwork and is measured by clear benchmarks of discovery. These days scientists are
15 never far from their e-mail, rarely touch paper and cannot lecture without PowerPoint. If electronic media were hazardous to intelligence, the quality of science would be plummeting. Yet discoveries are multiplying like fruit flies, and progress is dizzying. Other activities in the life of the mind, like philosophy, history and cultural criticism, are likewise flourishing, as anyone who has lost a morning of work to the Web site Arts &
20 Letters Daily can attest.

Critics of new media sometimes use science itself to press their case, citing research that shows how "experience can change the brain." But cognitive neuroscientists roll their eyes at such talk. Yes, every time we learn a fact or skill the wiring of the brain changes; it's not as if the information is stored in the pancreas. But the existence of
25 neural plasticity does not mean the brain is a blob of clay pounded into shape by experience.

Experience does not revamp the basic information-processing capacities of the brain. Speed-reading programs have long claimed to do just that, but the verdict was rendered by Woody Allen after he read "War and Peace" in one sitting: "It was about
30 Russia." Genuine multitasking, too, has been exposed as a myth, not just by laboratory studies but by the familiar sight of an S.U.V. undulating between lanes as the driver cuts deals on his cellphone.

Moreover, as the psychologists Christopher Chabris and Daniel Simons show in their new book "The Invisible Gorilla: And Other Ways Our Intuitions Deceive Us," the effects
35 of experience are highly specific to the experiences themselves. If you train people to do one thing (recognize shapes, solve math puzzles, find hidden words), they get better at doing that thing, but almost nothing else. Music doesn't make you better at math, conjugating Latin doesn't make you more logical, brain-training games don't make you smarter. Accomplished people don't bulk up their brains with intellectual
40 calisthenics; they immerse themselves in their fields. Novelists read lots of novels, scientists read lots of science.

The effects of consuming electronic media are also likely to be far more limited than the panic implies. Media critics write as if the brain takes on the qualities of whatever it consumes, the informational equivalent of "you are what you eat." As with primitive
 45 peoples who believe that eating fierce animals will make them fierce, they assume that watching quick cuts in rock videos turns your mental life into quick cuts or that reading bullet points and Twitter postings turns your thoughts into bullet points and Twitter postings.

Yes, the constant arrival of information packets can be distracting or addictive,
 50 especially to people with attention deficit disorder. But distraction is not a new phenomenon. The solution is not to bemoan technology but to develop strategies of self-control, as we do with every other temptation in life. Turn off e-mail or Twitter when you work, put away your Blackberry at dinner time, ask your spouse to call you to bed at a designated hour.

And to encourage intellectual depth, don't rail at PowerPoint or Google. It's not
 55 as if habits of deep reflection, thorough research and rigorous reasoning ever came naturally to people. They must be acquired in special institutions, which we call universities, and maintained with constant upkeep, which we call analysis, criticism and debate. They are not granted by propping a heavy encyclopedia on your lap, nor are
 60 they taken away by efficient access to information on the Internet.

The new media have caught on for a reason. Knowledge is increasing exponentially; human brainpower and waking hours are not. Fortunately, the Internet and information technologies are helping us manage, search and retrieve our collective intellectual output at different scales, from Twitter and previews to e-books and online encyclopedias. Far
 65 from making us stupid, these technologies are the only things that will keep us smart.

Boundaries Between Humans and Machines

Humanoid Robotics: Ethical Considerations

David Bruemmer

May 30, 2006

The Idaho National Laboratory

<http://www.inl.gov/adaptiverobotics/humanoidrobotics/ethicalconsiderations.shtml>

The world's population of real humans continues to steadily grow. One might ask why we would want to make a machine that looks, thinks and emotes like a human when we have plenty of humans already, many of whom do not have jobs or good places to live. It is important to re-emphasize that humanoids cannot and will not ever
 5 replace humans. Computers and humans are good at fundamentally different things. Calculators did not replace mathematicians. They did change drastically the way mathematics was taught. For example, the ability to mentally multiply large numbers, although impressive, is no longer a highly valued human capability. Calculators have not stolen from us part of what it means to be human, but rather, free our minds for
 10 more worthy efforts. As humanoids change the contours of our workforce, economy

and society, they will not encroach on our sovereignty, but rather enable us to explore and further realize the very aspects of our nature we hold most dear.

