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Guest Editor

Technology within Society

Franz A. Foltz

Over two decades ago, Langdon Winner, a leading scholar of Science and Technology Studies (STS), asked the question "Do Artifacts have Politics?" His answer was that technology is intertwined with our culture and has values embedded within it that helps to shape society. Our world has a particular look – Interstate highways, strip malls, fast-food drive thrus, and sleeper communities – because of the automobile. This idea of technology shaping society is often referred to as technological determinism.

The countervailing position within the field of STS is called social construction (see Bijker, Hughes, & Pinch, 1987). Social constructivists would argue that the car looks and performs like it does because society shapes the nature of technology. Consumers, auto manufacturers, and various levels of government come together to shape the car. We are currently at a potential change in the nature of automotive travel. The SUV – gas guzzling, heavyweight, family carrying, low-efficiency vehicles – has become the norm, simply because people wanted them. It appears that due to rising fuel prices the SUV may be replaced with higher efficiency hybrid technology. This change comes from society's demands.

Together, social construction and technological determinism make up the two extremes within the field of STS. For most STS scholars, it is not one extreme or the other. Technology affects society and in turn society affects technology. Most would agree with Winner (1986) that technology and human culture are inextricably linked together.

Most STS scholars would also agree with the historian of technology, Thomas Hughes (1979, 1987), that when we talk about technology we must talk about technological systems. The automobile is by itself not a very useful technology. We need a system of highways, gas stations, and even traffic laws for us to travel any great distance by car. To maintain this system, we need road crews, snowplows, mechanics, and police. They operate as one complex socio-technical system. The larger system provides much more benefit than any single bit of technology on its own. A single home computer allows us to do some tasks, but when it becomes part of the greater Internet system, its potential grows exponentially.

In the end of his discussion on the politics of technology, Winner argues that the values embedded within technology come from those that design technology. In most cases this is a small elite, who because of their position can in turn shape society as a whole. Winner argues that the only way within a democratic society to ensure that the right values become embedded within technology is to open the design process to a greater range of input. He would argue that we need society as a whole to construct technology and not just a small sample of society.

In the following articles, various viewpoints and arguments are made concerning the nature of the relationship between technology and society. Some are constructivists in nature, while others are more deterministic in their outlook. Most come from an STS perspective, but some are more narrowly focused. They represent viewpoints from technology studies, policy studies, criminal justice, history of technology and even education. All explore technology's intersections with social, political, economic, religious, and engineering domains, demonstrating diverse viewpoints concerning technology's relationship to society.

The first article by Benjamin Sovacool, the 2004 winner of the National/International Association of STS (NASTS/IASTS) Graduate Paper Contest, provides an oversight of the four dominant social construction of technology models. It provides a good introduction for individuals not familiar with technology studies. The next two articles by John Monberg and Mary L. Cummings are traditional social construction of technology pieces. They both deal with computer related issues. The first focuses on the idea of artificial intelligence and the latter reflects on human-computer interfaces, particularly in regard to modern weapon systems.

The fourth and fifth articles deal with how technology has changed society. Sam McQuade looks at how new technology may have unintended consequences as criminals adapt it for use in their criminal behavior. He comes from a traditional criminal justice tradition but shows how technology, in this case computers, affects society in a way that has been given little attention. Chien Yu and Teri Brandenburg take an educational look at how computers have affected distance education and provide insights for individuals who may want to become online instructors.

The next two question the idea that technology is itself the answer to all our problems. The first, by Evan Michelson, the 2005 winner of the IASTS Graduate Paper Contest, looks at how civil society organizations in the developing world use information and communication technology from a more policy-oriented point of view. The next, by Mabel CPO Okojie, Anthony A. Olinzock, and Tinukwa C. Okojie-Boulder takes an educational viewpoint and suggests that simply introducing technology into the classroom may not improve the educational experience. Technology and pedagogy need to be integrated.

The eighth and ninth articles have a strong history of technology foundation but also suggest potential impacts for the future. Richard F. Hirsh and Benjamin K. Sovacool show how technological systems build up an inherent momentum over time that limits the ability for society to make changes. Laurie Robertson looks at the conflict between the values embedded within voting machines and U.S. beliefs concerning elections. She questions if a machine can adequately meet the high expectations of the American voter.

The final three articles have more of a technology policy aspect to them. William M. Shields looks at the epistemic value of "cautionary tales" when dealing with risky technology. Constantine Hadjilambrinos questions the current direction of U.S. nuclear waste policy that seems to be treading water instead of addressing some very important issues. In this case, we see an inherent momentum in the system, which limits society's ability to deal with nuclear waste, though this time; it comes from policy makers and not the technology itself. The final article by Franz Foltz and Frederick Foltz argues that we need to increase the ability of various social groups to participate in the design process for new technology. They show what insights the religious community could provide that would aid in the development of nanotechnology and argue that opening up the process to allow more social groups into the process would only improve the design of new technology.

References

Bijker, Wiebe E., Thomas P. Hughes, and Trevor F. Pinch, (Eds.) (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge: MIT Press.

Hughes, Thomas P. (1979) The electrification of America: The system builders. *Technology and Culture* 20 (June): 124-141.

Hughes, Thomas P. (1987) The evolution of large technological systems. In Wiebe E. Bijker, Thomas P. Hughes, and Trevor F. Pinch (Eds.) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge: MIT Press: 51-82.

Winner, Langdon. (1986) *The Whale and the Reactor*. Chicago: University of Chicago Press.

Reactors, Weapons, X-Rays, and Solar Panels: Using SCOT, Technological Frame, Epistemic Culture, and Actor Network Theory to Investigate Technology

Benjamin K. Sovacool

Every major technical change reverberates at many levels, economic, political, religious, cultural. Insofar as we continue to see the technical and the social as separate domains, important aspects of these dimensions of our existence will remain beyond our reach.
–Andrew Feenberg, *Questioning Technology*

Abstract

The article explores how four different theories have been used to investigate technology. It highlights the worth and limitiations of each theory and argues that an eclectic, ever-evolving approach to the study of technology is warranted.

Introduction

Traditional approaches to the history of science and technology have been challenged for being too narrow, deterministic, and selective. For instance, before the creation of the Society for the History of Technology (SHOT) and the International Association for Science and Technology Studies (IASTS), historical investigations of scientists and technology tended to focus exclusively on "men and machines" at the expense of larger social, political, and economic circumstances (Hirsh 1983; Nye, 1984). When these approaches did attempt to investigate the context surrounding science and technology, they typically reduced changes to secondary effects of economic and social policy, often subscribing to doctrines of technological and social determinism. When historians and sociologists of science and technology did endeavor to look closer at context and determinism, they tended to be inconsistent and parochial in their selection of case studies, habitually focusing on great technological systems like electricity or military weapons at the expense of topics such as gender, culture, and race.

In contrast, the progressive field of science and technology studies (STS) has adopted as its fundamental concern the "investigation of knowledge societies in all their complexity: their structures and practices, their ideas and material products, and their trajectories of change" (Jasanoff 2004, 2). This perspective views technological knowledge and its material embodiments as at once products of social work and indicative of different forms of social life. A growing number of academic STS programs, the increased technological sophistication of society, and the interdisciplinary nature of its subject matter have coalesced to deepen the significance and application of STS. Correspondingly, the number of scholars subscribing to its views – and the literature and intellectual momentum attached to them – has spawned dozens of different theories, case studies, and analytical tools designed to illuminate the interplay between technology and society.

To help focus on the foundations of the discipline, this paper will investigate four widely used methodological approaches for studying technology. Specifically, it will argue that the social construction of technology, technological frame, epistemic culture, and actor network theory together offer a more varied and dynamic way of differentiating the interconnections between the "black box" of technology and cultural, social, political, and economic structures. The central argument of this paper holds that these concepts are useful in describing (a) the different social groups involved in the production of technological artifacts that might otherwise remain concealed; (b) the relationship such technology has with socio-cultural structures and practices; (c) the tendency for technological artifacts to have meanings that are mediated and negotiated, rather than fixed, and contingent on discourses of conflict, difference, and strategy; and (d) the often invisible role of knowledge, expertise, technical practices and material objects that shape, sustain, and transform relations of authority and institutions of policymaking.

This paper is not intended to provide a comprehensive investigation of these technologies or theories. Rather, it is designed to provide a helpful and concise guide for scholars and educators wishing to sample a variety of STS methods and topic areas. To do so, it focuses on four of the most cited and used theories in the field. The paper begins with a discussion of SCOT and nuclear reactors before examining technological frame and military weapons, epistemic culture and x-ray hair removal, and actor network theory and solar panels.

The Social Construction of Technology (SCOT) & Nuclear Reactors

Sociologists such as Wiebe Bijker (1992, 1996), Donald MacKenzie (1993, 1999), Trevor Pinch (1999, 2001), and historian Thomas Hughes (2001) have promoted a model called the social construction of technology. This model holds that technological systems commit policymakers to a particular set of technical arrangements and are inherently "socially constructed artifacts" (Hughes 2001, 52; Bijker & Law 1992; Kline & Pinch 1999). These authors propose that large technological systems often involve many distinct agents, subjecting them to an interpretive flexibility that gives the same technological artifact varying meanings for different groups (Kline & Pinch 2001, 113-114). Or, as political theorist Landon Winner (1999) puts it, "artifacts have politics."

The methodological approach called the social construction of technology (SCOT) suggests that technological systems are often organized according to five interrelated themes. First, technological artifacts are viewed as intrinsically complex and, like "the social" or "the economic," contain meaning that is not fixed but emergent (MacKenzie 1998; Bijker & Law 1992). This meaning materializes through what John Law refers to as "heterogeneous engineering," the process by which multiple meanings get manufactured into technological objects. Second, because the development of technology involves competing organizations, consumers, entrepreneurs, and politicians seeking to maintain a particular set of technical arrangements, artifacts are often the product of conflict, difference, and resistance. Third, technologies involve strategy and "are not neutral servants of whatever social or political order chooses to adopt them. Their adoption and operation involves changes to that order – changes that are not automatic consequences of new technology but must themselves be engineered, often in the face of conflict and resistance" (MacKenzie 1998, 14). Fourth, since "technological systems contain messy, complex, problem-solving components," technologies encompass not only physical artifacts but also an entire network of organizations, processes, people, research programs, regulatory laws, and knowledge systems (Hughes 2001; Bijker, Hughes, & Pinch 2001). Fifth, since technologies are "invented and developed by system builders and their associates, the components of technological systems are socially constructed artifacts" with disparate effects on social, economic, and cultural practices (Hughes 2001, 52; Bijker & Law 1992).

Thus, SCOT proposes that both social determinism and technological determinism are flawed because "neither the purely social nor the exclusively technical is a determinant" in constructing technology. Rather, technological designs are shaped both by inescapable physical realities and ambient socio-cultural factors. Approaches to understanding technology, then, must recognize that objects are not universal or independent of context (MacKenzie 1998, p. 216). Rather, SCOT can reveal that apparently stable technologies started with many possible futures and have been shaped by "particular social interests and relevant social groups and interpretations" (Mort 2002, p. 22).

The classic example of a socially constructed technology is Langdon Winner's discussion of the American nuclear reactor. Winner proposes (1986, 1999) that the construction and operation of nuclear reactors in the United States requires an authoritarian, systems-centered, immensely powerful but inherently unstable technological approach. This approach blurs the distinction between social and technological determinism. Nuclear reactors are deeply woven in the conditions of modern politics, and fundamentally change the exercise of power and the experience of citizenship. As one environmentalist lamented in the 1970s:

> The increased deployment of nuclear power facilities must lead society toward authoritarianism. Indeed, safe reliance upon nuclear power as the principle source of energy may be possible only in a totalitarian state. (cited in Winner 1986, p. 19)

Yet social values and norms also exert great influence on the technology of nuclear reactors. Nuclear reactors can be socially constructed in two ways. First, many theorists working in the history and philosophy of technology have noted that the adoption of a given technical system actually requires the creation and maintenance of a particular set of social conditions as the operating environment for that system. Some kinds of technology, like nuclear reactors, require their social environments be structured in a particular way much like an automobile "requires wheels to move" (Winner 1986, p. 32). In this sense, the specific features in the design of nuclear reactors provide a convenient means of establishing patterns of social power and authority.

In addition, normative social values become entrenched into the design process of a nuclear reactor. The average cost of a traditional nuclear power plant ranges between $5-7 billion, not including the expense for storage of spent nuclear fuel, maintenance, and decommissioning; thus, the existence of a reactor requires a society with significant amounts of wealth. It also requires a society that uses electricity and demands extremely large quantities of energy for consumption (Nye 1992, 1999; Hirsh 1999; Melosi 1985). Moreover, the extensive transmission networks designed to distribute the electricity provided from nuclear reactors to millions of customers requires a certain level of democracy, coupled with the intent that citizens should have equal access to electricity. In contrast, nuclear power also requires authoritarian management styles and extremely tight security precautions. It is one of those structures whose hazards and vulnerabilities, in the words of Langdon Winner, require "ourselves to become increasingly well policed" (1986, p. 175). And, finally, the truly gargantuan nature of nuclear power plants reflects the American notion of progress, but progress in a very unique way: a monument to gigantism, science, and the domination of people over nature. Thus, the nuclear reactor is not simply a social or technical artifact. Instead, it is a multifarious technology that fundamentally embraces democratic and authoritarian tendencies at the same time (thus being a product of tension and negotiation) while also embedding social values related to wealth, electricity consumption, and progress.

Technological Frame & Military Weapons

Similarly, the concept of a technological frame is often mentioned in conjunction with SCOT. In his influential work establishing a theory of socio-technical change, Wiebe Bijker (1995) holds that the idea of a "technological frame" attempts to enclose the interactions that occur between, rather than in or above, the actors. It comprises "all elements that influence the interactions within relevant social groups and lead to the attribution of meanings to technical artifacts – and thus to constituting technology" (Bijker 1995, p. 123). Bijker argues that a technological frame must include three components: (1) the array of values, methods, goals, tacit knowledge, user practices, and testing procedures used by a group of practitioners when developing a particular technology; (2) the individual actors that constitute such a group; and (3) the technological artifact itself. Bijker emphasizes that a "technological frame" is intentionally an abstract concept and is intended for use as an analyst's tool when investigating technology.

For example, when investigating the social construction of Bakelite, the first synthetic plastic, Bijker contrasts two distinct social groups, one involving celluloid chemists and the other electrochemical engineers. The chemists, Bijker documents, were primarily concerned with the production of fancy articles, price of the solvent camphor, flammability of celluloid, shrinkage and distortion of plastic, application of heat and pressure, and the use of presses and preheaters to manufacturing celluloid (Bijker 1995, p. 126). These goals, problems, strategies, theories, and artifacts are significantly different from those of the electrochemical engineers. The engineers were primarily concerned with the flow production of chemicals, corrosion and reaction efficiency of plastic, the design of diaphragms, industrial flow processing, fluid dynamics, and basic inorganic chemistry (Bijker 1995, p. 141).

By focusing on social groups, Bijker demonstrates that artifacts possess interpretive flexibility. That is, different social groups see particular technologies in different ways. These technologies, then, become "heterogeneous" because their meaning, rather than being fixed, are interpreted and negotiated by those social groups connected to it. An emphasis on a particular group of practitioners can reveal the wider social interests invested in technology, other associated groups that might otherwise remain hidden, and the different strategies these actors use in their contest over the negotiation of technology.

Such an approach can be especially useful for studying the social interests attached to the production of military weapons. Ken Adler (1997) uses the notion of technological frame particularly well in *Engineering the Revolution*, where he follows the role of Enlightenment French engineers in their design of gunpowder weapons and cannons. Adler holds that the gun transformed the relationship among officers, soldiers, and the nation-state in the same way that our modern landscape is changed by the presence of computers and nuclear weapons.

Using technological frame, here, reveals three interesting things. First, by tracing the work of engineers working in the French artillery service, Adler demonstrates the importance of Honore Blanc, who invented interchangeable tumblers, locks, plates, frizzens, pans, cocks, sears, bridals, screws, and springs in muskets. Blanc's inventions were viewed by Thomas Jefferson during a visit to France, and convinced Jefferson to promote interchangeable gun parts at the armories in Harpers Ferry and Springfield, a move that ultimately influenced Eli Whitney and modern techniques for mass production of products with moving parts. Consequently, the group-centered approach is useful for tracing the course of a technology as it is transferred among different actors.

Second, by following engineers Adler shows that the role of the French government as the provider of productive order was changing. The French Revolution, in eradicating the monarchy, attempted to establish a new state based on the absolute right to property and free trade. This ideal, however, was deeply influenced by engineers, who presented their own vision of the nation and its technological life in their discussions with citizens and politicians. In short, the engineers expanded their role as benefactors of the state, establishing themselves as important actors in creating a productive French order.

Third, such an emphasis on these engineers reveals that they were most successful, not in their technology, but in their social influence. At the beginning of the 1700's, French military engineers were at the periphery of power, connected to a hodgepodge of eclectic social backgrounds, and answerable to lordly patrons. By the end of the century, the engineers represented a highly specialized, autonomous, and professional elite with a clearly defined workforce backed by social institutions and universities. Their corresponding technical advances in the musket, cannon, and M177, while important, were not nearly as influential. Adler's approach reminds scholars of a profound paradox: the engineer's greatest triumph was the assertion to the right of technocratic rule on the basis of a technical mastery that they did not possess. Yet by connecting their vision to popular French ideals and needs, engineers secured the use of automatic machinery and positioned themselves at the center of French industrialization.

On a more contemporary plane, the concept of technological frame is especially insightful for investigating large technological systems, like electric utility equipment, military weapons, and industrial and manufacturing facilities. For example, when applied to the development of the United States National Missile Defense (NMD) system (formally called the Strategic Defense Initiative and then Theatre Missile Defense), technological frame helps reveal at least three separate groups – engineers, politicians, and security analysts – that might otherwise remain hidden.

The requirements for NMD are incredibly complex, demanding thin margins of error and the most difficult aspects of rocket science. Aerospace, electrical, computer, systems, and civil engineers must work together to create a system with the precision needed to "hit a bullet with a bullet" (Mitchell, 2000). This ability to target and intercept incoming missiles is further complicated when adversaries can attempt to overwhelm the system through the construction of decoys, attempts to Multiple Independently Targetable Reentry Vehicle (MIRV) warheads, missile saturation techniques, and the deployments of cruise missiles and weather balloons to overwhelm computer targeting systems (Eland 2000). For these engineers, an NMD system is about protecting the American homeland from a missile attack, and they must focus on making its technology work.

Politicians, in contrast, emphasize the importance of using an NMD system to protect American allies and provide American aerospace and defense firms with lucrative international contracts. The United States supplies over 51 percent of military technology sold globally, and members of the Department of State and Department of Defense have already signed agreements and memorandums with Israel, India, Taiwan, and South Korea promising to export our NMD technology (Sadowski 1992; Warren & Floodin 2001; Mitchell 2000).

Finally, security analysts, often working in association with large security and defense think tanks and government institutions, are charged with providing the justifications for an NMD system by assessing hostile enemies and "states of concern," such as Iran, Libya, and North Korea, that may want to attack the United States. For these analysts, NMD requires the assessment of rogue nations needed to create popular support for the missile shield, and the psychological assurance that such a system will deter and prevent an attack on the American homeland (Mitchell 2000; Spring & Anderson, 2000).