So why should we have intelligent, emotion exhibiting humanoids? Emotion is often considered a debilitating, irrational characteristic. Why not keep humanoids, like calculators, merely as useful gadgetry? If we do want humanoids to be truly reliable and useful, they must be able to adapt and develop. Since it is impossible to hard-code high-utility, general-purpose behavior, humanoids must play some role as arbiters of their own development. One of the most profound questions for the future of Humanoid Robotics is, "How we can motivate such development?" Speaking in purely utilitarian terms, emotion is the implementation of a motivational system that propels us to work, improve, reproduce and survive. In reality, many of our human "weaknesses" actually serve powerful biological purposes. Thus, if we want useful, human-like robots, we will have to give them some motivational system. We may choose to call this system "emotion" or we may reserve that term for ourselves and assert that humanoids are merely simulating emotion using algorithms whose output controls facial degrees of freedom, tone of voice, body posture, and other physical manifestations of emotion.

Most likely, two distinct species of humanoids will arise: those that respond to and illicit our emotions and those we wish simply to do work, day in and day out, without stirring our feelings. Some ethicists believe this may be a difficult distinction to maintain. On the other hand, many consider ethical concerns regarding robot emotion or intelligence to be moot. According to this line of reasoning, no robot really feels or knows anything that we have not (albeit indirectly) told them to feel or know. From this perspective, it seems unnecessary to give a second thought to our treatment of humanoids. They are not 'real.' They are merely machines.

At their onset, all technologies seem artificial, and upset the perceived natural way of things. With the rise of the Internet, we coined the notion of a "virtual world" as a means to distinguish a new, unfamiliar arena from our usual daily life. This once clean distinction between a "real world" and "virtual world" already seems ephemeral. To someone who spends 10 hours a day logged into Internet chat rooms, the so-called "virtual world" is as real to them as anything else in their lives. Likewise, the interactions humans have with humanoids will be real because we make them so. Many years from now, our children will be puzzled by the question, "Does the robot have 'real' intelligence?" Intelligence is as intelligence does. As we hone them, enable them to self-develop, integrate them into our lives and become comfortable with them, humanoids will seem (and be) less and less contrived. Ultimately, the most relevant issue is not whether a robot's emotion or intelligence can be considered 'real,' but rather the fact that, real or not, it will have an effect on us.

The real danger is not that humanoids will make us mad with power, or that humanoids will themselves become super intelligent and take over the world. The consequences of their introduction will be subtler. Inexorably, we will interact more with machines and less with each other. Already, the average American worker spends astonishingly large percentages of his/her life interfacing with machines. Many return home only to log in anew. Human relationships are a lot of trouble, forged from dirty diapers, lost tempers and late nights. Machines, on the other hand, can be turned on and off. Already, many of us prefer to forge and maintain relationships via e-mail, chat rooms and instant messenger rather than in person. Despite promises that the Internet will take us anywhere, we find ourselves—hour after hour—glued to our

chairs. We are supposedly living in a world with no borders. Yet, at the very time we
60 should be coming closer together, it seems we are growing further apart. Humanoids
may accelerate this trend.

If it is hard to imagine how humans could develop an emotional connection to a
robot, consider what the effects would be of systematically imparting knowledge,
personality and intentions to a robot over a sustained period of time. It may well be
65 that much of the software for intelligent humanoid robot control is developed under
an Open Source paradigm, which means that thousands or even millions of developers
will be able to modify the software of their own or other people's robots. Source code
aside, humanoids will be given the ability to develop and learn in response to the
input they receive. Could a cruel master make a cruel humanoid? Will people begin
70 to see their robots as a reflection of themselves? As works of art? As valuable tools?
As children? If humanoids learn "bad behavior," whom should we hold responsible? The
manufacturer? The owner? The robot? Or the surrounding environment as a collective
whole? The ethical question of nature vs. nurture is relevant for humanoids as well as
humans. It will be hard enough to monitor the software and mechanical 'nature' of
75 humanoids (i.e., the state in which humanoids emerge from the factory crate). 'Nurture'
presents an even greater challenge.

Isaac Asimov believed that robots should be invested with underlying rules that
govern all behavior. Although generations of readers have admired and enjoyed
Asimov's ability to depict the theoretical interplay of these rules, it may be that such
80 encompassing, high-level rules are simply impracticable from a software engineering
perspective. Robot intelligence is the emergent effect of layered, low-level mappings
from sensing to action. Already, software developers are often unable to predict the
emergent effect of these behaviors when subjected to a non-Markovian (i.e., real-
world) environment.

85 Whatever else it may be, technological progress flows with a swift current. The Internet
continues to grow with little oversight, offering an incredible wealth of information and
services while at the same time presenting a new and devastating opportunity for fraud,
theft, disruption of commerce and dissemination of misinformation. One lesson to be
learned from the Love Bug virus and Y2K is that the better a technology is, the more
90 dependent we become upon it. Humanoids pose a grave threat for the very reason that
they will be of great service. As our technologies become more complex, more pervasive
and more dangerous, we will be ever more likely to employ the aid of humanoids.
They will not come in to work with hangovers, get tired or demand profit sharing, and
although they will never be perfect, humanoids may someday prove more reliable than
95 their creators.

Most likely, humanoids will never rise up and wrest control from our hands. Instead,
we may give it to them, one home, one factory, one nuclear facility at a time until
'pulling the plug' becomes, at first infeasible and then eventually unthinkable. Even
now, imagine the economic havoc if we were to disable the Internet. We are steadily
100 replacing the natural world with the products of our own minds and hands. As we
continue to disrupt and manipulate the existing state of our world (often for the
better), the changes we make require successive intervention. Technologies engender
and demand new technologies. Once unleashed, it is difficult to revoke a technology
without incurring profound economic, social and psychological consequences. Rather,
105 the problems that arise from new technologies are often met with more complex and
daring technologies.

Yet, no matter how quickly technological progress seems to unfold, foresight and imagination will always play key roles in driving societal change. We cannot shirk responsibility by calling the future inevitable. It is difficult to direct a snowball as it
 110 careens down the slope; thus, it is now—when there are only a handful of functional humanoids around the world—that we must decide the direction in which to push. Humanoids are the products of our own minds and hands. Neither we, nor our creations, stand outside the natural world, but rather are an integral part of its unfolding. We have designed humanoids to model and extend aspects of ourselves
 115 and, if we fear them, it is because we fear ourselves.

Smart Robots*

Michael Bond

23 May—5 June, 2009

Engineering and Technology

www.inl.gov/adaptiverobotics/humanoidrobotics/ethicalconsiderations/

It may be an old fantasy, but the basic premise that we will one day engineer machines that are at least as smart as us and whose behaviour is indistinguishable from ours is, according to many roboticists, closer to reality than we might like to think.

Our understanding of the human brain, and our ability to 'reverse engineer' it—
 5 to analyse how it works and replicate its processes—is increasing dramatically, such that within a couple of decades we should know all about the mechanics of human intelligence and, crucially, learning, and be able to apply this to machines.

Ray Kurzweil, an inventor and writer and one of the leading thinkers on artificial intelligence (AI), believes a profound shift in our capacity to engineer intelligence is not
 10 far off. "Extending our intelligence by reverse engineering it, modelling it, simulating it . . . and modifying and extending it is the next step in [human] evolution," he states in his 2005 book 'The Singularity is Near'.

He predicted a vastly accelerated pace of technological change that, in a few decades, would lead to machines that would "encompass all human knowledge and
 15 proficiency, ultimately including the pattern-recognition powers, problem-solving skills and emotional and moral intelligence of the human brain itself"—a merger between technology and human biology that would enable us to transcend our biological limits.

Four years on, Kurzweil is just as optimistic. Computing speeds and memory are continuing to improve exponentially, he says, and at the same time "we are making
 20 very rapid gains in reverse-engineering the brain, which will be a key source of the software for human intelligence."

The prospect of super-intelligent machine-human hybrids will seem fantastical to some. Yet a few decades ago, the notion of AI of any kind seemed unlikely; we are now surrounded by it—in the cars we drive, the computers we use, the video games and
 25 toys our children play with.

Devices that respond to their environment and learn from it—the basis of intelligence—are key to everything from speech and text recognition software and spam filters to medical diagnostics and financial trading systems.

We take it all for granted and it seems quite benign. But things look different and a
 30 little more unsettling when you apply the thinking behind this AI revolution to the field of robotics. A robot may look like a collection of steel and wires, but watch how people

*This article is from a British publication and contains some British spellings.

cannot help but respond with empathy when one speaks to them or casts sad-looking eyes in their direction and you'll realise the line between human and non-human can seem distinctly opaque.