Technological frame highlights that these different social groups employ disparate production habits, methods, and techniques. For instance, engineers work mostly in aerospace and scientific laboratories, evaluate their findings through research, development, and demonstration, and present their results at academic conferences. In contrast, politicians must report to different committees and panels within Congress and the Federal Government, evaluate the "success" of missile projects only in terms of economic development, the creation of jobs, and establishment of export markets, and present their findings through public deliberation. Security analysts create their knowledge at various think tanks from reading literature and citing similar authors, evaluate their findings through the internal workings of their institution, and present their research directly to the public through reports and statements. Yet while these groups approach NMD differently, they play an indispensable role in designing, selling, and justifying the technology.

In sum, the concept of technological frame can be useful for studying historical and contemporary military technology. In the case of arms manufacturing in Enlightenment France, the concept helps reveal how a particular ensemble of actors transfer their technology, establish their profession, mold the course of society, and use the power of vision and deception to retain political influence. In the case of NMD, the concept reveals that the NMD system is not merely a technical system with military implications. Instead, it emerges through a web of social groups concerned about the technology's feasibility, economic potential, and psychological protection. In this instance, each social group directly relates to the other: a system that cannot work provides no comfort; a system that cannot make money will not appease aerospace contractors; and the lack of public support prevents the system from being built (and thus working), and so on. Technological frame reveals that the technical controversy over making NMD effective also concerns engineers, politicians, and security analysts. Put simply: the development of any large technological project – particularly one such as NMD – is conceived, planned, and designed to achieve a complex set of objectives that will enhance the security and economy of society. In doing so, it necessarily involves many distinct groups with competing and complementary values, goals, and techniques to achieve them. These each get built into such a technological system.

Epistemic Culture & X-Ray Hair Removal

In her work on the sociology of scientific knowledge, Karin Knorr-Cetina (1999) elucidates the concept of an epistemic culture when describing the operation of scientific laboratories. Knorr-Cetina begins by suggesting that scientific laboratories configure social and natural order, and that these reconfigurations work differently in disparate fields of science. As a result, scientific laboratories develop distinct cultural, social, and technical stances. Experiments within the laboratory, Knorr-Cetina elaborates, reflect this natural and social ordering, culminating in her notion of an "epistemic culture." For Knorr-Cetina, epistemic cultures are "those amalgams of arrangements and mechanisms – bonded through affinity, necessity, and historical coincidence – which, in a given field, make up how we know what we know" (1999, p. 1). Thus, epistemic cultures are individual communities of practitioners that create and warrant knowledge used to structure, mechanize, and configure ideas to a natural, scientific, or social order within the confines of their discipline.

This means that the production of technological knowledge is fundamentally social because it is defined or constituted by practices of work, trust, methods of analysis, methods of interpretation, values, and institutional arrangements within each epistemic culture. Knorr-Cetina refers to these sets of relations as "knowledge machinery" because they represent a complex social network – between agents and instruments – that constrain the production of knowledge. The concept of an "epistemic culture" can expose the ways that the construction of technology becomes an active social process that is constantly negotiated, implemented, superceded, and revised within the confines of corresponding scientific, social, and political epistemologies.

One insidious example concerns x-ray hair removal technology. Finding its roots with Darwin and the American Dermatological Association's emphasis on the ugliness of excess hair, from 1914-1945 the popular media promoted the ideal of the hairless feminine body. This image was connected to newly emerging conceptions of race, class, and gender identity: human hair reflected at once one's ethnicity, masculinity/femininity, and affluence. During the 1920s and 1930s, however, techniques to remove excess hair (such as abrasives, razors, tweezing, and waxes) remained painful, time intensive, and had to be repeated. Similarly, more expensive techniques such as chemical depilatories, diathermy and electrolysis offered permanent solutions, but were meticulous and extremely costly (Herzig 2003). The concept of using x-ray technology to remove hair, despite warnings from the American Medical Association's Bureau of Investigation about potential health effects, was initially promoted by a small group of doctors as a better alternative.

A group of practitioners working in medicine with x-ray technology developed the process of x-ray epilation, or using x-rays to remove excess hair from the face, back, neck, arms, and legs. Even though a team of researchers found that epilation was responsible for more than 35 percent of all radiation-induced cancer in women, the practice continued for three decades from the 1940s through the 1960s (Martin et al. 1970). The concept of an epistemic culture helps explain how the use of such damaging technology became self-sustaining. Practitioners placed faith in epilation not only because it was undeniably effective at removing hair, but because it bypassed the physicality of other techniques. Since they were invisible, x-rays were perceived to be harmless (and the harm from them was attributed to other factors). In addition, the use of x-ray technology was closely associated with notions of modernity, progress, and science. The "mystery" of "science" convinced both users and practitioners of the unquestioned benefit of x-ray technology. Furthermore, the use of x-ray technology established professional and class identity. For practitioners, it offered a well paying and respected profession. For users, it offered a hair removal procedure unequaled in cleanliness and luxury.

Taken together, the technology of the x-ray combined with social values about science, class, and contemporary notions of risk to create an epistemic culture of doctors, nurses, and patients convinced about the benefits of x-ray epilation. Here, the knowledge machinery – the complex network of instruments, people, and values – played a unique role in shaping the acceptance and continuation of x-ray hair removal. As part of this extensive knowledge machinery, the x-ray existed not as a passive object, but an active and interactive vessel that simultaneously stimulated and constrained knowledge practices.

Actor Network Theory & Solar Panels

Finally, theorists Steve Woolgar, Bruno Latour, and Michel Callon are largely responsible for developing the methodological tool known as Actor Network Theory (ANT) (Latour & Woolgar 1979; Latour 1987; Callon 1986; Callon & Latour 1986; Callon & Latour 1992). ANT suggests that the processes of creating and adopting technology are complex, interactive, and political (Mort 2001, 17). Successful technologies must not only get built; they must be built into society. Technical objects are not things in the usual sense, but "nodes in a network that contains both people and devices in interlocking roles" (Feenberg 2001, 114). ANT suggests that the social alliances in which technology are constructed are bound together by the very artifacts they create. Thus, social groups do not precede and constitute technology but "emerge with it" (Feenberg 2001, 114-115). In this way, it is possible to explore the process by which power relations are configured and rendered fixed, invisible, and logical by viewing power as something that circulates. ANT attempts to investigate the formation of power before it gets distributed, before facts and machines become inexplicably bound to societal perceptions and behaviors. At this level, scholars are able to see the ordering, not just the order (Mort 2001, 8-9). ANT, then, attempts to uncover the facts, machines, people, and bureaucracies that must be aligned, molded, and disciplined to create technological development; these combine to make up the actor world, an "overall environment that provides the conditions for a technology to succeed" (Mort 2001, 17).

In the process of creating this world, a diversity of animate and concealed entities must be enrolled into the network so that their primary function becomes the promotion of that network. This parallels the way that Latour & Woolgar (1979) talk about the scientific laboratory. Latour & Woolgar propose that the scientific laboratory can be understood as a system of literary inscription that uses the process of enrollment to establish "truth." Scientific laboratories must publish in science journals to raise funds for further research, so they often reduce their experiments to a series of graphs or statements in an article (and build their argument in association with other claims being made by similar scientists in different articles). Thus, scientific knowledge is sutured not through objective knowledge practices but a subtle process of indoctrination through literature. The structure of this network gives rise to the factual status of any given claim, rather than any "objective" notion of truth. For Latour (1987) and Callon (1986), when you connect enough actors and networks to a claim, it becomes a fact because such statements appear to be supported by all of the actors (or the weight of the network) behind it. The same is true for the technology: link an invention, like the microcomputer, to so many different projects, goals, actors, and businesses, and its importance becomes a "fact" rather than merely one among many possible historical outcomes. Thus, ANT proposes that the power of scientific knowledge is nothing more than the sheer power of the scientific network.

Three components of ANT – the socially constructed nature of technology, the process of enrollment, and the creation of socio-technic networks – help frame and conceptualize the current status of solar panels, or photovoltaic (PV) sources of energy, in the electric utility industry. Even though PV systems are relatively old (the photovoltaic effect was first discovered by French physicist Antoine-César Becquerel in 1839), cost effective, decentralized, modular, clean, and offer the ability to be implemented into architecture, they are not widely used to generate and produce electricity (Hirsh 1999; Abate 2004; Clayton 2004; Distributed Power News 2001; Renaud 2004; Sheer 2001). ANT is insightful for explaining why, despite these benefits, more consumers and utility companies do not rely on PV systems for electricity.

Put simply, the largest impediment to solar energy remains the traditional socio-technic network already established by electric utilities. Solar panels threaten the traditional way of generating power through large, centralized power plants because they are small and decentralized. Technically, it is more reasonable to build systems in disaggregated and distributed manner which reduces overall stress on the grid, insulates the grid from interruptions, and provides better quality power (Lovins 2002). Politically, the use of smaller on-site systems of electricity accommodate local needs more effectively and are more easily managed, accessible, and comprehensible (Winner 1986; 32-33). Yet, since the choice between conventional and renewable energy systems is really about the power of two competing sociotechnical networks (one consisting on the rapid expansion of centralized fossil fuel energy facilities, the other on decentralized and efficient renewable technologies), traditional systems have greater momentum. Even though solar panels offer many benefits – virtually renewable sources of energy, diversity, flexibility, advantages of scale, and the provision of better quality energy – ANT suggests that these benefits will never be realized as long as the goals, actors, and influence of the network behind fossil fuels is greater than that behind solar panels.

From an ANT perspective, the network predicated on fossil fuel extraction, the creation of new coal and uranium mines, maintenance of oil refineries, and American social attitudes about consumption and efficiency remains more established, understood, used, and accepted within society. Such a path can be understood as having, to borrow from Thomas Hughes (1983), significant momentum (i.e., mass, velocity, and direction involving many powerful industries, politicians, and consumers). In contrast, newer technologies such as photovoltaic systems have not yet achieved the credibility of conventional forms of energy production, making it illogical for consumers to accept them.

Thus, ANT highlights that the reason PV systems fail to gain widespread support is because the network behind them constituted by liberals, environmentalists, and local activists isn't large enough to offset the network created by conservative policymakers, investors, and utility operators. ANT suggests that the debate over PV systems is not just about technology; it is really a struggle involving persuasion and enrollment. Viewed this way, the struggle over PV systems is also a struggle over values, or competing knowledge systems. ANT can be noteworthy, then, for de-centering the technological artifact as the object of inquiry and expanding scholastic focus on "technology" to include the vast social and cultural networks that surround it, as well as focusing on the importance of credibility, communication, and the illusion of objectivity surrounding technological practices. By focusing on the relational aspects among engineers, inventors, analysts, politicians, artifacts, manufacturing techniques, marketing strategies, historical context, economics, and social and cultural factors, ANT highlights that technology emerges through a seamless web of material objects and immaterial epistemologies. This situates energy technologies as neither inevitable nor static. Instead, energy technologies are the product of a complex power play between divergent actors and their interests.

Conclusion

Using SCOT to investigate nuclear reactors reveals how social values become embedded in technological artifacts. Applying technological frame to French arms manufacturing and American National Missile Defense demonstrates that large technological systems extend across many different social groups. Considering epistemic culture when tracing the history of x-ray hair removal technology suggests that knowledge, expertise, and technical practices can combine to shape, sustain, and transform relations of authority and the institution of medical policy. ANT highlights that solar panels have meanings that are mediated and contingent on communicative or persuasive efforts by proponents and opponents enrolled in a large sociotechnic network.

In addition to equipping scholars and educators interested in technology with more dynamic tools to assess its relationship with society, these four tools are also important for empowering activists and citizens concerned with preserving their autonomy in a more technologically sophisticated society. Concepts like SCOT and ANT help refute the belief in the technological determinism of technological artifacts. They suggest that no technological system is truly self-sustaining, and that there is hope in dismantling even the most pervasive technological systems (like the military industrial complex). In addition, concepts like technological frame and epistemic culture help identify the different actors and interests involved in technology. Such tools suggest who activists should approach to mold sociotechnical change. Similarly, such efforts help re-politicize the usually technical discourse surrounding technology, showing that it is neither objective nor neutral. By identifying the relational aspects among people, artifacts, and knowledge, SCOT and ANT help show that there is no one person or institution masterfully manipulating the course of military technology. Instead, it is a complex amalgam of political, social, economic, and technical interests. Finally, because these approaches view technology as part of a social system, the failure and acceptance of certain technologies can sometimes have nothing to do with technical feasibility, and instead relate to contests over values, power, and interests (Moy 2001; MacKenzie 1993) (See Table 1).

Table 1. Summary of Four STS Methods and Case Studies

Approach	Primary Authors	Central Thesis	Key Concepts	Contribution
Social Construction of Technology (SCOT	Wiebe Bijker, Donald MacKenzie, Trevor Pinch, and Thomas Hughes	Technological artifacts are socially constructed.	Interpretive flexibility, heterogeneous engineering	Reveals that both social and technical factors concurrently shape technological artifacts.
Technological Frame	Wiebe Bijker	A single technological artifact is seldom worked on by only one group of people.	Relevant social groups	Helps reveal otherwise concealed actors connected to technological systems.
Epistemic Culture	Karin Knorr-Cetina	The sciences produce knowledge differently, and are bound by disparate epistemic communities and practices.	Knowledge machinery	Reveals that the way practitioners think about problems simultaneously enables and constrains their work.
Actor Network Theory (ANT)	Steve Woolgar, Bruno Latour, and Michel Callon	Technical objects are nodes in a network of people and devices in interlocking roles.	Enrollment, sociotechnical networks	Reveals that knowledge and power can be equally important in why technologies succeed and fail.

Two conclusions can be drawn from such a discussion. First, none of these theories need be viewed as mutually exclusive. They share many similarities, and can be used to complement each other. Their cumulative power suggests that the sociology of scientific knowledge, history of science, and history of technology have much to offer each other. ANT and epistemic culture widen approaches to studying technology by calling attention to systems of knowledge production, discipline formation, and the relations between actors and technological artifacts. SCOT demonstrates that social values can become constructed into technological systems, and technological frame shows that different social groups working on the same technology employ distinct methods and techniques to achieve differing goals.

Second, these theories highlight that the categories we use to describe, understand, and theorize technology should not be viewed as monolithic, and should always be open to revision. Thus, in the same way that neither social nor technological determinism can fully explain technology, the above theories will likely need to be adapted, revised, and perhaps discarded as our knowledge about science and technology expands. The meaning of technology, because it is intimately attached to social and cultural interests, will continue to change. Policymakers and analysts must recognize these changes, or make visible the social threads weaving the image of technology together, if they will devise truly sustainable and dynamic approaches to designing and understanding technology.

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References

Abate, Tom. (2004). "Solar energy's cloudy past." *The San Francisco Chronicle* (February 16): E1.

Adler, Ken. (1997). *Engineering the Revolution: Arms and Enlightenment in France.* Princeton, NJ: Princeton University Press.

Bijker, Wiebe. (1995). *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change.* Cambridge, MA: MIT Press.

Bijker, Wiebe E., & John Law. (1992) *Shaping Technology/Building Society Studies in Sociotechnical Change.* Cambridge, MA: MIT Press.

Bijker, Wiebe E., Thomas P. Hughes, & Trevor Pinch. (2001) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* Cambridge, MA: MIT Press.

Callon, M. (1986). "Some Elements of a sociology of translation: Domestication of the scallops of St Briuec Bay." In J. Law (Ed.) *Power, Action, and Belief: A New Sociology of Knowledge.* New York: Routledge.

Callon, M., & Latour, B. (1986) "Unscrewing the big Levitiathan: How actors macro-structure reality and how sociologists help them to do so." In K. Knorr-Cetina and A. V. Cicourel (Ed.) *Advances in Social Theory and Methodology.* New York: Routledge.

Callon, M., & Latour, B. (1992) "Don't throw out the baby with the bath school! A reply to Collins and Yearley." In A. Pickering (Ed.), *Science as Practice and Culture.* Chicago: University of Chicago Press.

Clayton, Mark. (2004). "Solar power hits suburbia." *The Christian Science Monitor,* (February 12): 14.

Distributed Power News. (2001). "Low Cost Solar Panels." (November): 2.

Eland, Ivan. (2000). "Let's make national missile defense truly national." CATO *Foreign Policy Briefing* (No 58, June 27).

Herzig, Rebecca. (2003). "Situated technology: Meanings." In Nina Lerman, Ruth Oldenziel, and Arwen Mohun (Eds.), *Gender and Technology: A Reader*. Baltimore, MD: Johns Hopkins University Press.

Hirsh, Richard F. (1983). "The development of electrical power." *Science* 221(4611): 640-641.

Hirsh, Richard F. (1999). *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System.* Cambridge, MA: MIT Press.

Jasanoff, Shelia. (2004). *States of Knowledge: The Co-production of Science and Social Order.* New York: Routledge.

Kline, Ronald, & Trevor Pinch. (1999). "The social construction of technology." In MacKenzie, Donald & Judy Wajcman, (Eds.), *The Social Shaping of Technology.* Philadelphia: Open University Press.

Knorr-Cetina, Karin. (1999). *Epistemic Cultures: How the Sciences Make Knowledge.* Cambridge, MA: Harvard University Press.

Latour, Bruno. (1987). *Science in Action.* Cambridge, MA: Harvard University Press.

Latour, Bruno, & Steve Woolgar. (1979). *Laboratory Life: The Construction of Scientific Facts.* Princeton, NJ: Princeton University Press.

Lovins, Amory et al. (2002). *Small is Profitable: The Hidden Benefits of Making Electrical Resources the Right Size.* Snowmass, CO: Rocky Mountain Institute.

MacKenzie, Donald. (1993). *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance.* Cambridge, MA: MIT Press.

MacKenzie, Donald (1998). *Knowing Machines: Essays on Technical Change.* Cambridge, MA: MIT Press.

Martin, H. et al. (1970). "Radiation induced skin cancer of the head and neck." *Cancer* 25: 61-71.

Melosi, Marvin V. (1985). *Coping with Abundance: Energy and Environment in Industrial America.* New York: Knopf Academic Publishers.

Mitchell, Gordon R. (2000). *Strategic Deception: Rhetoric, Science, and Politics in Missile Defense Advocacy.* East Lansing: Michigan State University Press.

Mort, Maggie. (2002). *Building the Trident Network: A Study of the Enrollment of People, Knowledge, and Machines.* Cambridge, MA: MIT Press.

Moy, Timothy. (2001). *War Machines: Transforming Technologies in the U.S. Military,* 1920-1940. College Station, TX: Texas A&M University Press.

Nye, David. (1984). "On the writing the history of technology." *Science, Technology, & Human Values 9*(2): 78-82.

Nye, David. (1992). *Electrifying America: Social Meanings of a New Technology, 1880-1940.* Cambridge, MA: MIT Press.

Nye, David. (1999). *Consuming Power: A Social History of American Energies.* Cambridge, MA: MIT Press.

Renaud, Jean-Paul. (2004). "The state: mainstream warming up to solar power." *Los Angeles Times* (April 4): B6.

Sadowski, Yahya (1992). "Scuds versus butter: The political economy of arms control in the Arab world." *Middle East Report* (177, July August): 2-13.

Sheer, Hermann. (2001). *A Solar Manifesto: The Need for a Total Energy Supply and How to Achieve It.* New York: Earthscan Publications.