35 **Robot Clone**

The most graphic example of this is Geminoid HI-1, the android robot created by Hiroshi Ishiguro at ATR Intelligent Robotics and Communication Laboratories near Kyoto, Japan. Geminoid HI-1 is Ishiguro's 'twin'—a near-perfect replica of himself that can mimic his movements and expressions using 46 small, air-powered pistons and air
40 bladders. The air bladders expand and contract to emulate his breathing, fidgeting and other movements, such as turning or nodding of the head, all of which Ishiguro can control from a remote computer.

When he speaks, a system of infrared sensors transmits his lip movements to the robot, while a speaker broadcasts his voice; a built-in camera allows him to 'see' through its eyes.

45 Ishiguro uses his twin to lecture to students while he sits at the controls in his office at the other side of town. People often treat it as real, he says, even when they know it isn't. This is not just a gimmick: he wants to discover the essential human-like social cues that an android robot must possess for people to communicate with it naturally. The idea is to pave the way for the development of robots with more human-like
50 qualities, to enable them to "integrate into human society as partners and have natural social relations with humans." Along the way, he hopes to discover more about what it is to be human.

Geminoid HI-1 is considered a ground-breaking development by many roboticists because it appears to have overcome a problem known as the 'uncanny valley,'
55 whereby we become increasingly comfortable with robots the more they resemble humans but start to get uncomfortable when they look close to humans because the absence of particular movements or behaviour makes them resemble a moving corpse. Ishiguro's twin is sufficiently realistic in its mannerisms that people are not repulsed by it. Yet those who predict a nearfuture in which people daily interact with
60 robots point out that a robot does not have to look much like a human for people instinctively to behave empathetically towards it.

Roboticians have had plenty of chances to observe this. Over the past 15 years, a whole family of 'social robots' has emerged in laboratories in Japan, the US and Europe. One of the earliest, Cog, was developed by a team led by Rodney Brooks at
65 the Humanoid Robotics Group at the Massachusetts Institute of Technology (MIT). Cog, now retired, was programmed to follow movement and to respond to its sensory inputs—for example, it could 'learn' to manipulate objects such as a Slinky toy by adjusting the raising and lowering of its motor arms in response to the weight of the object.

70 Cynthia Breazeal of MIT's Media Lab, who helped design Cog, went on to develop a headrobot called Kismet, which could express basic emotions through judicious manipulation of its eyebrows, eyes, lips and ears.

Kismet had built-in video cameras, microphone and speech recognition software that enabled it to interact with a person at a level similar to that of a six-month-old
75 child. Breazeal's latest project is Leonardo, a nondescript furry creature capable of articulated facial expression and with the apparent interactive sophistication of a five-year-old.

Remarkable Behaviour

You might ask whether there's anything remarkable about the way people behave towards robots. Their expressiveness is superficial, even though people respond as if it were something deeper. "Sociable robots inspire feelings of connection not because of their intelligence or consciousness, but because of their ability to push Darwinian buttons in people—making eye contact, for example—that cause people to respond as though they were in relationship with them," says Sherry Turkle, director of the MIT's Initiative on Technology and Self.

People often respond to any mechanical toy with empathy and emotion. Consider the commercial success of robot pets such as the Tamagotchi, My Real Baby, Sony's AIBO dog and the Furby, whose owners—adult as well as children—develop genuine attachment to them, and grieve if they break.

Even on the battlefield, a place not known for sentiment, soldiers have been known to humanise the autonomous devices they use for reconnaissance or mine clearance. US troops in Afghanistan and Iraq often treat them as fellow soldiers, naming them, giving them rank or awarding them medals after successful missions.

Given our propensity for bonding with just about anything that moves, is the special allure of Leonardo, Kismet and their ilk all down to sophisticated aesthetics and creative programming? Is there anything going on in there that would have Capek, Asimov, Dick and other AI fantasists rubbing their hands in anticipation? Are modern robots still anything more than machines? Their creators certainly think so.

*My Friend the Robot**

Kathleen Richardson

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Worried about being all alone in your old age? A robot companion could be the solution. While roboticists focus on developing humanoid robot helpers for the elderly, other researchers are as interested in building robots for use as human companions and challenging attitudes towards machines as they are in providing practical support for elderly people. But what might be the consequences of giving machines more status?

The baby boom in advanced capitalist economies is long gone; the population is set to age and keep on ageing. In the next 45 years in the US, 20 per cent of the population will be aged 65 or over. By 2050, the proportion of elderly dependent people in Europe is expected to increase to more than 51 per cent. Japan is likely to see one of the largest rises in the elderly dependents ratio, estimated to reach 71 per cent by the year 2050. In light of these forecasts, roboticists see elderly support and care by robots as an important area of their work.

Honda's Asimo (Advanced Step in Innovative Mobility) could be one such robot. It is the size of a small adult, has a humanoid form and is often photographed assisting people—such as collecting a newspaper or delivering the tea. Asimo is held up as an example of robots to come. In the US, researchers at Carnegie Mellon University have developed Pearl, a robot specifically designed to help the elderly. Pearl is about 1m tall and has a mobile base, a video-screen in the place of a torso, a grey face and a hefty price tag—more than \$100,000 (£50,800). Its human-like face is designed to encourage the elderly to interact.

*This article is from a British publication and contains some British spellings.

Robots such as Pearl and Asimo could have many uses for ageing populations, reminding them to take medication and assisting with chores. One US-based roboticist explained the advantages of designing robots in humanoid ways.

As human-like robots reflect aspects of the human physical, emotional or
 25 communicative repertoire, researchers hope this will make users feel comfortable, safer and able to interact with the technology without any specialised training. A robot with multiple skills, including mobility or communication, might have advantages over technology produced with one specific, inflexible role.

Yet some in the field want robots to be viewed as more than just sophisticated
 30 working appliances. Others resent their use as “servants” or “slaves.” They talk of developing robot companions that encourage relational bonds between humans and machines. One area where the use of robot companions is under way is among the elderly community, where isolation and depression are major problems.

Japanese researchers lead the way in robotic healthcare for the elderly. As well as
 35 funding research in this area, the Japanese Government bestowed an honour on the makers of the robot Paro in December 2006. Paro, which had been in the making since 1993, was developed by the National Institute of Advanced Industrial Science and was one of many robots at the Government-sponsored Robot Awards 2006.

However, Paro cannot help with chores or assist the elderly with mobility issues. This
 40 is because Paro is a furry seal-like robot. Its makers refer to it as a “mental commitment robot,” or companion robot. Paro was trialled at care homes in Japan, and the results are said to demonstrate how human and machine bonds are possible. The researchers looked to human-animal relations to study human bonds with other kinds of species.

Could companion robots be a technological solution to the problem of elderly
 45 alienation? And can technologists convince us that humans could really form relationships with machines?

“We have to be careful how we use the term ‘relationship,’” says Kerstin Dautenhahn, professor of artificial intelligence at Hertfordshire University. “I have a ‘relationship’ with my car, but it is not the same as a relationship with a human. Robots are not sentient
 50 creatures.” But do robotic innovations blur these boundaries? Scientists interviewed in a recently published report sponsored by the UK Government think so.

When surveyed about the future of technology, some scientists thought robots might one day demand rights. In Europe, “robot ethics” is a growing area of research. In fact, studies are under way that examine the treatment of robots by humans. An exhibit at
 55 the Boston Science Museum in the US showcases research that addresses this question. Ada Brunstein, a science researcher at the Massachusetts Institute of Technology, says: “It has been reported that children do possess a sense of moral responsibility to Aibo (a robotic dog made by Sony), but this could easily be because kids recognised that Aibo was an expensive and fragile toy, while a stuffed animal is clearly more durable.”

60 Is the very process of humanising machines enough to call into question the boundary between a human and machine?

Dautenhahn thinks not. “Interface” is the term she chooses to explain why she uses humanoid features in her research. “In my work, I employ some humanoid aspects in the design of the robots, but this is mainly as an interface. People like to know where to
 65 speak and look when talking to a machine.” Yet much research is focused on imparting human behavioural qualities to machines.