Spring, Baker, & James H. Anderson (2000). "NMD: The Issues." *Heritage Foundation Policy Briefing.*

Warren, Luke, & Eric Floden (2001). The Joint Strike Fighter in the Middle East. *Middle East Report,* 219, Summer.

Winner, Langdon. (1986). *The Whale and the Reactor:* A Search for Limits in an Age of High Technology. Chicago: University of Chicago Press.

Winner, Langdon. (1999). "Do artifacts have politics?" In MacKenzie, Donald & Judy Wajcman (Eds.), *The Social Shaping of Technology.* Philadelphia: Open University Press.

Conceptions of the Social that Stand Behind Artificial Intelligence Decision Making

John Monberg

Abstract

AI proponents possessed a seemingly odd predilection to tell stories about times in which no stories are or will be told. Their stories cover a range of time that exceeds that of human experience, beginning with a kind of creation myth about competing songs that are parasitic on the behavior of apes to trajectories of progress in which Man is finally superseded by Machine. AI researchers, funders, and enthusiasts attempt to redefine fundamental social and political concepts of intelligence, meaning, and agency. Their redefinitions emphasize a calculating, controlling, one-dimensional form of rationality, serving to legitimize and extend the power of an already powerful elite. AI theorists ignore the social ground of intelligence, the connection between their computers and the world, and most importantly, the connection between society and their own work. If we accept their claims as true, then their definitions re-order and restructure the social spaces we inhabit.

Introduction

When the 1980s began, computers were not part of the fabric of everyday life for most educated Americans, instead they were understood to be large, expensive mainframe machines requiring specialized facilities and the care of experts. By the end of the decade, personal computers, owned by millions of Americans became a familiar part of the cultural landscape, from Hollywood movies to *New Yorker* cartoons. During this time period artificial intelligence (AI) had matured as an academic discipline. The promises made about the possibility of computer-based intelligence that had been made for decades attracted government funding and media attention, but these promises were unfulfilled as the decade ended. This critical time period offered a chance for reflection about the place of science and technology in the world, in particular a focus on core aspects of intelligence.

To a great extent, the opportunity for reflection about intelligence was lost. This opportunity was foreclosed because the stories that explained and justified the artificial intelligence project were carefully constructed by proponents so that the chaos, uncertainty, and social and environmental complexity built into the deepest core of AI was left out of their stories. AI proponents possessed a seemingly odd predilection to tell stories about times in which no stories are or will be told. Their stories cover a range of time that exceeds that of human experience, beginning with a kind of creation myth about competing songs that are parasitic on the behavior of apes to trajectories of progress in which Man[1] is finally superseded by Machine (Feigenbaum and McCorduck 1983). Upon careful reading of these stories, a common theme emerges. Through their stories, AI researchers, funders, and enthusiasts attempt to redefine fundamental social and political concepts of intelligence, meaning, and agency. Their redefinitions emphasize a calculating, controlling, one-dimensional form of rationality, serving to legitimize and extend the power of an already powerful elite (Hoffman 1990).

I begin by briefly describing the context in which the AI efforts originated and expanded. The second part of this article explores the social aspects of intelligence and meaning making, aspects which set fundamental limits for any asocial, disembodied AI project. The final section examines the rhetoric of two AI partisans. I critique Marvin Minsky's connectionist form of a Society of the Mind and the Cyc mega-expert system project because they are prominent accounts of the major strands of the AI enterprise.

Ideas arise in a culture and they are shaped by that culture. These ideas in turn, can function to generate political capital, furthering the interests of their proponents. Support can accrue in direct forms, for example, increased levels of funding for specific projects. More importantly, support can be garnered in indirect forms by generating increased legitimacy for a certain type of political order. Ideas expressed as narratives that make sense of, and offer definitions of, the world consequently ought to be considered of central importance. The power of narrative to set the public agenda has been a frequent topic of inquiry in a general political sense (Lasswell 1977; Edelman 1967; Edelman, 1988; Feldman 1989), as well as in a more particular sense for science (Dickson 1988; Nelkin 1987;

Wuthnow 1987; Ezrahi 1990). The formation of a potential common-sense understanding of the world is of prime cultural and political importance because the process of meaning construction is hidden, and people take as "how the world simply is" what may be only in the interest of a narrow elite (Geertz 1983). The creation of persuasive ideologies and systems of meaning grants political power, whether these beliefs spread through the mass media or diffuse through face-to-face interactions. Such power reduces political conflict, encourages the acquiescence of a majority of the population, reduces the space available for critical reflection, and functions as normalizing discourse (Adorno 1990; Hardt 1992; Thompson 1990). In limiting the scope of social imagination, such narratives set the framework for all decisions made about the funding levels, goals, priorities, and expectations for AI technologies.

The narratives surrounding AI are important because the computer is such a powerful metaphor in our society. Computers are a defining technology as we think about human capabilities, agency, and our place in the world. When rights and responsibilities are framed in terms of the computer, these conceptions have direct political repercussions. The popular literature burgeons with examples like the account in *Scientific American* that begins by stating bluntly, "The brain is a remarkable computer" (Hinton, 1992). We are redefined as information processors in a world that is held to be an environment of information to be processed. "Thus, human beings and computers are two members of a larger class defined as information processors, a class that includes many other information-processing systems – economic, political, planetary – and, in its generality, a class that threatens to embrace the universe" (McCorduck, 1988, p.74). This threatening embrace may turn out to be not merely metaphorical when information systems mediate global decision making in fields as consequential as military force projection, flows of financial investments, and environmental monitoring and modeling.

The AI literature continues the long tradition of epistemological certainty and self-righteousness exemplified by Descartes, Hume, Bertrand Russell and the logical positivists. A pointed aggressiveness appears time and time again in the rhetoric of AI practitioners. All previous modes of knowledge that cannot be readily assimilable to AI forms are no longer valid. They simply are no longer worth knowing. If the position of the most vigorous AI proponents is taken seriously as a model for human agency, some fear we may fall into a rationalized, closed system in which Weber's iron cage of bureaucracy reaches full fruition and from which there might be no escape;

> The increase of computer use in society and in all scientific disciplines could lead to an unforeseen consequence: the impossibility of thinking outside the dominant paradigm. The paradigm of computer culture would become part of the culture, if not all. A troublesome techno-culture of calculus, where policy has no meaning anymore since it is supported by so-called clarified criteria; where alternatives are also ranked by supposedly less enigmatic and erratic procedures; because computing has become 'laws of thought.' (Berleur 1990, p. 415)

The AI community constitutes one branch of a broader worldview. This worldview understands technology as a new type of cultural system that restructures the entire social world as an object of social control. This worldview has in turn provoked a rich tradition of social analytical critique. In the perspective of these critics, technology, either inherently or as a tool of elite control, generates domination in the social and natural worlds (Ellul 1964; Merchant 1980; Habermas 1987). Analysts have explored the alienating and repressive role of technology in the workplace (Braverman 1974; Weizenbaum 1976; Noble 1984; Feenberg 1991). A growing literature examines the potential or actual uses of information technology in particular, to effect a more stringent degree of control in the workplace (Clement 1988 1990; Roszak 1986).

Sophisticated, capital-intensive technologies are not developed in a social vacuum, but are developed to meet the needs and further the goals of the groups that fund them. Support for the AI community has come primarily from military, and to a lesser extent, corporate sources. Justification for this largely public funding has been framed in terms of military force projection and multiplication, and corporate productivity and competitiveness (especially after the establishment of Japan's much-ballyhooed Fifth Generation Project).

The Defense Department's Advanced Research Project Agency (DARPA) has been a prime supporter of AI projects, establishing the Strategic Computing Initiative in the pursuit of voice recognition, machine vision, and battle management for the Strategic Defense Initiative. The hundreds of millions of dollars channeled by this organization has been integral to the establishment of every major AI research community; those at the RAND Corporation, MIT's Lincoln Laboratories, Carnegie-Mellon University, the Stanford Research Institute, and the consulting group Bolt, Beranek and Newman (Johnson, 1986, p. 129). Defense dollars supported the work of virtually every light in the AI pantheon: John von Neumann, Herbert Simon, John McCarthy, Alan Turing, Allen Newell, and Marvin Minsky (Minsky, 1985, pp. 323-324). In short, AI is a product of military funding. It is then not surprising that so much of the work done in AI assumes a mechanistic universe, an overly-narrow rationality governed by formalizable and programmable rules, a sense of objective knowledge that proceeds with a neutral, universal logic uncontaminated by social and political "impurities," and an emphasis on refinement of technique and information technology as an instrument of administration in pursuit of more precise control over the natural and the social world. AI researchers manifest a common blind spot with regard to their own work: they see themselves in a quest for "disinterested," "universal," and "value-free" knowledge which supports an endeavor which is nothing if not supremely interested, value-laden, and politically potent.

Social Ground of Intelligence

Having begun with rapid progress in the mid-1950s—an early example was Newell and Simon's General Problem Solver—AI practitioners made bold predictions that the possibility of understanding the universal logic of intelligence would soon be within reach. Almost four decades later, the AI project has made little progress toward reaching its ultimate objective. This lack of progress has not been due to a lack of funding, or to accidental circumstances. The AI project has failed to progress as expected because, as it has been carried out up to this point, the AI project has assumed an impoverished model of intelligence, a model subject to strict and inherent limitations.

With close ties to psychology and analytic philosophy, the AI project assumed that intelligence is located within independent, atomistic individuals; that humans are Cartesian knowers in fundamental respects. The aspects of intelligence stemming from the complex interactions of embodied, social, experiential, and cultural learners and doers have been virtually ignored. Social cognition is "a domain about which cognitive science and the attendant philosophical literature have had virtually nothing to say" (Jackendoff, 1991, p. 420). This impoverished conception of self has come under increasing attack from a broad range of phenomenologists, hermeneuticists, feminists, pragmatists, and other intellectual camps. Common to these groups is the belief that the self is not an isolated being and can only be understood as an actor in a social context. This richer conception of self and of intelligence has been taken up recently in a variety of ways, in disciplines including psychology (Hermans, 1992) and political theory (Dallmyr, 1984), to offer only a few of the many possible examples.

The interactive, social understanding of self derives in part from the work of George Herbert Mead. The Meadian concept of mind requires the ability to take the point of view of another, requiring from the outset an understanding of the social dimensions of self as "selves can only exist in definite relations to other selves" (Mead, 1963, p. 46). Even the possibility of becoming a social self requires interaction with another social self. As the self only comes into existence as a social being, the interactive aspects of self are central to an analysis of intelligence. As Marcelo Dascal noted, "It is not by digging deeper into the individual's head that one discovers the relevant parameters of his mental life. For these parameters are social, not individual, public, not private, context-relative, not universal" (1989, p. 40). It is only through an analysis of the social, that mystifying claims can be avoided. Dascal continues, "It is only by reference to such a context that these allegedly 'mental' phenomena can be understood and accounted for in a non-mysterious way" (1989, p. 42).

That intelligence only emerges in a social setting holds for computers as well as humans. Without the experience of social life, computers cannot be understood as intelligent creations:

> Computers are not part of the social process; they are not personalities for whom a life process is a unity of biological, psychological and social processes. In order to understand meanings or meta-meanings in the context of communication between

> human beings, and in order to form relevant social values, the computer must have lived a practical life which is changing the world in sensory, concrete terms. (Fuchs-Kittowski, 1990, p. 465)

AI researchers have failed to pursue the creation of "social" computers. The programs created attempt to distance the AI system not only from the social world, but also from any connection to the world outside the system. AI theories create representations of the world, not connections to or interactions with the world. Jerry Fodor terms this, "methodological solipsism"—"the machine lives in an entirely notational world; all its beliefs are false" (1981, p. 315).

What should count as an example of intelligence? It is clear that a rote enactment of preset rules, regardless of circumstances, does not qualify as an exhibition of intelligent behavior. We do not grant the microwave oven a robust sense of intelligence. The minimal requirement for intelligence is sensitivity to the surroundings of a creature. Thus a computer must not merely respond inflexibly to a stimulus in an environment, but must possess the ability to respond appropriately to a variety of possible situations. In a rule-driven system, rules must be carefully optimized to respond to a specific kind of environment. The system requires different sets of rules to handle different types of circumstances. If the system is completely rule-driven, then a high-level set of rules must determine which set of lower-level rules to execute. But in order to guide this higher-level set of rules in a flexible manner, there must be a still higher level of rules. This never-ending hierarchy falls victim to the Wittgensteinian regress. Implicit in every case of rule following is a *ceteris paribus* condition regarding the application of the rule that cannot be understood within the terms of the rule specified (Dreyfus, 1979, pp. 56-57):

> In social life, rules and language games are always embedded in practice, and this practice bridges the gap between rules and their application. Through interaction, participants in a conversation can negotiate an understanding without being trapped within an infinite loop. Wittgenstein's arguments against the possibility of a private language also apply to any AI approach which functions as a closed system. Because the system is closed there exists no possibility of a check, the outside world has no purchase on the interpretation of the system. Truth verification for such a system would be the equivalent of reading copy after copy of the same newspaper to verify facts read in the first edition. This limitation sets a boundary condition for a closed AI system, it is necessary to take into account the context as a factor which is capable of changing completely the initial semantic interpretation.

Given the paradoxes of rule following, how is it that human beings can be considered intelligent? We are not trapped within the constraints of a formal system. We interact with others in settings that are open in important respects, creating gaps between our beliefs and our experience of the world. The everyday world provides the backdrop that an analysis of formal rules can never provide, making it possible to act in a contingent world, rule-governed creatures without a theory of action, without always already understanding what all possible rules are. We are able to accomplish contextual definitions of the circumstances we find ourselves in using culturally available conventions.

> people have told each other stories and listened to stories in all cultures at all times. In doing so, people arrive at an understanding and ordering of the world and the self. (Hermans, 1992, p. 23)

AI adherents continue to tell stories about the world, stories which aim towards an understanding and an ordering of the world. They tell stories about the possibility of a rule-based, acontextual intelligence, stories about the overcoming of stories. Two of the most important stories are told by Marvin Minsky in his *The Society of Mind* and by supporters of the Cyc mega-expert system.

What is mind? Minsky's model of mind is the corporate bureaucracy, a metaphor that Minsky returns to time and time again in his book. Wired into the brain is a tiny, finely-organized, complex corporation. For Minsky the homology is almost perfect – the mind becomes a corporation *par excellence*. The title of his book is misleading, for he focuses on activity internal to a disembodied mind, with little connection to the outside world, and refers to the social world only in passing. In Minsky's mind, a hierarchical structure of "subordinate" agents pass information up and down a management chain directed by "boss" agents at the top of the pyramid. The discussions of cross linkages of agents at the same level are few.

Minsky is obsessed with control. He envisions a most intricately adjusted system of rewards and penalties that has evolved to ensure that every subordinate part functions according to plan, or will be made to do so in short order. Although the snippets taken from St. John, Shakespeare, and Simone DeBeauvoir that are sprinkled throughout Minsky's writing might indicate a humanist sensibility, Minsky believes every facet of our cultural heritage functions as a control system.

In Minsky's Mind, language functions as a system of control, "If we're to understand how language works, we must discard the usual view that words denote, or represent, or designate; instead, their function is control: each word makes various agents aware of what various other agents do" (p. 196). As do emotions, "Our earliest emotions are built-in processes in which inborn proto-specialists control what happens in our brains" (p. 172). And so for social institutions in general, "All human organizations evolve institutions of law, religion and philosophy, and these institutions both adopt specific answers to circular questions and establish authority-schemes to indoctrinate people with those beliefs" (p. 49).[2]

Minsky finds the need for control outside the mind as well, "Those lower-level agents need to be controlled. It's much the same in human affairs. When any enterprise becomes too complex and large for one person to do, we construct organizations in which certain agents are concerned not with the final result, but only with what some other agents do" (p. 34). He appreciates servants who possess the least voice, "No supervisor can know everything that all its agents do. . .The best subordinates are those that work most quietly" (p. 60). This emphasis on control is evident in the structure of his book as well. Minsky has stated that the interconnections between his essays are so varied and complex that a standard book format would be ineffective and that the format of his book itself had to be modified. However these varied connections do not become apparent in his book; on the contrary his format does not encourage flexibility. His book consists of a series of essays carefully arranged and finely categorized in a linear hierarchy ordered from 1.1 to 31.8:

Despite all of his emphasis on control, Minsky neglects to discuss the role of power in his systems. Conflict is interpreted only in the context of miscommunication or lack of information. What limits are to be placed on a control system? What application of control is allowable? What type of power even is to be preferred? How can elements of the system be made accountable to other elements within the system or to larger elements outside of the system? Does it make sense to speak of any range of freedom or autonomy to be accorded to the agents (whether of high or low level) within Minsky's system?

A discussion of power is not all that is missing from Minsky's Mind. Intentionality, understanding, purpose, autonomy, feelings, aspirations are all reduced to a one-dimensional focus on order and control. In his Mind, rules are not only regulative, but also constitutive of the "experience" of the system. What would it be like to **be** such a system? What would such a system be willing to die for? Or, for that matter, what would such a system have to live for? Minsky's Mind is not a von Neumann machine, a kind of computer architecture in which one central processor executes a rule-driven algorithm. Instead sets of connections exist on many processors that execute instructions concurrently. These connections are not made explicitly by a system programmer, and indeed may not even be understandable to an observer outside of the machine. Connections evolve through trial-and-error processes that reconfigure the connections in ways aimed at minimizing the discrepancy between data input into the machine and the desired output.[3]

Connectionist machines function differently than explicitly rule-guided machines do, but they remain bound by similar restrictions with regard to the implementation of intelligence. The agents that Minsky envisions in his system cannot have intelligence, or each agent would be a *homunculus*, and Minsky would be assuming at a lower level just what he is trying to enact at a higher level. Minsky is clear on this point, "Each mental agent by itself can only do some simple things that needs no mind or thought at all" (p. 19).

If these agents do not possess even a rudimentary intelligence, his analogy between his Society of Mind and the society of humans breaks down. Subject to the constraints of their culture, individuals possess a sense of agency in that they can shift their attention between a larger social whole and the parts they play, they can negotiate an understanding of a situation, and they can give accounts of their actions. Minsky's agents are necessarily devoid of agency. They have no sense of their pasts, and no way of taking into account the new or unexpected. Minsky is also clear about this, "Those tiny mental agents simply cannot know enough to be able to negotiate with one another or to find effective ways to adjust to each other's interference" (p. 33). The lack of even a limited possibility of autonomy on the part of these sub-systems in turn sets a limit on the potential the system has for intelligence. The results generated from the connectionist computer systems that have been implemented so far have remained scant. Systems are able to model only "toy problems" (Papert, 1990, p. 13). Even given the great strides in processor speed, the number of interconnections possible, and memory size which have been made in the past decade, the state of the art has not advanced beyond what was possible when computer systems were much less powerful. The possibility of scaling-up these systems to tackle more realistic problems does not seem amenable, even given what will surely be very large advances in computer hardware.

Get A Bigger Hammer Approach: The Mega-Expert System

The Cyc project to create the largest expert system ever constructed began in 1984 at the Microelectronics and Computer Technology Corporation, a research consortium in Austin, Texas. The consortium exists on the support of Apple, Digital Equipment Corporation, Eastman Kodak Corporation, NCR Corporation and other large computer manufacturers and users. The goal of this project is unlike that of most traditional expert system approaches which focus on gathering a great deal of specialized information about a narrowly focused technical area – the most efficient way to deploy a telephone switching network, for example.

Instead, the Cyc system is an attempt to collect and code common-sense reasoning. A person cannot walk through a wall. Water falls downhill. All animals live, die and stay dead. The goal of the knowledge base is the support of 100 million of these common-sense assertions, creating a system that is 10,000 times as large as an average expert system (Harrar, 1990, p. F7).

The rhetoric surrounding the development of expert systems, even the systems of such vast complexity as Cyc, has been more restrained. In this context one does not find the grandiose claims of a universal model of intelligence like those of Simon, Minsky, et al. The claims made on the behalf of these systems are straightforward: they are designed to effect a transfer of the control of knowledge from workers to management. Workers, it is hoped, may be made more cheap, reliable, and productive. Joseph Scullion, director of strategic planning at NCR, explained that, "Just being able to capture common-sense intelligence in a work-station means that whatever application you can run can be more complex. And lightly trained people can be made more productive" (Harrar, 1990, p. F7). Even given the vast quantity of data stuffed into this system, the constraints suffered by any formal rule-based system hold. It is difficult to describe all the relevant attributes of a given context, if it is not known in advance what the criteria for relevance is, or how the criteria for relevance may change over time. Even if the context can be defined appropriately, how will the machine determine when the context changes and what the optimal procedure to follow is? Marcelo Dascal asks,

"A system cannot always use the same script or schema. If it is to not behave stupidly, it must be able to shift from one schema to another when required. But how is a system to know when this is required?" (1989, p. 46).

We arrive again at the Wittgensteinian infinite regress; and in the everyday world in which we inhabit, it is no trivial matter to come across exceptions to rules, exceptions to the exceptions of rules, unforeseen circumstances, dashed expectations, new appreciations of old situations, *ad infinitum*. Bruno Latour's (1992) description of doors and other mundane objects provides a rich illustration of the often-unnoticed complexities in our lives that a rigid, formal system would adapt to with great difficulty.

The Moral of the Story

The AI project should be understood as a typical extension of the long Western quest for a kind of universalistic epistemological certainty. AI theorists ignore the social ground of intelligence, the connection between their computers and the world, and most importantly, the connection between society and their own work. This purposeful ignorance allows the AI community to discredit every other form of knowledge, which is replaced by a technocratic, controlling, bureaucratic understanding of the world. If we accept their claims as true, then their definitions re-order and restructure the social spaces we inhabit. Our world becomes a bit colder and grayer, and our understanding of our own place in the world becomes constricted and diminished.

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References

Adorno, T. (1990). Culture industry reconsidered. In J. C. Alexander & S. Seidman (Eds.), *Culture and society: Contemporary debates* (pp. 275-282). New York: Cambridge University Press.

Berleur, J. (1990). Recent technical developments: Attitudes and paradigms. In J. Berluer, A. Clement, R. Sizer & D. Whithouse (Eds.), *The information society: Evolving landscapes*. North York, Ontario: Springer-Verlag.

Braverman, H. (1974). *Labor and monopoly capitalism*. New York: Monthly Review.

Clement, A. (1990). Office automation and technical control of information workers. In J. Berluer, A. Clement, R. Sizer & D. Whithouse (Eds.), *The Information society: Evolving landscapes*. North York, Ontario: Springer-Verlag.

Dallmyr, F. (1984). *Polis and praxis*. Cambridge: MIT Press.

Dascal, M. (1989). Artificial intelligence and philosophy: The knowledge of representation. *Systems Research*, 6(1), 39-52.

Dickson, D. (1988). *The new politics of science*. Chicago: University of Chicago Press.

Dreyfus, H. (1979). *What computers can't do: The limits of artificial intelligence*. New York: Harper.

Edelman, M. (1967). *The symbolic uses of politics*. Urbana: University of Illinois Press.

Edelman, M. (1988). *Constructing the political spectacle*. Chicago: University of Chicago Press.

Ellul, J. (1964). *The technological society*. trans. J. Wilkinson. New York: Vintage.

Ezrahi, Y. (1990). *The descent of Icarus: Science and the transformation of contemporary democracy*. Cambridge: Harvard University Press.

Feenberg, A. (1991). *Critical theory of technology*. New York: Oxford Press.

Feigenbaum, E., & McCorduck, P. (1983). *The fifth generation*. Reading, Mass.: Addison-Wesley.

Feldman, M. (1989). *Order without design: Information production and policy making*. Stanford: Stanford University Press.

Fodor, J. (1981). Methodological solipsism. In J. Haugeland (Ed.), *Mind Design*. (pp. 67-94). Montgomery, Vermont: Bradford.

Fuchs-Kittowski, K. (1990). Information and human mind. In J. Berluer, A. Clement, R. Sizer & D. Whithouse (Eds.), *The Information society: Evolving landscapes*. North York, Ontario: Springer-Verlag.

Geertz, C. (1983). *Local knowledge: Further essays in interpretive anthropology*. New York: Basic Books.

Habermas, J. (1987). *The theory of communicative action: Volume two, lifeworld and system: a critique of functionalist reason*. Boston: Beacon Press.

Hardt, H. (1992). *Critical communication studies communication, history and theory in America*. London: Routledge.

Harrar, G. (1990). The software with good sense. *The New York Times*. April 1, F7.

Hermans, H. (1992). The dialogical self: Beyond individualism and rationalism. *American Psychologist*, 47, 23-33.

Hinton, G. (1992). How neural networks learn from experience. *Scientific American*, 267 (September), 144-151.

Hoffman, R. (1990). John McCarthy: Approaches to artificial intelligence. *IEEE Expert*, 5(3), 87-89.

Jackendoff, R. (1991). The problem of reality. *Nous*., 25, 411-433.

Johnson, G. (1986). *Machinery of the mind*. Redmond, Washington: Tempus.

Lasswell, H. (1977). *On political sociology*. Chicago: University of Chicago Press.

Latour, B. (1992). Where are the missing masses? The sociology of a few mundane artifacts? In W. Bijker & J. Law (Eds.), *Shaping technology/building society* (pp. 225-258). Cambridge: MIT Press.

MacIntyre, A. (1984). *After virtue*. Notre Dame: University of Notre Dame Press.

McCorduck, P. (1988). Artificial intelligence: An apercu. In S. R. Graubard (Ed.), *The artificial intelligence debate* (pp. 65-83). Cambridge: MIT Press.

Mead, G. H. (1963). *Mind, self, and society*. Chicago: University of Chicago Press.

Merchant, C. (1980). *The death of nature*. San Francisco: Harper and Row.

Minsky, M. (1985). *The society of mind*. New York: Touchstone.

Nelkin, D. (1987). *Selling science*. San Francisco: W. H. Freeman and Company.

Noble, D. (1984). *Forces of production*. New York: Oxford University Press.

Oakeshott, M. (1991). *Rationalism in politics and other essays*. Indianapolis: Liberty Press.

Papert, S. (1988). One ai or many? In S. R. Graubard (Ed.) *The artificial intelligence debate* (pp. 1-14). Cambridge: MIT Press.

Roszak, T. (1986). *The cult of information*. New York: Pantheon.

Thompson, E. P. (1966). *The making of the English working class*. New York: Vintage.

Thompson, J. (1990). *Ideology and modern culture*. Stanford: Stanford University Press.

Weizenbaum, J. (1976). *Computer power and human reason*. San Francisco: W. H. Freeman.

Wuthnow, R. (1987). *Meaning and moral order: Explorations in cultural analysis*. Berkeley: University of California Press.

Notes

[1] The use of the gender-loaded term Man reflects the gender imbalance of the AI research community. More importantly for this essay, it expresses a universalistic, asocial, disembodied model of rationality.

[2] Minsky's emphasis on control is even more pronounced when contrasted with the role tradition plays in lived experience found in the work of authors as varied as Geertz, 1983; Thompson, 1966; Oakeshott, 1991 and MacIntyre, 1984.

[3] For explanations of the various connectionist approaches see Cowan and Sharp, 1990; Hinton, 1992; and Papert, 1990.

Automation and Accountability in Decision Support System Interface Design

Mary L. Cummings

Abstract

When the human element is introduced into decision support system design, entirely new layers of social and ethical issues emerge but are not always recognized as such. This paper discusses those ethical and social impact issues specific to decision support systems and highlights areas that interface designers should consider during design with an emphasis on military applications. Because of the inherent complexity of socio-technical systems, decision support systems are particularly vulnerable to certain potential ethical pitfalls that encompass automation and accountability issues. If computer systems diminish a user's sense of moral agency and responsibility, an erosion of accountability could result. In addition, these problems are exacerbated when an interface is perceived as a legitimate authority. I argue that when developing human computer interfaces for decision support systems that have the ability to harm people, the possibility exists that a moral buffer, a form of psychological distancing, is created which allows people to ethically distance themselves from their actions.

Introduction

Understanding the impact of ethical and social dimensions in design is a topic that is receiving increasing attention both in academia and in practice. Designers of decision support systems (DSS's) embedded in computer interfaces have a number of additional ethical responsibilities beyond those of designers who only interact with the mechanical or physical world. When the human element is introduced into decision and control processes, entirely new layers of social and ethical issues (to include moral responsibility) emerge but are not always recognized as such. Ethical and social impact issues can arise during all phases of design, and identifying and addressing these issues as early as possible can help the designer to both analyze the domain more comprehensively as well as suggest specific design guidance. This paper discusses those accountability issues specific to DSS's that result from introducing automation and highlight areas that interface designers should take into consideration.

If a DSS is faulty or fails to take into account a critical social impact factor, the results will not only be expensive in terms of later redesigns and lost productivity, but possibly also the loss of life. Unfortunately, history is replete with examples of how failures to adequately understand decision support problems inherent in complex sociotechnical domains can lead to catastrophe. For example, in 1988, the USS *Vincennes*, a U.S. Navy warship accidentally shot down a commercial passenger Iranian airliner due to a poorly designed weapons control computer interface, killing all aboard. The accident investigation revealed nothing was wrong with the system software or hardware, but that the accident was caused by inadequate and overly complex display of information to the controllers (van den Hoven, 1994). Specifically, one of the primary factors leading to the decision to shoot down the airliner was the perception by the controllers that the airliner was descending towards the ship, when in fact it was climbing away from the ship. The display tracking the airliner was poorly designed and did not include the rate of target altitude change, which required controllers to "compare data taken at different times and make the calculation in their heads, on scratch pads, or on a calculator – and all this during combat" (Lerner, 1989).

This lack of understanding the need for a human-centered interface design was again repeated by the military in the 2004 war with Iraq when the U.S. Army's Patriot missile system engaged in fratricide, shooting down a British Tornado and an American F/A-18, killing three pilots. The displays were confusing and often incorrect, and operators, who only were given ten seconds to veto a computer solution, were admittedly lacking training in a highly complex management-by-exception system (32nd Army Air and Missile Defense Command, 2003). In both the *USS Vincennes* and Patriot missile cases, interface designers could say that usability was the core problem, but the problem is much deeper and more complex. While the manifestation of poor design decisions led to severe usability issues in these cases, there are underlying issues concerning responsibility, accountability, and social impact that deserve further analysis.

Beyond simply examining usability issues, there are many facets of decision support system design that have significant social and ethical implications, although often these can be subtle. The interaction between cognitive limitations, system capabilities, and ethical and social impact cannot be easily quantified using formulas and mathematical models. Often what may seem to be a straightforward design decision can carry with it ethical implications that may go unnoticed. One such design consideration is the degree of automation used in a decision support system. While the introduction of automation may seemingly be a technical issue, it is indeed one that has tremendous social and ethical implications that may not be fully understood in the design process. It is critical that interface designers realize the inclusion of degrees of automation is not merely a technical issue, but one that also contains social and ethical implications.

Automation in decision support systems

In general, automation does not replace the need for humans; rather it changes the nature of the work of humans (Parasuraman & Riley, 1997). One of the primary design dilemmas engineers and designers face is determining what level of automation should be introduced into a system that requires human intervention. For rigid tasks that require no flexibility in decision-making and with a low probability of system failure, full automation often provides the best solution (Endsley & Kaber, 1999). However, in systems like those that deal with decision-making in dynamic environments with many external and changing constraints, higher levels of automation are not advisable because of the risks and the inability of an automated decision aid to be perfectly reliable (Sarter & Schroeder, 2001).

Various levels of automation can be introduced in decision support systems, from fully automated where the operator is completely left out of the decision process to minimal levels of automation where the automation only presents the relevant data. The application of automation for decision support systems is effective when decisions can be accurately and quickly reached based on a correct and comprehensive algorithm that considers all known constraints. However, the inability of automation models to account for all potential conditions or relevant factors results in brittle-decision algorithms, which possibly make erroneous or misleading suggestions (Guerlain et al., 1996; Smith, McCoy, & C. Layton, 1997). The unpredictability of future situations and unanticipated responses from both systems and human operators, what Parasuraman et al. (2000) term the "noisiness" of the world makes it impossible for any automation algorithm to always provide the correct response. In addition, as in the *USS Vincennes* and Patriot missile examples, automated solutions and recommendations can be confusing or misleading, causing operators to make suboptimal decisions, which in the case of a weapons control interface, can be lethal.

In addition to problems with automation brittleness, significant research has shown that there are many drawbacks to higher levels of automation that relegate the operator to a primarily monitoring role. Parasuraman (2000) contends that over-automation causes skill degradation, reduced situational awareness, unbalanced workload, and an over-reliance on automation. There have been many incidents in other domains, such as nuclear power plants and medical device applications, where confusing automation representations have led to lethal consequences. For example, in perhaps one of the most well-known engineering accidents in the United States, the 1979 cooling malfunction of one of the Three Mile Island nuclear reactors, problems with information representation in the control room and human cognitive limitations were primary contributors to the accident. Automation of system components and subsequent representation on the instrument panels were overly complex and overwhelmed the controllers with information that was difficult to synthesize, misleading, and confusing (NRC, 2004).

The medical domain is replete with examples of problematic interfaces and ethical dilemmas. For example, in the Therac-25 cases that occurred between 1985-1987, it was discovered too late for several patients that the human-computer interface for the Therac-25, which was designed for cancer radiation therapy, was poorly designed. It was possible for a technician to enter erroneous data, correct it on the display so that the data appeared accurate, and then begin radiation treatments unknowingly with lethal levels of radiation. Other than an ambiguous "Malfunction 54" error code, there was no indication that the machine was delivering fatal doses of radiation (Leveson & Turner, 1995).

Many researchers assert that keeping the operator engaged in decisions supported by automation, otherwise known as the human-centered approach to the application of automation, will help to prevent confusion and erroneous decisions which could cause potentially fatal problems (Billings, 1997; Parasuraman, Masalonis, & Hancock, 2000; Parasuraman & Riley, 1997). Reducing automation levels can cause higher workloads for operators; however, the reduction can keep operators cognitively engaged and actively a part of the decision-making process, which promotes critical function performance as well as situation awareness (Endsley, 1997). Higher workloads can be seen as a less-than-optimal and inefficient design approach, but efficiency should not necessarily be the primary consideration when designing a DSS. Keen and Scott-Morton (1978) assert that using a computer aid to improve the effectiveness of decision making is more important than improving the efficiency. Automation can indeed make a system highly efficient but ineffective, especially if knowledge needed for a correct decision is not available in a predetermined algorithm. Thus higher, more "efficient" levels of automation are not always the best selection for an effective DSS.

While it is well established that the use of automation in human computer interfaces should be investigated fully from a design standpoint, there are also ethical considerations, especially for interfaces that impact human life such as weapon and medical interfaces. What might seem to be the most effective level of automation from a design viewpoint may not be the most ethical. The focus on the impact of automation on the user's actions is a critical design consideration; however, another important point is how automation can impact a user's sense of responsibility and accountability. In one of the few references in the technical literature on humans and automation that considers the relationship between automation and moral responsibility, Sheridan (1996) is wary of individuals "blissfully trusting the technology and abandoning responsibility for one's own actions."

Overly trusting automation in complex system operation is a well-recognized decision support problem. Known as automation bias, humans have a tendency to disregard or not search for contradictory information in light of a computer-generated solution that is accepted as correct (Mosier & Skitka, 1996; Parasuraman & Riley, 1997). Automation bias is particularly problematic when intelligent decision support is needed in large problem spaces with time pressure like what is needed in command and control domains such as emergency path planning and resource allocation (Cummings, 2004). Moreover, automated decision aids designed to reduce human error can actually cause new errors in the operation of a system. In an experiment in which subjects were required to both monitor low fidelity gauges and participate in a tracking task, 39 out of 40 subjects committed errors of commission, i.e., these subjects almost always followed incorrect automated directives or recommendations, despite the fact that contraindications existed and verification was possible (Skitka et al., 1999). Automation bias is an important consideration from a design perspective, but as will be demonstrated in the next section, it is also one that has ethical implications as well.

Automation and Accountability

While automation bias can be addressed through training intervention techniques (Ahlstrom et al., 2003, however see Skitka, et al., 1999 for conflicting evidence), the degradation of accountability and abandonment of responsibility when using automated computer interfaces are much more difficult and ambiguous questions to address. Automated decision support tools are designed to improve decision effectiveness and reduce human error, but they can cause operators to relinquish a sense of responsibility and subsequently accountability because of a perception that the automation is in charge. Sheridan (1983) maintains that even in the information-processing role, "individuals using the system may feel that the machine is in complete control, disclaiming personal accountability for any error or performance degradation."

Some research on social accountability suggests that increasing social accountability reduces primacy effect, i.e., the tendency to best remember the salient cues that are seen first (Tetlock, 1983), which is akin to automation bias. Social accountability is defined as people having to explain and justify their social judgments about others. In theory, increased accountability motivates subjects to employ more self-critical and cognitively complex decision-making strategies (Tetlock & Boettger, 1989). However, previous studies on social accountability focused on human judgments about other humans and did not incorporate technology, specifically automation, so they are somewhat limited in the application of social accountability to the discussion of computers and accountability.

Skitka, Mosier, and Burdick (2000) attempted to bridge the gap in researching accountability from a purely social perspective to one that included technology in the form of automation. The specific intent of this study was to determine the effects of social accountability on automation bias. Instead of being held accountable for their judgments about other people, subjects were required to justify strategies and outcomes in computerized flight simulation trials. The results showed that not only did increased social accountability lead to fewer instances of automation bias through decreased errors of omission and commission, but also improved overall task performance (Skitka, Mosier, & Burdick, 2000).

If increased accountability can reduce the effects of automation bias, how then could decision support systems be designed to promote accountability? For complex socio-technical systems, accountability will most likely come from an established organizational structure and policies put in place by higher-level management. However, one tangible design consideration for accountability would be the number of people required to interact with a given decision support system. Research indicates that responsibility for tasks is diffused when people work in collective groups as opposed to working alone, and this concept is known as "social loafing" (see Karau & Williams, 1993 for a review). By designing systems that require the fewest individuals in a decision-making component, it is possible that erosion in accountability through social loafing could be diminished. However, while research indicates that people experience degraded task responsibility through collective action, the potential loss of a sense of moral responsibility and agency for operators interacting collectively through human-computer interfaces is not as clearly understood. It is likely that the computer interface becomes another entity in the collective group so that responsibility, and hence accountability, can be cognitively offloaded not only to the group, but also to the computer. This is one area in human-computer interaction and accountability research that deserves significantly more attention.