The Cognitive Robot Companion, or Cogniron, project aims to design machines with manners. Cogniron researchers believe that a robot with manners could help humans relate to it more comfortably. In addition to "robotiquette," other researchers
70 have embarked on making robots that can trigger human empathy. At the University of the West of England, roboticist Peter Jaeckel is studying how to get a person to feel empathy with a machine. Jaeckel's human-like robotic platform Eva (designed by David Hanson at the University of Texas) does this by mimicking facial expressions. Jaeckel wants Eva to perform the expected facial responses to humans who interact with it.

75 But can companion robots benefit the elderly? In studies of elderly-robot relations, a person's biographical details often reveal a complex picture, with the elderly-robot relationship positively affected, often directly, by illness or feelings of estrangement from the person's family. Sherry Turkle, professor of science, technology and society at MIT, was until last year a distinguished supporter of robot care for the elderly. In
80 her work, she has examined the therapeutic role of robots as relational objects. The robots' use as an outlet for anger or loneliness were some of the positive results found in studies such as Turkle's, but these results cannot be separated from the challenging situations that many elderly people face.

This should not diminish the use of robots as therapeutic tools, but still, a therapeutic
85 tool is quite different from a machine alternative to a human companion.

Robot companions may, in the short term, ease the problem of loneliness in much the way that pets do, but can these robots work over longer periods and connect with deeper human yearnings? For some roboticists, there may be little difference in quality between a human and machine, but for others a human-like robot is nothing more
90 than a machine with a face.

The redefining of robots as companions is imaginative and may lead to some innovative research. But confusing the qualities of human and machine muddy the practical development of this technology.

I think the following examples symbolise the inherent problem in equating robots
95 and humans. While conducting fieldwork at MIT, I was shown a photograph of a robot pushing a wheelchair; behind the robot were several adult males pushing the robot. In another case, a similar scenario was played out when I saw the robot Asimo. The physical form and human mimetic performance of Asimo did seem eerily human-like. But when one steps back from the visual effects of the robot the illusion is revealed.

100 In a recent UK television commercial, Asimo can be seen walking unaided, but Asimo is remote-controlled and requires an army of highly skilled researchers to make it work. Metaphorically speaking, both examples illustrate the ineffective, confused and illusionary nature of the research. Put another way, in the absence of a human-centred vision, the technology's benefits to the elderly will be uncertain and limited.

105 If researchers apply ethics to machines, the potential of the technology will be overshadowed by an uncertainty about who and what it is for. In this sense, machines might be judged less on what they can do and how they are useful and more on how they look, behave and how we relate to them—a very useful sticking plaster, in fact, for our own feelings of alienation from, and responsibility to, other human beings.

QUESTIONS FOR WRITING ABOUT THE IMPACT OF TECHNOLOGY

For each writing assignment, use evidence from several of the articles in this Theme to support your position. You may also use evidence from your own experience or additional sources you find.

1. What are the benefits and the drawbacks of using the Internet as a source of information?
2. How can new technologies such as the Internet and social media be used most effectively? That is, how can we minimize their negative effects and enhance their positive effects?
3. When the written language began to be widely used in Greece in the fourth century B.C., Socrates, a philosopher of the time, opposed it, saying that writing was a lot less flexible than oral language and also that it would have a negative affect on our mind, destroying our ability to memorize. What are some similar objections to the development of the Internet?
4. Consider a definition of addiction and discuss whether it is possible to become addicted to social media.
5. Will using robots as caregivers help or damage relationships within the family?
6. How are robots similar to and different from animal pets?
7. What is consciousness? Is a robot conscious?
8. If robots have emotions and act as caregivers and if people have increasingly more artificial body parts such as neural implants and prosthetic limbs, what does it mean to be human?

MORE QUESTIONS FOR WRITING ABOUT THE IMPACT OF TECHNOLOGY

To write about these questions, in addition to taking supporting evidence from the articles in this Theme, you will need to use evidence from other Themes in *Sourcework* or find additional sources on your own.

1. How have social media affected the concept of friendship among people of different age groups?
2. How has the Internet affected education?
3. How does new technology make it easier for humans to create a lifestyle that sustains the environment?
4. Do inventors of new technologies, especially those that benefit large numbers of people, qualify as heroes?
5. Do advances in technology, such as the Internet and other social media create changes in society or do changes in society, such as more globalization of business, create new technologies? Which is cause and which is effect?
6. How will humanity have enough money and resources to give the benefits of innovative technology to all people? Or, will only the rich benefit from new technologies, creating ever more social inequities?