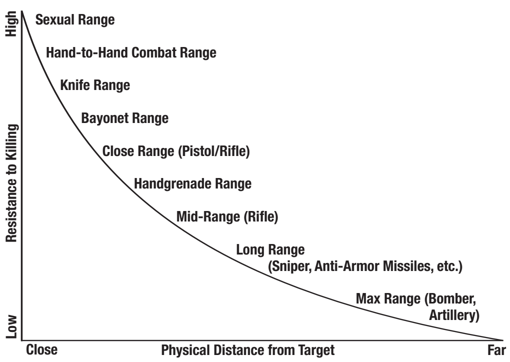
Designing a moral buffer

Because of the diminishment of accountability that can result from interactions with computers and automation, I argue that when developing a human computer interface for any system that has the ability to harm people, such as interfaces for weapons and medical interfaces, the possibility exists that a moral buffer, a form of distancing and compartmentalization, is created which allows people to morally and ethically distance themselves from their actions. The concept of moral buffering is related to but not the same as Bandura's (2002) idea of moral disengagement in which people disengage in moral self-censure in order to engage in reprehensible conduct. A moral buffer adds an additional layer of ambiguity and possible diminishment of accountability and responsibility through an artifact or process, such as a computer interface or automated recommendations. Moral buffers can be the conduits for moral disengagement, which is precisely the reason for the need to examine ethical issues in interface design.

A key element in the development of a moral buffer is the sense of distance and remoteness that computer interfaces create for their users. This sense of distance created by computer interfaces can best be illustrated through a military weapons interface example; although, as will be demonstrated, moral buffers can occur in other domains. The military is currently developing smart weapons such as cruise missiles and unmanned combat aerial vehicles (UCAVs), which once launched, can be redirected in-flight to a target of opportunity in a matter of minutes. While these weapons will provide the military with unprecedented rapid battlefield response, developing technologies of this sort also have the potential to become moral buffers that allow humans to kill without adequately considering the consequences. In general, these types of weapons can be fired from remote distances; for example, the military recently used missiles in Iraq that can be fired from over 1,000 miles from their intended target with pinpoint accuracy. While this distance is effective in protecting our own forces, it is also likely that increasing the distance from the battlefield diminishes a sense of accountability.

The desire to kill the enemy from afar, termed "distant punishment," is deeply rooted in the military culture, and even using the term "distant punishment" is a euphemistic form of moral buffering. Military historian and psychologist Dave Grossman contends that military personnel have a deep-seated desire to avoid personal confrontation, and thus use distant punishment as a way to exert military will without having to face the consequences of combat (Grossman, 1998). Grossman depicts the level of resistance to firing a weapon as a function of proximity to the enemy in Figure 1. In addition, he reports that there have been virtually no instances of noncompliance in firing weapons from removed distances, while there are significant instances of refusal to fire for soldiers engaged in hand-to-hand combat (Grossman, 2000).

Figure 1. Resistance to Killing as a Function of Distance (Grossman, 1995)



In addition to the actual physical distance that makes it easier for people to kill, Grossman (1995) contends that emotional distance is a significant contributor as well. Emotional distancing in many domains is necessary for job performance, such as police work, the medical community, and in the military in general. However, there is a distinct difference in developing emotional distance for self or team preservation, and developing emotional distance through technology to make killing another human more palatable. Grossman contends that emotional distance in the context of killing can be obtained through social factors that cause one group to view a particular class of people as less than human, which include cultural elements such as racial and ethnic differences, as well as a sense of moral superiority. However, the primary emotional distancing element hypothesized by Grossman that should be of concern to interface designers is that of mechanical distancing. In this form of emotional distancing, some technological devices provide the remote distance that makes it easier to kill. These devices can be TV and video screens, thermal sights, or some other mechanical apparatus that provides a psychological buffer, an element that Grossman terms "Nintendo® warfare" (Grossman, 1995). With the recent advancements in smart weapons that are controlled through computer interfaces that resemble popular video games, both the physical and emotional distancing that occur with remotely launching and controlling weapons provides an even greater sense of detachment than ever seen previously in modern warfare.

The famous Milgram studies of the early 1960s help to illustrate how the concept of remoteness from the consequences of one's actions can drastically alter human behavior. In these studies, the focal point of the research was to determine how "obedient" subjects would be to requests from someone they considered to be a legitimate authority. Under the impression that the real purpose of the study was to examine learning and memory, subjects, as the "teachers," were told to administer increasing levels of electric shocks to another person, the learner, who was actually a confederate participant, when this person made mistakes on a memory test. While many different types of experimental conditions were examined, the one most pertinent to this discussion of moral buffers is the difference in subject behavior that was dependent on whether or not the teacher could see the learner. When the learner was in sight, 70% of the subjects refused to administer the shocks, as opposed to only 35% who resisted when the subject was located in a remote place, completely out of contact with the teacher (Milgram, 1975).

Milgram (1975) hypothesized that the increase in resistance to shocking another human when the human was in sight could be attributed to several factors. One important factor could be attributed to the idea of empathetic cues. When people are administering potentially painful stimuli to other humans in a remote location, they are only aware in a conceptual sense that suffering could result. Milgram had this to say about the lack of empathetic cues in military weapons delivery, "The bombardier can reasonably suppose that his weapons will inflict suffering and death, yet this knowledge is divested of affect and does not arouse in him an emotional response to the suffering he causes" (Milgram, 1975). Milgram proposed that several other factors account for the distance/obedience effect including narrowing of the cognitive field for subjects, which is essentially the "out of sight, out of mind" phenomenon. All of these factors are clearly present in the use of a weapons delivery computer interface, especially for one that controls weapons from over 1,000 miles away.

In addition to physical and emotional distance, the sense of remoteness, and detachment from negative consequences that interfaces can provide, it is also possible that without consciously recognizing it, people assign moral agency to the computer, despite the fact that it is an inanimate object, which adds to the moral buffering effect. The human tendency to anthropomorphize computers has been well-established (Reeves & Nass, 1996). Furthermore, it has been established that automated decision support systems with "low observability" can cause humans to view the automated system as an independent agent capable of willful action (Sarter & Woods, 1994). Low observability occurs in a complex system with high levels of automation authority (automation acts without human intervention) but little feedback for the human operator (Sarter & Woods, 1994). Viewing automation as an independent agent is also known as "perceived animacy" and examples of this can be found in commercial airline cockpits where pilots will ask questions about flight management automation such as, "What is it doing?" and "Why did it do that?" (Sarter & Woods, 1994).

In a research study designed to determine subject views about computer agency and moral responsibility, twenty-nine male computer science undergraduate students were interviewed concerning their views of computer agency and moral responsibility in delegation of decision making to the computer. Results suggested that these educated individuals with significant computer experience do hold computers at least partially responsible for computer error (Friedman & Millet, 1997). It follows then that if computer systems can diminish users' senses of their own moral agency and responsibility, this would lead to erosion of accountability (Friedman & Kahn, 1997). In automated supervisory systems, human users can be isolated in a compartmentalized subsystem and detached from the overall system mission. This disengagement can cause them to have little understanding of the larger purpose or meaning of their individual actions. Because of this diminished sense of agency, when errors occur, computers can be seen as the culprits. When this diminished sense of agency occurs, "individuals may consider themselves to be largely unaccountable for the consequences of their computer use" (Friedman & Kahn, 1997).

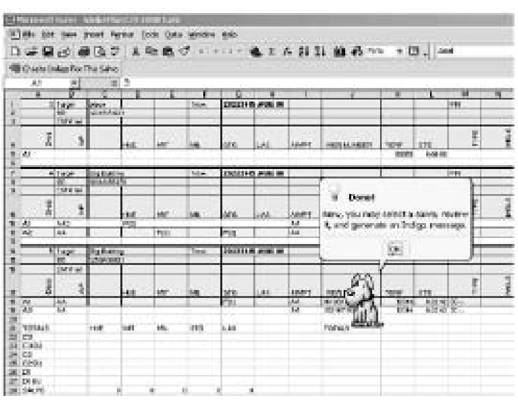
An example of how a computer decision support tool can become a moral buffer between the human and computer is that of the Acute Physiology and Chronic Health Evaluation (APACHE) system. The APACHE system is a quantitative tool used in hospitals to determine the stage of an illness where treatment would be futile. While it could be seen as a decision support tool to provide a recommendation as to when a person should be removed from life support systems, it is generally viewed as a highly predictive prognostic system for groups, not individuals (Helft, Siegler, & Lantos, 2000). The APACHE system could provide a moral buffer through allowing medical personnel to distance themselves from a very difficult decision ("I didn't make the decision to turn off the life support systems, the computer did"). By allowing the APACHE system the authority to make a life and death decision, the moral burden could be seen as shifting from the human to the computer.

The designers of this system recommend that APACHE only be used as a consultation tool to aid in the decision of removing life support and should not be a "closed loop" system (Friedman & Kahn, 1997). The ethical difficulty arises when technologies like APACHE become entrenched in the culture. Since the system has consistently made accurate recommendations, the propensity for automation bias and over-reliance could allow medical personnel, who are already overwhelmed in the workplace, to increasingly rely upon this technology to make tough decisions. When systems like the APACHE system are deemed to be a legitimate authority for these types of decisions, the system could in effect become a closed-loop system, which was not its original intent. Instead of guidance, the automated recommendations could become a heuristic, a rule-of-thumb, which becomes the default condition, and hence a moral buffer.

The same psychological phenomenon that creates possible moral buffers in the use of computer interfaces for medical advice may apply to decision support systems for weapons delivery, and indeed, for any computerized system that can inflict harm upon people. Acting through a seemingly innocuous apparatus like a computer interface and making potentially fatal decisions such as directing weapons through the click of a mouse can create a moral buffer and allow people to perceive themselves as not responsible for whatever consequences result. It could be argued that those people who actually control in-flight weapons are only following orders of superiors, and thus the actual operators are not responsible for their actions. In older military systems, a commander would make a weapons-firing decision and then, for example, order an underling to push the button that actually launched a weapon. Unfortunately, command and control technology have outpaced both human reasoning capabilities and traditional command structures. In smart weapons control of the future, weapons will no longer be controlled by junior enlisted personnel with little training. Smart weapons control in the future will require complex problem solving and critical analysis in real-time, which will be accomplished by educated, highly trained personnel who have the ability to both approve and disapprove of a weapons launch (such as pilots who have the authority to not drop a bomb if the situation warrants.) It is precisely this group of decision makers who will be most affected by a moral buffer.

An example of how a particular design element could contribute to a moral buffer in the use of computer interfaces can be seen in Figure

Figure 2 . A Military Planning Tool



2. This is a screenshot of an actual military missile planning computer program based on Microsoft's Excel® software package, which aids a military planner in planning an "optimal" mission (LoPresto, 2002). The user of this interface is likely to be a mid-career officer who is well educated and has the authority to choose between both resources and targets. The task of mission planning carries with it great responsibility, as millions of dollars in weapons, immeasurable hours in personnel, and scheduling of ships, planes, and troops are at the disposal of the planner. With users (the planners) bearing such serious responsibility, it is curious that the interface designers chose to represent the help feature using a happy, cute, and non-aggressive dog. A help feature is no doubt a useful tool for successful mission accomplishment, but adding such a cheerful, almost funny graphic could aid in the creation of a moral buffer by providing a greater sense of detachment in planning certain death through such an innocuous medium. It could be argued that in fact, this kind of interface is desirable as not to add to the already high stress of the mission planner; however, making the task seem more "fun" and less distasteful is not the way to reduce user stress.

A weapons control interface, even with the most elegant and thoughtful user design, may become a moral buffer, allowing users, who will be decision makers with authority and not subordinates "just following orders," to distance themselves from the lethality of their decisions. Interface designers should be cognizant of the buffering effect when designing interfaces that require a very quick human decision, and be careful when adding elements such as the happy dog in Figure 2 that make a computer interface more like a leisure video game than an interface that will be responsible for lost lives. If computers are seen as the moral agents (i.e., I was only following the recommendations of the automation), military commanders may be tempted to use remotely operated weapons in real-time retargeting scenarios without the careful deliberation that occurred with older versions of weapons that required months of advance planning, and that once launched, cannot be redirected. Likewise, the same elements apply for users of any interface that affect human life, such as medical devices and emergency response resources.

Conclusion

Because of the inherent complexity of socio-technical systems, decision support systems that integrate higher levels of automation can possibly allow users to perceive the computer as a legitimate authority, diminish moral agency, and shift accountability to the computer, thus creating a moral buffering effect. This effect can be particularly exacerbated by large organizations and the physical distancing that occurs with remote operation of devices such as weapons. For interface designs that require significant human cognitive contribution, especially in decision support arenas that directly impact human life such as weapons and medical systems, it is paramount that designers understand their unique roles and responsibilities in the design process. The need for careful reflection on ethical issues should be a concern for the development of decision support systems for weapons; however, all domains in which computers have the potential to impact human life deserve the same level of ethical and social impact analysis.

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References

32nd Army Air and Missile Defense Command (2003). "*Patriot Missile Defense Operations during Operation Iraqi Freedom*." Washington DC: U.S. Army.

Ahlstrom,V., & Longo, K. (2003). "*The Human Factors Design Standard*." Washington DC: FAA.

Bandura, A. (2002). "Selective Moral Disengagement in the Exercise of Moral Agency." *Journal of Moral Education, 31*(2), 101-119.

Billings, C. E. (1997). *Aviation Automation: The Search For A Human-Centered Approach.* Hillsdale, N.J: Lawrence Erlbaum Associates.

Cummings, M. L. (2004). "*Automation Bias in Intelligent Time Critical Decision Support Systems.*" Paper presented at the AIAA Intelligent Systems Conference.

Endsley, M. (1997, June). *Situation Awareness, Automation, and Free Flight.* Paper presented at the FAA/Eurocontrol Air Traffic Management R&D Seminar, Saclay, France.

Endsley, M. R., & Kaber, D. B. (1999). "Level of automation effects on performance, situation awareness and workload in a dynamic control task." *Ergonomics, 42*(3), 462-492.

Friedman, B., & Kahn, P. H. (1997). Human Agency and Responsible Computing: Implications for Computer System Design. In B. Friedman (Ed.), *Human Values and the Design of Computer Technology* (pp. 221-235). Stanford, CA: CSLI Publications.

Friedman, B., & Millet, L. I. (1997). Reasoning About Computers As Moral Agents: A Research Note. In B. Friedman (Ed.), *Human Values and the Design of Computer Technology* (p. 205). Stanford, CA: CSLI Publications.

Grossman, D. (1995). *On Killing*. Boston: Little Brown & Co.

Grossman, D. (1998). *The Morality of Bombing: Psychological Responses to "Distant Punishment".* Paper presented at the Center for Strategic and International Studies, Dueling Doctrines and the New American Way of War Symposium, Washington DC.

Grossman, D. (2000). Evolution of Weaponry, *Encyclopedia of Violence, Peace, and Conflict.* Academic Press.

Guerlain, S., Smith, P., Obradovich, J., Rudmann, S., Strohm, P., Smith, J., & Svirbely, J. (1996). "Dealing with brittleness in the design of expert systems for immunohematology." *Immunohematology, 12*, 101-107.

Helft, P. R., Siegler, M., & Lantos, J. (2000). The Rise and Fall of the Futility Movement. *New England Journal of Medicine, 343*(4), 293-296.

Karau, S. J., & Williams, K. D. (1993). Social loafing: a meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*(4), 681-706.

Keen, P. G. W., & Scott-Morton, M. S. (1978). *Decision Support Systems: An Organizational Perspective*. Reading, MA: Addison-Wesley.

Lerner, E. J. (1989, April). "Lessons of Flight 655." *Aerospace America,* 18-26.

Leveson, N. G., & Turner, C. S. (1995). "An Investigation of the Therac-25 Accidents." In H. Nissenbaum (Ed.), *Computers, Ethics & Social Values* (pp. 474-514). Upper Saddle River, NJ: Prentice Hall.

LoPresto, L. M. (2002, February 14). *PC-based Mission Distribution System (PC-MDS).* Paper presented at the Cruise Missile Seminar, Norfolk, VA.

Milgram,S. (1975). *Obedience to Authority.* New York: Harper and Row.

Mosier, K. L., & Skitka, L. J. (1996). Human Decision Makers and Automated Decision Aids: Made for Each Other? In R. Parasuraman & M. Mouloua (Eds.), *Automation and Human Performance: Theory and Applications* (pp. 201-220). Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

NRC Office of Public Affairs. (2004). "*The Accident at Three Mile Island*." Washington DC: United States Nuclear Regulatory Commission.

Parasuraman, R. (2000). "Designing automation for human use: empirical studies and quantitative models." *Ergonomics, 43*(7), 931-951.

Parasuraman, R., Masalonis, A. J., & Hancock, P. A. (2000). "Fuzzy signal detection theory: Basic postulates and formulas for analyzing human and machine performance." *Human Factors, 42*(4), 636-659.

Parasuraman,R., & Riley, V. (1997). "Humans and Automation: Use, Misuse, Disuse, Abuse." *Human Factors, 39*(2), 230-253.

Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). "A Model for Types and Levels of Human Interaction with Automation." *IEEE Transactions on Systems, Man, and Cybernetics, 30*(3), 286-297.

Reeves B., & Nass, C. (1996). *The media equation: How people treat computers, television and new media like real people and places*. Stanford, CA: CSLI Publications.

Sarter, N. B., & Schroeder, B. (2001). "Supporting decision making and action selection under time pressure and uncertainty: The case of in-flight icing." *Human Factors, 43*, 573-583.

Sarter, N. B., & Woods, D. D. (1994, April). "*Decomposing Automation: Autonomy, Authority, Observability, and Perceived Animacy*" Paper presented at the First Automation Technology and Human Performance Conference.

Sheridan, T. B. (1996). "Speculations on Future Relations Between Humans and Automation." In M. Mouloua (Ed.), *Automation and Human Performance* (pp. 449-460). Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Sheridan, T. B., Vamos, T., & Aida, S. (1983). "Adapting Automation to Man, Culture and Society." *Automatica,19*(6), 605-612.

Skitka, L. J., Mosier, K. L., & Burdick, M. D. (1999). "Does automation bias decision-making?" *International Journal of Human-Computer Studies, 51*(5), 991-1006.

Skitka, L. J., Mosier, K. L., & Burdick, M. D. (2000). "Accountability and automation bias." *International Journal of Human-Computer Studies, 52*, 701-717.

Smith, P., McCoy, E., & C. Layton. (1997). "Brittleness in the design of cooperative problem-solving systems: The effects on user performance." *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans, 27*, 360-371.

Tetlock, P. E. (1983). "Accountability and the perseverance of first impressions." *Social Psychology Quarterly, 46*(4), 285-292.

Tetlock, P. E., & Boettger, R. (1989). "Accountability: A Social Magnifier of the Dilution Effect." *Journal of Personality and Social Psychology, 57*(3), 388-398.

van den Hoven, M. J. (1994). "Towards ethical principles for designing politico-administrative information systems." *Informatization and the Public Sector, 3*, 353-373.

Technology-enabled Crime, Policing and Security

Sam McQuade

Abstract

Crime, policing and security are enabled by and co-evolve with technologies that make them possible. As criminals compete with security and policing officials for technological advantage perpetually complex crime, policing and security results in relatively confusing and therefore unmanageable threats to society. New, adaptive and ordinary crimes emerge over time to create technology crime waves, the magnitude of which can theoretically be measured, compared and predicted. These principles underscore a new theory of technology-enabled crime, policing and security pertinent for understanding contemporary threats posed by emerging forms of cybercrime, transnational crime and terrorism networks that defy traditional methods criminal justice and security measures for preventing and controlling crime.

Introduction

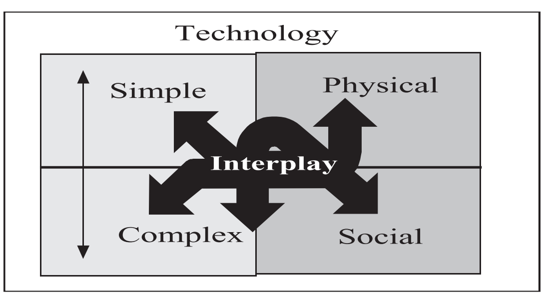
Few things are as fundamental to human history and ongoing development of society as technology. Readers of this article know full well that technology may be variously conceptualized, categorized and defined; is ubiquitous and serves seemingly infinite purposes; and evolves in its design, engineering, materials, components, manufacturing processes, adoption, implementation, systems integration and diffusion. When coupled with science, which in its broadest meaning denotes systematized learning across scholarly fields of research, technology and the interactive forces which make these possible (e.g., imagination, processing of raw materials, economics, and political processes) accommodate human preferences and enable societal functions in astounding ways. It is also well understood that synergistic science and technology may result in good or evil as determined by how they are used in relation to social norms, ethics and laws. Hence, the notion that technology has always and inevitably been used for socially abusive or criminal purposes as determined through processes of social construction and thereafter (hopefully) arrested via the administration of justice when not prevented is not surprising. Indeed this is expected and generally regarded as the way in which technology functions in and affects society.

Given the obvious role that technology has in the enablement and evolution of crime, and in countervailing policing and security functions of society, it is surprising however, that criminologists who have long sought to explain causes and correlates of crime and corresponding victimization have not significantly considered technology-related principles, processes and theories. Theories of the Classical School of criminology for example, examined 18th-century legal structures and criticized arbitrarily-designated criminal behavior and punishment imposed without regard for human rights, justice, or fairness (Williams and McShane, 1993) but did not consider the theoretical role of technology in crime. Similarly, 19th-century Positive School theories ignored the role of technology even when considering criminal behavior, "use of scientific methodology, assumption of pathology, classification of criminal types, prediction of criminality, and treatment of criminals" (Williams & McShane, 1993). And while Sutherland's (1947) Differential Association Theory identified simple-to-complex techniques as an aspect of criminal learning processes later specified by Akers along with other scholars (see e.g., Akers 1998; 1985; Burgess & Akers, 1966; Burgess et al., 1966), even as Cohen and Felson (1979) referenced technology when observing that crimes are more likely to be committed by motivated offenders who have suitable targets in the absence of capable guardians, no unifying theory about criminal use of technology, and countervailing use of technology for policing and security purposes, has been developed. This paper contributes to that process.

Physical and Social Technology Interplay

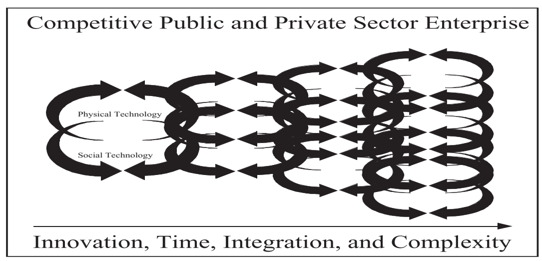
Technology can be defined as the application of hard and/or soft science knowledge, methods, and materials to practice arts and skills. This definition implies a distinction between hard "physical technologies" and soft "social technologies." Whereas physical technologies are tools enabling accomplishment of tasks, social technologies are methods or techniques which pertain to how human activities, behaviors, and interactions occur. Physical and social technologies range from being simple-to-complex, and complexity often has to do with the number of components or systems involved in technological functions or processes. As used here, complexity refers to the use of technology which cannot be explained by an investigative or security expert to similar experts across time and distance. This operationalization is adapted from the original definition developed by Kash and Rycroft (1997) to address complex technology-related issues and processes in organizational settings. In practice technologies are used conjunctively. It is also notable that both physical and social technologies facilitate research and theory-building in the hard and social sciences such as criminology. As shown in Figure 1, combinations of interplay between simple-to-complex physical and social technologies that enable knowledge-building and other human accomplishments are conceivably infinite with respect to inputs, processes, outputs and outcomes. Complete technology intertwining, and thus maximum complexity, occurs as all parties involved concurrently employ myriad technologies which combine components, systems, interactive processes and effects to defy understanding among experts. Over time complexity diminishes as the uses and effects of technology are better understood and become more manageable.

Figure 1. Dynamic intertwining and substitution of simple to complex, physical and social technologies. Perpetually Complex Technology-enabled Competition



When technologies establish reliability they tend to be adopted. This is because human enterprises generally seek to improve, and because nobody likes to get worse at anything. Even those persons or organizations preferring to remain static in their use of technology may be forced to adapt to market or other forces, and thereby adopt new tools or processes. "Perpetual innovation" (Kash, 1989; Kash and Rycroft, 1996) is a concept pertaining to synthetic analysis of tacit knowledge and skills residing in individuals, groups and organizations that enable continual discovery and adoption of new tools and techniques. Essentially, it is the notion that people involved in competitive enterprises are always trying to do things just a little bit better. Perpetual innovation applies to the interplay of physical and social technologies used by public and private enterprises operating in competitive environments. Perpetual improvement of products and services developed within organizational environments may lead to new discoveries, spin-off inventions and innovation of these. Hence, combinations of tools and techniques may be transformed into new technologies in their own right. The overall effect is creation of invention-to-obsolescence cycles in which physical and social technologies become more integrated and complex with time as shown in Figure 2.

Figure 2. Perpetual innovation-to-obsolescence cycles



Note that new technologies designed to achieve competitive advantage may constitute state and/or trade secrets, each having crime-related competitive implications (e.g., development or acquisition of weapons of mass destruction by terrorist organizations and/or theft of proprietary information by corporations). Thus, as previously acknowledged, new technologies are adopted for illicit purposes as well as countervailing policing and security purposes. Further, although perpetual innovation is intended to improve matters such as organizational processes, products, services, and profits etc., actual improvements are often unclear or subjective. Not everyone agrees for example, that a new gadget or way of doing things is better, or that these will result in greater benefits when compared to costs at the level of the organization much less within broader society. At the time of its adoption, a given technology might be just too complex to understand or operate, or not cost effective given extant states of research and development in varying scientific, technological, organizational, economic, and political environments. Even if technology is affordable to develop, adopt, implement and master by personnel involved it may nonetheless result in more harm than good and be considered economically inefficient in the grand scheme of outcomes. And because perpetual innovation only and necessarily occurs under conditions of competition, winners and losers will eventually emerge unless a technological balance is struck and maintained among competitors. For this to occur, all parties involved must believe that achieving technological advantage is either futile or undesirable, and that their would-be opponents are not secretly trying to resurrect or invent new threatening capabilities. Crime versus policing and security are inherently competitive and distrusting enterprises, and there is nothing novel about these technology-related principles, although considering them explicitly in theoretical terms as integral aspects of crime, policing and security is long overdue.

Technology as Crime, Policing and Security

Cunning criminals have always taken advantage of new technologies often as the result of learning how to do so from other people including fellow criminals. Periodically they experiment with existing tools or techniques in order to develop a satisfactory *modus operandi* with which they are comfortable and believe gives them reasonable advantages over the security technologies of intended targets, as well as police who may be prowling about physical and cyber environments for signs of crime. Upon establishing their M.O., successful criminals are disinclined to change either their preferred tools or techniques, although on rare occasions enterprising criminals may concoct new ways in which to commit their illicit activities. As a natural byproduct of perpetual technology innovation and criminal adoption and adaptation, methods of committing crime can change at the societal level. Thus crime consisting of myriad methods of gaining technological advantage for illicit purposes can be conceived of as social technology with its own innovation-to-obsolescence cycles. Graycar and Grabosky for instance, referred to the evolution of the technology of money laundering (1996, p. viii). Today we are also witnessing systemic changes in the technological nature and technology-enabled organization of transnational crime networks, terrorist cell operations, and cybercrimes.

Crime as social technology will almost always involve use of physical technologies (i.e., tools), although rape, assault, and murder committed without the use of weapons or other instruments such as those used to penetrate body cavities are notable exceptions. Conceiving of crime as social technology incorporating use of physical technologies allows for construction of a matrix similar to that used by Kash and Rycroft (1997), but differentiating as depicted in Figure 3 between: (1) simple crime committed using simple tools; (2) simple crime committed using complex tools; (3) complex crime committed using simple tools; and (4) complex crime committed using complex tools. As indicated above, complex crime occurs to the extent combinations of relatively complex physical and social technologies are employed.

Just as various types of crime (e.g., money laundering) can be considered a social technology, so can various methods of policing.

Figure 3. Simple-to-complex crimes committed with simple-to-complex tools.

1. Simple Crime Committed Using Simple Tools	3. Complex Crime Committed Using Simple Tools
Single suspect using a manual instrument to unlawfully threaten, harm, damage, or gain entry to a vehicle or structure.	Traditional racketeering, vice, and corruption using relatively simple physical technologies.
2. Simple Crime Committed Using Complex Tools	**4. Complex Crimes Committed Using Complex Tools**
A marijuana grower who uses a cellular phone and pager to facilitate his own frequent drug sales, and a computer to store digitized records of his transactions, expenses, and income.	Combined drug smuggling, gang violence, and money laundering of victims across multiple jurisdictions using a variety of digital devices to generate, transmit, and store encrypted crime-related information.

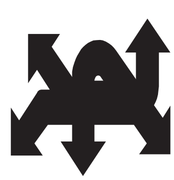
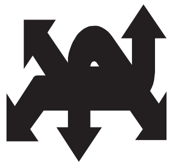


Figure 4. Categories, interplay, and examples of simple-to-complex policing methods and physical technology.

A. Simple Policing Using Simple Tools	B. Complex Policing Using Simple Tools
An officer on foot patrol conducting building checks at night with a flashlight.	A community Police officer issuing citizens Neighborhood Block Watch stickers in the course of conducting crime prevention seminares and "hot spot" problem-solving within a community.



C. Simple Policing Using Complex Tools	D. Complex Policing Using Complex Tools
Random preventative patrol using a modern, well-equipped police cruiser.	Undercover store-front sting operation using electronic surveillance equipment and GIS tracking technology to investigate cellular phone theft and fraud.

Community policing for instance, often described as a philosophy that emphasizes problem-solving in partnership with community members to enhance crime prevention methods may be conceptualized as a social technology. Obviously security and policing technologies are also physical and range from being relatively simple to complex. Thus, analogous to crime as technology, the interplay of simple-to-complex policing or security methods and tools such as described by the examples in Figure 4 are also social technologies that are bound only by human ingenuity.

Perpetually Complex Crime and Policing

It follows that crime and policing/security co-evolve with technology invented or adapted for these purposes and that as the result of competition in a manner akin to a civilian arms race is limited only by available resources broadly defined (e.g., imagination, knowledge, skills, money, time.). Figures 3 and 4 represent conceptual analogues of crime and policing/security which combine tools and techniques (or methods) into practical functions that are subject to change as new technologies are developed, learned, adopted and implemented by individuals, groups, organizations and even entire regions or societies. Referring only to crime for the moment, we may conceptualize its evolution sequentially and at the micro level of an individual. For example, a young thief might first learn to shoplift using her purse for concealment, and later graduate to stealing from multiple victims using a computer. Thus, and in reference to Figure 3, a Category 1 crime (i.e., simple crimes committed with simple tools) might evolve into Category 2, then into Category 3, and eventually Category 4 crimes with corresponding increases in technological complexity. Figure 3 depicts this interplay and provides an example of hypothetical crime(s) in each category, while Figure 2 depicts technology as intertwining physical and social technologies that may used to commit crime , and thus crime itself being innovated, integrated, and becoming more complex over time.

A more realistic conception of technologically evolving crime would involve all four categories of the matrix in Figure 3 co-evolving with increases in resources coupled with intensity of motive (i.e., the drive) of criminal groups and organizations as well as individuals, and in environments consisting of various levels of policing/security where detection avoidance by criminals is also required. After all, individual criminals and organized networks of criminals use various levels of simple-to-complex technology to commit various types of crimes while learning from one another, all the while also avoiding police and security officers and/or overcoming crime prevention, detection and apprehension technologies.

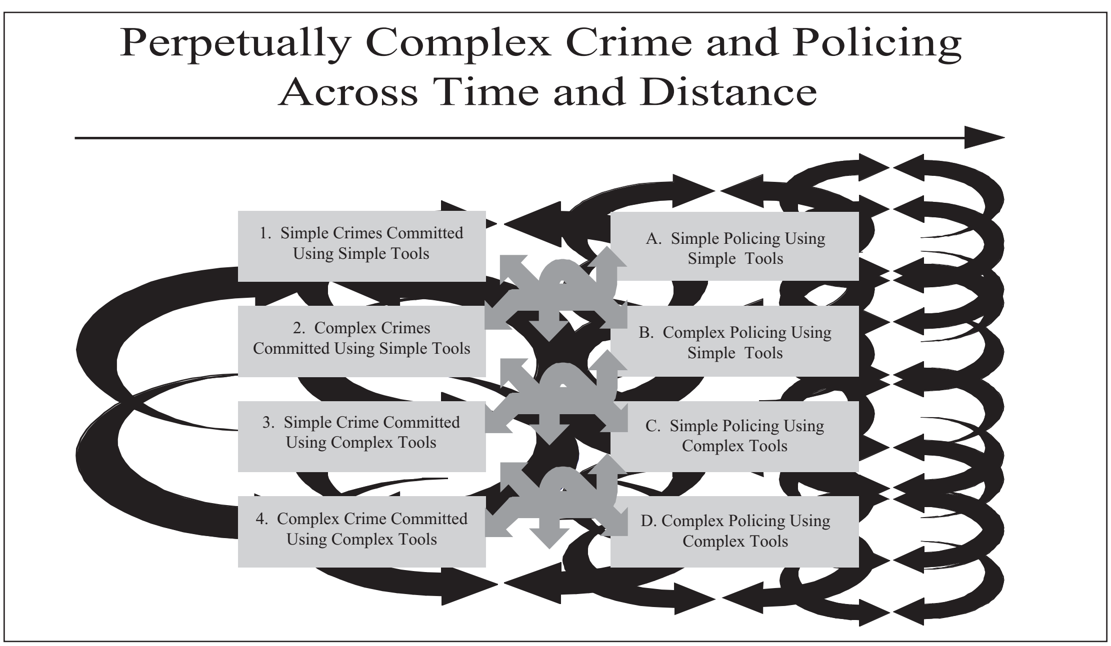
Some crooks however, may prefer to remain operating in relatively simple ways they deem satisfactory, or they may be incapable of advancing their knowledge and skills beyond a certain level of technological complexity. Collectively however, competitive society (and therefore, crime as well as policing/security) perpetually innovates even if individual criminals or criminal organizations become static in their own invention, adoption and use of particular technologies. As criminals become more sophisticated in their use of technology, forms of crime committed by them also become increasingly complex and difficult to understand and manage. Thus police and security officials must stay current in their knowledge and understanding of emerging crime, and both well resourced and expert regarding their own technological capabilities.

Crime and policing/security are technologically competitive enterprises that are inextricable, dynamic and co-evolving. Criminal innovations drive policing and security innovations, and by extension each perpetually co-evolves the other throughout time and society. As intentionally shown in the hopelessly complicated Figure 5 below, the gamut of simple-to-complex physical and social technologies used by these enterprises are dynamically intertwined, and they become more complex over time and distance subject to broad social, cultural, political and economic conditions and constraints.

Thus, crime and methods for preventing it via security and policing evolve together as a function of these factors plus human ingenuity. And as crime in a given geographic location or cyber realm emerges in a new way, police and security officials inclusive of technology developers respond accordingly. Who in computerized societies does not continually experience the technological competition surrounding creation and release of malware (i.e., computer viruses, worms, Trojans, spyware and adware) for which firms are continually writing prevention, detection and removal code? Conversely, if security or police officials in a given realm develop new tactics and/or employ new tools, criminals will adjust their activities to reclaim technological advantages. This insidious cat and mouse game may involve considerable financial and other resources, and periodically may also culminate in significant destruction of property, physical injury or even death. But as long as the security officials and police are winning the overall game, there is relatively little cause for alarm. After all, these processes are inevitable — crime, however socially constructed and legislated against, occurs naturally given human nature. Yet, when it comes to preserving a safe, secure and orderly society, security and police forces using their technological capabilities must ultimately triumph over criminals.

What matters most is not the type or amount of crime measured in incidence or prevalence within a given geographic location or cyber realm, rather reasonable innovation and perpetuation of relatively sophisticated security and policing which is capable of deterring, preventing, interdicting, suppressing or otherwise displacing existing capabilities of criminals regardless of the relative complexity of crimes committed. In other words, policing and security officials should stop obsessing with crime rates, and

Figure 5. Dynamic crime and policing technology co-evolution



with the help of researchers, develop practical ways in which to measure how level the playing field really is. This requires systematic rethinking, education, training, equipping, and organizing of police and security forces to some extent so that they may continually anticipate and recognize crime threats, and then formulate and implement forward-looking prevention and control strategies consistent with their resource limits.

Happily, in the game of perpetually complex crime and policing/security, the "good guys" (and girls!) usually have many advantages. For example, they are generally well trained, equipped, and organized, and they often lend interagency assistance and work in inter/multi-agency task forces in order to address complex crime problems, etc. Historically, the Federal Government has created huge new policing and security organizations in order to address emerging technology-enabled crime problems. For example, in 1909 a new unit officially named the Bureau of Investigation as the FBI was then known began investigating emerging interstate prostitution under authority granted by the White Slave Traffic (Mann) Act. This is how the Federal Government became involved in policing organized interstate crime which, until onset of the automobile combined with ubiquitous long distance telephone service, was conceived of in the press and by the public as merely local crime.

Following the terrorist attacks of September 11, 2001, against the World Trade Center towers and Pentagon, Congress acted with unprecedented speed to authorize creation of the new Department of Homeland Security to combat, prevent, and interdict terrorism in all its forms in concert with intelligence and military components of the federal government, as well as in cooperation with state and local policing agencies and private sector security firms. Problems arise however when during the emergence of new forms of crime, security and police capabilities within society loose their competitive advantage. On this point there is no substitute for informed and supportive policy makers who are willing in the midst of uncertainty (i.e., lack of understanding about complex crime problems) to make fiscal investments and pass adequate crime legislation before the onset of crises. The danger lies in providing police with too little technology relative to crime-fighting needs, or with too much technology relative to adequate controls on their power.

Ordinary, Adaptive, and New Forms of Crime

Since crime is technologically dynamic and can become increasingly complex over time and distance in accordance with supporting resources such as money or culture versus constraining factors such as lack of money or culture, it is useful to categorize the evolution of perpetual innovation as it applies to potential crime and security breaches in three ways, each denoted with a technical term. *Ordinary crimes* are conventional. They routinely occur in many places, are recognized and well understood in their variations, and are actively prevented, investigated, and prosecuted. A clear indication that crime is ordinary is the existence of statutes defining criminal behavior, an accompanying body of case law to reference when developing prosecution strategies and making arguments before a court, and police or security record-keeping systems which track frequency and location of occurrences. For example, all crimes tracked by the FBI's Uniform Crime Reporting (UCR) system are, technologically speaking, ordinary crimes (e.g., common varieties of theft, burglary, and robbery).

Adaptive crimes are new technological variations of ordinary crime. They are manifested through incremental and innovative use of technology. As such they subsume one or more existing forms of crime or security threats, and they occur relatively frequently even though they may not initially constitute legally defined criminal behavior. As such, adaptive crime can be prosecuted in its essence under existing crime legislation supported by a body of case law albeit with varying precision and success. It may not be necessary to prosecute technologically adaptive crimes via an untested legal strategy because adequate statutory and case law will afford clear authority if not ample precedence based on similar case facts.

New crimes involve radical innovative use of technology to commit an act of social abuse which is not necessarily illegal at the time of first occurrence. Truly new forms of social abuse (i.e., new crimes) happen rarely and may initially go undetected or even unrecognized because police and security officials will typically have little or no training and no basis of experience to understand what is happening. Since new crime does not conform to broader social experiences it seems mysterious and complex to other government officials, the media and members of the public. Mysterious because it is not understood; complex because it may: (a) involve relatively complicated technologies; (b) involve many suspects, victims, and considerable amounts of harm and/or loss; (c) subsume varieties of ordinary and/or adaptive crime; (d) not be explainable by investigative experts to other investigative experts across time and distance sufficiently to formulate prevention and control strategies; (e) generate intensity in the form of public outrage not only against the act and its perpetrators, but also against police or security officials for not responding adequately to the crime or security threat; and (f) diffuse at varying rates across many geopolitical jurisdictions or cyberspace. New crimes cause considerable public amazement, perhaps even shock, disbelief, and/or outrage once they are discovered. They are also often labeled in sensational albeit confusing terms such as “data rape” (Szwak, 1995). Such terms are often created by the media which understandably is always seeking something new to report and thereafter create headlines to promote profits through direct sales of publications or advertising of air time. While new crimes are socially abusive, because they are not initially defined as being criminal, the consummate act (or significant portions thereof) may be extremely difficult if not impossible to prosecute. For instance, many states and the federal government were unable to successfully prosecute early computer abuse. Even prosecution of Robert Morris Jr. for his releasing of the first Internet worm in 1988 was difficult under the then newly passed Computer Fraud and Abuse Act. Today however, the federal government and all fifty states have at least one and in many cases several specific computer crime laws under which cybercriminals can be prosecuted for specific acts.

Obviously new crimes via the copycat crime phenomena (Pease & Love, 1984) become adaptive crime and eventually ordinary crime. Table 1 distinguishes between the three stages of crime evolution with respect to their occurrence, innovative use of technology, social cognizance (i.e., observe-ability and understanding), and legal sanctions. Note that the suicidal terrorist airliner bombings of September 11, 2001, may be considered examples of new crime because although the crime itself, murder, previously existed, the technological means (crashing hijacked airliners into buildings) involved radical innovation, societies (not limited to the United States) did not immediately comprehend the nature of the terrorist threat, and there existed no specific crime laws against the consummate act of hijacking an aircraft in order to simultaneously commit suicide, mass murder and incredible amounts of property damage for political or religious purposes. Similarly, in 1971 when bomb-strapped D. B. Cooper commandeered a Northwest Airlines 727 in Portland, commanded it to land in Seattle, and thereafter parachuted (possibly to safety) over the Columbia River gorge on the border of Washington and Oregon, there existed no term or label, much less a crime law against hijacking. Obviously that all changed as Cooper’s original form of social abuse was copied and modified technologically to become adaptive crime and eventually ordinary crime committed by terrorists. Note that although hijacking incidents were always extremely serious and upsetting, they eventually occurred with sufficient frequency that they were not featured by many media sources as sensational events.

Table 1. Aspects and examples of ordinary crime, adaptive crime, and new crime.

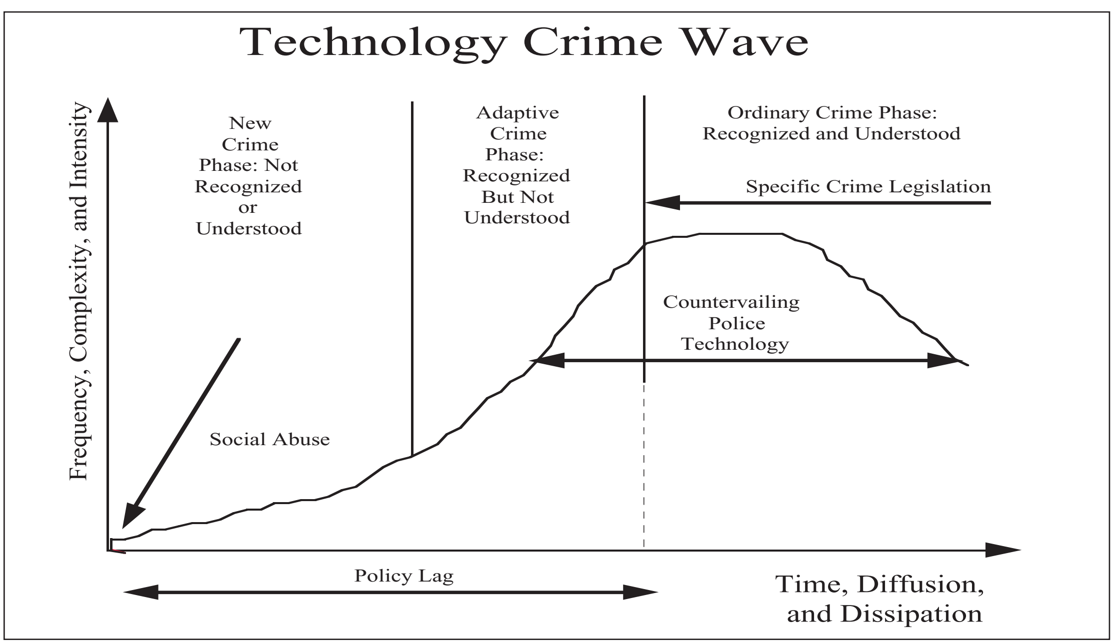
Feature/ Crime Type:	Occurrence	Use of Technology	Social Cognizance	Legal Sanctions and Prosecution Strategy	Contemporary Examples
Ordinary Crime	Routinely	No innovation	Recognized and well understood	Clearly violates existing crime law	Common theft, burglary, etc.
Adaptive Crime	Relatively frequently	Incremental innovation	Recognized but not well understood	Violates existing laws in some respects and does not require innovative prosecution	Releasing a new computer virus onto the Internet
New Crime	Rarely	Radical innovation	Not widely recognized and not understood	Consummate act does not violate existing laws; Impossible to prosecute as an explicit overarching criminal offense	Human Molotov missiles of Sept. 11, 2001

Criminal Purposes and Technology Crime Waves

People who commit crime use technology for ten core technology-enabled purposes: surveillance, planning/record-keeping, communication, transportation, coercion, protection, concealment, value storage, to inflict harm and to expand their operations. These purposes should not be confused with legal intent or personal motives for committing crime, which are different. Whenever radical new and socially abusive use of technology occurs for any of these core purposes, new crime emerges. When an increasing minimum (and arbitrary) number of the same kind of new crime occurs within a certain period of time (e.g., seven slight variations of a new crime within thirty months) a new *technology crime wave* begins to form (see Figure 6). Such waves occur periodically, strike across geopolitical jurisdictions and with varying levels of force, and spread and dissipate at rates inversely related to development of countervailing understanding and implementation of security and policing technologies. Other factors including social, cultural, economic and political conditions, coupled with media attention and perhaps other forces may also contribute to the spread or dissipation of a technology crime wave. Here also, do not confuse the concept of a technology crime wave with the conventional expression "crime wave" which typically refers to a rash of similar crimes in a particular location (e.g., a rash of burglaries in a neighborhood). In contrast, a technology crime wave comes about as the result of unique technology abuse that is not understood rather than numbers of conventional crimes. The time period between the emergence of a new crime and development and implementation of countervailing security and police technologies as signaled by formulation of crime legislation prohibiting the consummate illegal act represents policy development and implementation lag time.

As shown in Figure 6, technology crime waves always begin with an original incident of unusual social abuse and increase in the frequency of technologically similar incidences over time. As the number of similar and still-unusual incidents increase, the intensity of the emerging wave (i.e., social concern, disdain, or outrage surrounding radical innovative use of technology for abusive purposes) also increases. In the long term, three technology stages each corresponding to cognitive phases further corresponding to the continuum of new crime, adaptive crime, and ordinary crime results. Each of these stages/phases varies in duration depending on the number and frequency of incidences, complexity of technology involved, intensity generated, and rate of diffusion and dissipation. Like waves in the ocean, technology crime waves start small and develop more energy, travel at different rates, overlap, and collide. In the real world, multiple smaller waves exist within larger waves, such that only general wave patterns are measurable. Figure 6 depicts how a single technology crime wave originates with social abuse, forms into a new form of crime, picks up energy via copycatting becoming adaptive crime, and

Figure 6. Technology crime wave



eventually transforms into ordinary crime as security, policing, prosecution and other forces for law and order prevail.

Research exploring the nature of technology crime waves could contribute to criminology and to criminal justice and security policies and practices involving technology invention, innovation, adoption, procurement, implementation, routine use and diffusion. As a point of departure it may be useful to determine how different technology crime waves defined on the basis of core criminal purposes and simple-to-complex tools and techniques used by criminals for innovative purposes vary initially and over time and distances. Determining the magnitude of a technology crime wave relative to various contributing and constraining factors, and under varying circumstances which combine to affect its emergence and dissipation would be extremely challenging. How technologically complex is a given type of crime? The answer matters because crimes which are complex relative to security and policing understanding and technological capabilities are less manageable. Thus, determining the extent to which new forms of technology-enabled social abuse and crime are more complex, less manageable and also potentially harmful to society is useful from the standpoint of allocating security and policing resources.

To this end consider that estimates of the number of suspects, victims, and geopolitical jurisdictions, and some measure of technological systems relied upon by criminals in given incidents are calculable and therefore theoretically capable of being used to establish a *complexity factor*. Similarly, an *intensity factor* estimating harm (i.e., death, injuries, and property loss in terms of dollars) and the extent of public outrage based potentially on the amount of media coverage could also be developed. Finally a *diffusion factor* consisting of frequency of incidences, across different jurisdictions, and within a specified period of time could also be determined. Data on each of these factors could possibly be gathered and/or estimated from combinations of police and media reports describing incidences of social abuse (operationally defined as new crime). Obviously such data, to the extent it exists or could be generated, would empirically demonstrate the existence of technology crime waves, although determining when new crime ends and adaptive crime begins within a wave would necessarily be subjective and need to be controlled for in research studies. Nonetheless, when combined and quantified such data could be used to measure and compare the magnitude of technology crime waves representing different types of emerging social abuse, in which: (Mw) is the overall magnitude of the crime wave (area under the curve), and complexity (C), intensity (I), diffusion (D), recognition of new crime (R), and understanding (U) are combined into the following general formula (McQuade, 1998):

$$Mw = (C * I * D)/(R * U).$$

Thus, the area under the curve (see Figure 6) represents the magnitude of a single technology crime wave for a specified place (or cyber realm) and period of time. Depending on the number of separate or integrated waves examined, formulation of a prediction model for potential crime or known emerging crime, along with estimates of the magnitude of new crime/security-related threats to society may also be possible. Analysis of crime legislation enactment and media accounts of new crime could provide external validity to these concepts thereby bolstering support for a formal theory of technology-enabled crime, policing and security. By analogy, if we can predict the onset and intensity of earthquakes and volcanic eruptions although imprecisely, as well as model potential new strains of disease and their negative public health impacts, perhaps it is also possible to estimate (albeit initially unreliably) the onset and magnitude of social abuses that are inherently illicit if not initially illegal and threaten society.

Summary: General Theoretical Propositions[1]

Technologies are combinations of tools and techniques ranging from simple-to-complex in their design, materials, construction and manufacturing processes, adoption, social implementation, technical/systems integration and applications. Criminals, police and security professionals employ a full range of technologies that are available to them for similar and countervailing purposes.

New forms of deviance, social abuse or crime, that is new crimes, are committed through innovative use of technology. Initially new crime is not well understood, and is therefore relatively complex, because investigative experts tend not to be able to explain how criminals are using technologies to other investigative experts across time and distance. Faced with relatively complex crime and attendant management problems, police, security professionals and prosecutors innovate with countervailing technologies and legal strategies to overcome and if possible stay ahead of technological gains made by criminals.

With increased understanding and law enforcement interdiction, new crimes transform into better-understood adaptive crimes, and laws making criminally adaptive behaviors explicitly illegal begin to be enacted. The process of formulating and enacting new crime laws and regulations raises public awareness of crime problems threatening society. Combined with media attention about these issues, attitudinal and behavioral changes emerge in ways that precipitate arrest and prevention of adaptive crimes. Eventually, adaptations of laws are widely adopted and diffused as a form of legal/social technology that leads to increased investigation and prosecution. When this happens, once new and then adaptive crime transforms into ordinary crime that is much better-understood, routinely recognized and responded to, and may be systematically targeted for prevention. New crime, adaptive crime and ordinary crime emerge sequentially to form a technological crime wave in which technological complexity increases across time and distance unless and until countervailing awareness, knowledge and understanding and attendant security/policing technology capabilities are developed to afford greater manageability of the crime problem. Enhanced enforcement, combined with continual technological advances in society, compel smart criminals intent on getting away with ordinary crime to adopt new technologies. This begins anew the cycle of technological competition between criminals and the police (i.e., the emergence of deviance/social abuse, new crime, adaptive crime, and ordinary crime). Criminals that do not adopt new technologies are at greater risk of being caught unless and until their technological capabilities exceed those of law enforcement and security professionals. Similarly, law enforcement and security professionals must consistently develop, adopt, and diffuse new technologies or risk falling behind in their crime fighting capabilities.

Over time, recurring criminal and police innovation cycles have a ratcheting-up effect akin to a civilian arms race. Crime and policing become increasingly complex as a function of increasingly complex tools and/or techniques available in society and employed by criminals, police or security professionals. The result is perpetually complex, technology-enabled crime, policing and security management — a never-ending competition in which police and security professionals will, in general, react to criminological innovation. Tools and techniques once developed, adopted, and understood tend to remain in use by criminals, police and security professionals because of their continuing functionality and/or constraints to technology development or adoption. The result is a full range of relatively simple (ordinary) to relatively complex (new) forms of crimes and countervailing investigation and protective methods. Concerned criminals and police are always wondering about their adversary's activities, and each group may not fully understand the consequences of their own operations (i.e., use of technology). This can result in unintended positive and negative spin-off effects. Over time, technology employed in crime, policing and security management is better understood, thus relatively less complex, and in the case of crime (hopefully) more manageable, except to the extent that criminal innovations disrupt relatively stable technological competitions between law abidance and violating forces of society.

Conclusion

Concepts of technology-enabled crime, policing and security, along with perpetually complex aspects of these concepts, and technology crime waves have been described as a way of understanding how technology-enabled innovative social abuse and criminal behavior emerges, impacts society and then diffuses. Technology-enabled social abuse and crime are usually inevitable negative spin-offs of technology R&D, and initially new crimes are relatively more complex and less manageable because investigative and other experts tend not to be able to explain what is happening across time and distance to other experts. The result is a series of new, adaptive and ordinary crimes grounded in technological capabilities of criminals versus those of security and policing officials. General hypotheses concerning a formal theory of technology-enabled crime, policing and security were advanced that incorporate the concepts of technological complexity and technology crime waves. These concepts are intended to complement, but not supplant, existing theories of crime causality and technology development and diffusion. Indeed, many of the concepts described in this paper are not new and draw upon long-held views and conventional wisdom of experienced practitioners as well as various research findings having to do with crime, security, technology and competition within many sectors of society. Accordingly, this paper did not focus on why crime occurs, but rather how it may occur with respect to innovative use of technology. These issues are relevant for assessing the technological nature, extent and potential threats posed by crime and terrorism, and potentially for allocating resources for deterring, preventing, interdicting, displacing or otherwise controlling these socially undesirable behaviors. Important considerations in taking the topic further are: (a) whether the somewhat amorphous concepts preliminarily presented here can be more theoretically, conceptually, and methodologically bound in order to logically and convincingly make the case for the existence and utility of technology crime waves thereby supporting a more general theory of technology-enabled crime, policing and security; and (b) the ability to collect or generate sufficient data on complexity, intensity, and diffusion factors for testing hypotheses related to new, adaptive and ordinary crime stages and cognitive phases.

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References

Akers, R. L. (1985). *Deviant behavior: A social learning approach (3rd ed).* Belmont, California: Wadsworth.

Akers, R. L. (1998). *Social learning and social structure: A general theory of crime and deviance.* Boston: Northeastern University Press.

Burgess, R. L., & Akers, R. L. (1966). A differential association-reinforcement theory of criminal behavior. In Joseph E. Jacoby (Ed.), *Classics of criminology,* 2nd, 1994 *edition,* (pp. 228-235). Prospect Heights, Illinois: Waveland Press, Inc.

Cohen, L. E., & Felson, M. (1979). Social change and crime: A routine activity approach. In Joseph E. Jacoby (Ed.), *Classics of criminology*, 2nd, 1994 *edition,* (pp. 66-74). Prospect Heights, Illinois: Waveland Press, Inc.

Graycar, A., & Grabosky, P. (1996). *Money laundering*. Sidney: Australian Institute of Criminology.

Kash, D. E. (1989). *Perpetual innovation : The new world of competition.* New York: Basic.

Kash, D. E. (1996). Complexity. Chapter 4, unpublished manuscript.

Kash, D. E., & Rycroft, R. (1997). Technology policy in the 21st century: How will we adapt to complexity? Presented at the annual meeting, American Association for the Advancement of Science, Seattle, Washington, February 13-18.

McQuade, S. (1998). *Towards a theory of technology enabled crime.* Unpublished manuscript. George Mason University, Fairfax, Virginia.

McQuade, S. (2001). *Cops versus crooks: Technological competition and complexity in the co-evolution of information technologies and money laundering*. George Mason University, Fairfax, Virginia

McQuade, S. (2005). Theoretical and social perspectives of cybercrime. Chapter 5 in, *Understanding and managing cybercrime.* Boston: Allyn & Bacon.

Pease, S. E., & Love, C.T. (1984). Copycat crime phenomenon. In, Ray Surette (Ed) *Justice and the media* (pp. 199-211). Springfield, Illinois: Charles C. Thomas.

Sutherland, E. H. (1947). Differential association theory. In, Frank P. Williams III and Marilyn D. McShane (Eds.), *Criminology theory: Selected Readings*, (pp. 54-59). Anderson: Cincinnati.

Szwak, D. A. (1995). Data rape: High tech theft of credit identities. *National Law Journal*, 17, (20), 18.

U.S. Department of Justice (1980). *Computer crime: Legislative resource manual.* (BJS Contract No. J-LEAA-007-80). Washington, DC: Bureau of Justice Statistics.

Williams, F. P. & McShane, M. D. (1993). *Criminology theory: Selected classic readings*. Cincinnati: Anderson.

Notes

[1] (McQuade, 1998; McQuade, 2001; McQuade, 2005)

I Would Have Had More Success If . . . : The Reflections and Tribulations of a First-Time Online Instructor

Chien Yu and Teri Brandenburg

Abstract

This paper is to explore "I-would-have-had-more-success-if…," the reflections of a beginning online teacher and her students in an undergraduate Web-based course. The data used in the paper was gathered using the instructor's journals, student feedback, and an analysis of online discussions. The instructor maintained journals reflecting upon students' experiences as she developed and delivered the online course. The students' feedback was gathered through student journals, e-mails sent to the instructor, and an end-of-course evaluation survey. This paper can provide insights for online educators in their efforts to be effective in developing strategies that can promote learning. The instructor attempted to share her experience that could help online instructors understand areas of improvement identified by students when taking online technology-based courses.

For the past decade, Web technology has taken center stage of emerging technology and innovation in society. The trend of Web technology development has driven educators to create online courses or Web-based course supplements. The development of Web-based courses has challenged the educational learning environment and forced some educators to use technology for teaching and learning effectiveness. Web-based instruction provides teachers with a means of meeting the social needs of nontraditional students with differing abilities, interests, cultures, and backgrounds. Through Web-based instruction, these students can expand their knowledge base and improve their ability to access, analyze, evaluate, synthesize, and communicate information.

However, Web-based course design is different from traditional courses. Traditional instructional design models can be successfully applied for the development of classroom instruction but could be limited in the development of Web-based teaching. Koszalka and Bianco (2001) indicated that supporting the learning process can be achieved by providing multiple means of presenting instruction, information, and activities. Interaction through discussion and collaboration has become an essential component of any Web-based course (Wulff, Hanor, & Bulik, 2000). Research literature affirms that the level of interaction among students and between students and their teachers has a major impact on the quality of Web-based instruction. Perrin and Mayhew (2000) indicated that distance education courses might not be able to create the level of interaction achieved in face-to-face courses. However, Miller and Webster (1997) found that faculty teaching distance education courses could provide their online students with levels of interaction similar to their on-campus students. The literature also reveals that designing collaborative online learning environments is an obvious strategy for promoting interactivity (Northrup, 2001). Through online collaboration and communication, Web-based courses may include conversation in a chat room, discussion groups, bulletin boards, e-mails, listservs, and inquiries. These communication tools can play a major role in successful Web-based instruction and learning by encouraging and nurturing a collaborative sense of community and developing components of social and academic interaction.

Most efforts to create educational applications that support learning have focused on students (Loveless, 1996). Zhao (1998) argues that without providing support to teachers to adopt and appropriately use these applications, these efforts will not result in any widespread impact on education. The purpose of this article is to explore and compare the reflections of a beginning online teacher and that of her students in an undergraduate, technology-based, online course. As the instructor developed the technology-based course for a Web-based environment, she continually went through the process of ongoing changes and adjustments. The data used in this article was gathered using the instructor's journals, student feedback, and an analysis of online discussions. The instructor maintained her journals reflecting upon students' experiences as she developed and delivered the online course. The students' feedback was gathered through student journals, e-mails sent to the instructor, and an end-of-course evaluation survey. After examining students' feedback and comments in response to questions with the stem "I would have had more success if…," the instructor compared how she reflected on the same questions as she delivered the Web-based course. The categories that emerged from this process focused on the following areas:

- Online interactions and communications
- Students' learning and performance
- Online collaboration
- Hardware and software issues
- Administrative support

This study will be important since the experiences of first-time instructors need to be researched and disseminated, so that informed decisions about professional development and support can be devised to assist future and current instructors teaching online technology-based courses. In addition, this paper can provide insights for online educators in their efforts to effectively develop strategies that can promote learning and help them understand areas of improvement identified by students for online technology-based courses.

Course Background

The course that the instructor taught online was offered to undergraduate students as a computer literacy course at a southeastern university. Different from most conceptual or theory-based courses, the content of this technology-based course focused mainly on computer applications proficiency, such as word processing, spreadsheet analysis, presentation graphics, database management, and related technology competencies. In addition to the online session, this technology-based course was also offered through traditional face-to-face sessions. The instructor taught two sessions of the traditional face-to-face class before teaching the online session.

Although without any face-to-face interactions between instructors and students, the instructor emphasized students' hands-on experience and practice as she did in the traditional face-to-face courses. The WebCT course management system was used for the course. Although the instructor was familiar with the software applications and had used WebCT to supplement traditional courses before, she had never used WebCT to develop a totally online technology-based applications course.

Students' Prior Online Experience

There were 29 students enrolled in the online course. For evaluation purposes, the instructor and the graduate assistant designed an evaluation survey (Appendix A) with open-ended questions so that students could comment on the online course and their online learning experience. The survey was administered at the end of the semester through WebCT's survey tool. Thirteen students replied to the survey. The overall return rate was 44.83%. Table 1 shows students' online learning experience, including this online course.

Table 1. Students' Online Course Experience

Number of Online Courses Taken	Number of Students	Percentage	Cumulative Percentage
1	3	23.08%	23.08%
2	3	23.08%	46.16%
3	1	7.69%	53.85%
5	3	23.08%	76.93%
8	1	7.69%	84.62%
9	2	15.38%	100.00%

The mean number of online courses that students had taken was over 4 courses (mean = 4.08).

Discussion

Based on the instructor's journals and the feedback from students in response to the class evaluation, the following section will focus on the instructor's personal Web-teaching experience in the areas of online interactions and communications, students' learning and performance, online collaboration, hardware and software issues, and administrative support.

Online Interactions & Communications

I would have had more success if I had maintained a better balance of online interaction and communication with my students.

Brooks et al. (2001) pointed out that the most effective online teaching materials require active learning. The key word for active learning is interaction–the more interaction, the better (Northrup, 2001). Needless to say, interaction has become an essential component of any Web-based course (Wulff, Hanor & Bulik, 2000).

One of the greatest challenges for the instructor was to maintain a balance between the amount of time the students needed from the instructor online and the amount of time the instructor required for class management and other daily tasks both online and office. The instructor used every channel she could to interact or communicate with her students (e.g., e-mail, discussion, phone, online chatting). In order for students to receive timely feedback, the instructor spent daily office hours online so that she was able to communicate with students quickly. Although all of the students indicated in the class survey that they agreed or strongly agreed that they received timely feedback from the instructor (mean = 4.67), in general, the instructor spent about double the amount of time to facilitate the online course as compared to a traditional face-to-face course. Time management was one of the biggest challenges for the instructor in Web-teaching. Without eye contact, body language or voice inflection, online communication and interaction between the instructor and students became one of the most time-consuming tasks for the instructor.

As she delivered the course, the instructor found that students asked many of the same questions. She and a graduate assistant created weekly *mini-syllabi* during the class to provide students with more specific details on the assignments or projects to make them as clear as possible. From the class survey, the students indicated that the *mini-syllabi* gave them sufficient information to complete their weekly assignments. The instructor found the *mini-syllabi* to be beneficial to students' online learning.

I would have had more success if I had met the class once before the course started.

The first activity of the class was to have the students create their own bios. Therefore, the instructor had the opportunity to learn about the students; through the online postings, the students had the chance to get to know each other too. The information posted by the students was valuable for class management because their bios were not just about what was written, but also presented the students' use of language and attitude toward the class and online learning. However, the instructor felt there was a need for the instructor and students to have a pre-class session in which the class could meet informally in a hands-on environment using the delivery technology and learn about other classmates, course expectations, rules, and responsibilities of technical support staff. Providing the opportunity to meet in a face-to-face environment would also help the instructor and students to establish a more personal relationship. Therefore, students could feel more comfortable asking for help and wouldn't feel as "isolated" while learning online. On the class survey, one student also suggested "… at least one in-class meeting to see where everyone is in the class." The instructor believes the meeting could not only help students clarify expectations that may have been new for them, but also narrow the distance between the instructor and students and the distance among the students too.

Students' Learning and Performance

I would have had more success if I had better managed deadlines for students' assignments.

Although online courses provide learning opportunities for those who may have difficulty accessing traditional classrooms, some traditional courses and content may not be a good fit for the Web-based learning environment. As the instructor delivered the computer applications course, because of the intense work associated with this course, she found some students had some difficulty completing the assignments and meeting the deadlines. Without face-to-face communications and instant demonstrations, sometimes it was especially difficult for the instructor and students to "show" what exactly went wrong in a Web-based environment. Therefore, the instructor was forced to be more flexible in terms of deadlines in order for students to fully understand and resolve the questions they had raised. As a result, allowing flexibility of deadlines caused additional work for the instructor (e.g., follow-up with students' assignments and course delay). Responding to the flexibility of deadlines, the students' reactions were diverse. For example, some indicated, "I had no difficulty meeting deadlines," and "there was ample time to complete the assignments." Others reported, "I could only work on the assignments after I completed my full-time job" and

> My computer sometimes had problems. Other times an assignment was so detailed that if you missed one little thing the whole assignment was wrong and it was hard to backtrack and find out what happened. It was even harder for our teacher to try and figure out what went wrong to help us. Occasionally, I thought there were too many assignments and too much reading given in too short of a time to complete.

Overall, the majority of the class (92.31%) indicated the flexibility of deadlines contributed to their success in the course. From this online teaching experience, the instructor learned she has to delineate expectations and ground rules of assignments more clearly next time.

I would have had more success if I had surveyed my students' learning styles before starting.

On the survey, 38% of the students indicated they were visual learners, 31% indicated they were tactile learners, and another 31% indicated they were kinesthetic learners. Not surprisingly, people learn differently. Although most students indicated in the class survey that they felt comfortable working on the Internet, a general course design may not meet each student's learning needs, especially without eye contact, body language, or voice inflection as with face-to-face courses. Awareness of the students' various learning styles and needs can influence the choice of appropriate activities for the online environment. For example, some additional multimedia technology like a desktop recording program (e.g., Camtasia, CamStudio) could be integrated with the PowerPoint class notes for visual learners, and other audio recording could be included with hands-on activities for auditory or kinesthetic learners.

Online Collaboration

I would have had more success if I had created more online collaboration among the students.

The instructor believes that teamwork is a critical skill for students, and group projects are required for students to develop teamwork skills. Having group projects in a face-to-face class was challenging, but it was even more challenging in an online learning environment.

Palloff & Pratte (1999) pointed out that students' collaborations do not happen automatically. In order to incorporate collaborative activities into the online learning environment, the instructor must consider the characteristics of an effective engaged learning activity. During the class, the instructor assigned groups to complete their final group projects based on the guidelines provided. The students interacted with their group members through e-mail, discussion board, or chat room. While reviewing the group interaction responses in the survey, the instructor found the students' reactions were once again diverse. Some indicated, "Excellent, especially in my small group project. We became very close." However, some commented, "The students did well. I believe at one point or time everyone became frustrated," and "Ok, but not well enough to complete a group project."

The perception of interpersonal connections was an important factor in online learning. For better group interactions and project outcomes, the instructor felt the timing of online collaborative activities was important–not only when the group collaboration should occur during the course, but also the timeframe in which students would interact when conducting the online collaborative activity. Therefore, the instructor learned to group the students at the beginning of the course so that they can "talk" to each other and have enough time to develop interpersonal connections with others.

Hardware and Software Issues

I would have had more success if I had used various multimedia technologies in the online environment.

Different educators use technology differently. Using the Web in teaching requires something imaginative, new, and a good fit for the technology (Hopper, 2001). Therefore, the instructor thought that using multimedia (video, audio, etc.) could be a good idea to help the students, especially to complete more complex and difficult exercises. However, results from the class survey showed differences between the students' and the instructor's perceptions. For example, 69% of the students indicated that video examples of the more complex and difficult exercises were not an important factor in having more success in the course; conversely, 31% of the students supported the use of video examples in the class.

Instead of multimedia presentation of the content, most students seemed to care more about their home computers or necessary software at their end. Over 60% of the students agreed or strongly agreed that they would have had more success in the online course if their home computer had been newer or if they had access to a computer lab with newer equipment. Over 69% of the students agreed or strongly agreed that they would have had more success in the online course if they had understood before they registered that the Microsoft Office XP software suite was required to take this course. Although the required minimum software was indicated on the course syllabus, the students seemed very concerned about their equipment in order to perform well in the class.

Administrative Support

I would have had more success if I had asked for more administrative support and help.

McAlister et al. (2001) indicated that without administrative support "a Web-based curriculum may not get the opportunity to mature into a successful venture" (Administrative Support, p. 11). Because most of the university's online courses are offered through the Division of Continuing Education, the students had to go through Continuing Education to register for the course and receive the course information, etc.

On the class survey, almost two thirds of the students indicated that the Division of Continuing Education personnel did not provide accurate information about the course. Some of the students indicated they would have had more success in the course if they had understood prior to registration what text was required. Moreover, 53% of the students indicated that they would like to receive the text, lectures, and homework exercise files on a CD prior to the class beginning. One student suggested, "… some type of presentation be made for new online students explaining how an online course works…" The instructor learned to communicate with the Continuing Education administrative unit in order to provide better service to students for future online courses. Providing up-to-date course information (e.g., course syllabus, required software, text, lecture topics, homework, and assignments) and a checklist for students before registration would help prepare students for the class.

Conclusions

The growing pressure to use Web technology in teaching seems to force most institutions of higher education to provide converted online sections of their traditional courses to meet increasing demands. However, offering online courses can result in new challenges and issues for the administration, faculty, staff, and students. Despite the advantages and promises of distance education, a number of studies (McAlister, Rivera, & Hallam, 2001; Valentine, 2002) also revealed problems or challenges associated with distance education.

The purpose of this article was to explore some of the challenges and problems that a first-time online instructor faced while implementing an online class. In order to maintain and nurture a quality online learning environment, the instructor employed different methods and strategies to deliver instruction at a distance and continually went through a process of ongoing changes and adjustments. This article attempted to reflect the instructor's personal Web-teaching experience in the areas of online interactions and communications, students' learning and performance, online collaboration, hardware and software issues, and administrative support. Along with students' perceptions and comments indicated in the class survey, this article attempted to share information with other online educators in their efforts to be effective in developing strategies that can promote learning and help online instructors understand areas of improvement identified by students when taking online technology-based courses.

Web technology can affect how instructors teach and students learn. Teaching this Web-based course provided the instructor with a unique opportunity to teach students in a different way, and in the process experience personal growth as well. The Web is no longer merely a piece of technology; it has become one of the many educational aids teachers and students can use to make learning more effective. Despite the challenges of online courses, Web technology has become an integral part of teaching and learning within society. Although many issues challenge instructors in the Web-based teaching environment, educators who are willing to update their teaching skills can utilize a variety of options offered by Web technology to effectively promote quality teaching and learning.

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References

Brooks, D. W., Nolan, D. E., & Gallagher, S. M. (2001). *Web-Teaching: A guide to designing interactive teaching for the World Wide Web*. New York: Kluwer Academic/Plenum Publishers.

Hopper, K. B. (2001). Is the internet a classroom? *TechTrends*, *45*(5), 35-43.

Koszalka, T. F., & Bianco, M. B. (2001). Reflecting on the instructional design of distance education for learners: Learning from the instructors. *The Quarterly Review of Distance Education, 2*, 59-70.

Loveless, T. (1996). Why aren't computers used more in schools? *Educational Policy, 10*(4), 448-467.

McAlister, M. K., Rivera , J. C., & Hallam, S. F. (2001). Twelve important questions to answer before you offer a web based curriculum [Electronic version]. *Online Journal of Distance Learning Administration, 4*(2).

Miller, W. W., & Webster, J. (1997). *A comparison of interaction needs and performance of distance learners in synchronous and asynchronous classes.* Paper presented at the American Vocational Association Convention, Las Vegas, NV. (ERIC Dcoument Reproduction Service No. ED415411)

Northrup, P. (2001). A framework for designing interactivity into Web-based instruction. *Educational Technology*, March-April, 31- 39.

Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace*. San Francisco: Jossey-Bass.

Perrin, K. M., & Mayhew, D. (2000). The reality of designing and implementing an Internet-based course. *Online Journal of Distance Learning Administration, 3*(4). Retrieved April 11, 2003, from http://www.westga.edu/~distance/ojdla/winter34/mayhew34.html

Valentine, D. (2002). Distance learning: Promises, problems, and possibilities [Electronic version]. *Online Journal of Distance Learning Administration, 5*(3).

Wulff, S., Hanor, J., & Bulik, R. J. (2000). The roles and interrelationships of presence, reflection, and self-directed learning in effective World Wide Web-based pedagogy. In R. A. Cole (Ed.), *Issues in web-based pedagogy: A critical primer* (pp. 143-160). Westport, CT: Greenwood Press.

Zhao, Y. (1998). Design for adoption: The development of an integrated Web-based education environment. *Journal of Research on Computing in Education, 30*(3), 307-28.

Question 1
The Division of Continuing Education provided timely registration.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 2
I would have had more success in this online course if my home computer had been newer or if I had access to a computer laboratory with newer equipment near my home.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 3
I would have had more success in this online course if the following information had been posted about the course prior to my registration:
Answer

Question 4
The course syllabus gave me sufficient information to understand what would be expected of my performance in this online course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 5
The weekly mini-syllabi gave me sufficient information to complete the weekly assignments.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 6
I would have been able to learn the section exercises more easily if I had been in a traditional classroom setting rather than in an online course
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 7
The flexibility of deadlines contributed to my success in this course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 8
I would have had more success in this course if there had been video examples of the more complex and difficult exercises.
[ ] 1. Strongly Disagree[ ] 2. Disagree[ ] 3. Undecided[ ] 4. Agree[ ] 5. Strongly Agree

Question 9
The flexibility of deadlines was confusing and interfered with my success in this course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Question 10
I had difficultly meeting the assignment deadlines because:
Answer:

Question 11
The Division of Continuing Education personnel provided accurate information about this course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 12
I received timely feedback from the instructor in this online course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 13
I wanted more support from the instructor, such as:
Answer

Question 14
The quiz exercises were a better test of my skills than answering multiple choice questions.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 15
How many online courses have you participated in? Including this one:
Answer

Question 16
In comparison to other online courses I have taken, this course ranks:
[ ] 1. Better than other online courses I've taken, [ ] 2. I can't compare, this is the only online course I have taken, [ ] 3. No difference, equal to the other online courses, [ ] 4. Poorer than other online courses I've taken

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Question 17
I would recommend my friends take this online course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 18
I would take another online course with these instructors.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 19
I would describe myself as:
[ ] 1. Self-motivated, having no problem working alone, [ ] 2. Needing more guidance to perform to my potential, [ ] 3. Learning to be more motivated but not as disciplined as I would like to be, [ ] 4. Uneasy about "performing" without immediate classroom feedback.

Question 20
I am comfortable working on the internet in an online course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 21
My attitude about online courses would best be described as:
Answer

Question 22
I would have had a better understanding of the expectations of this online course if I had been able to see the Syllabus PRIOR to registration.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 23
My learning style is:
[ ] 1. Visual – I try to "see" the information, [ ] 2. Auditory – I sound out information, [ ] 3. Tactile – I often use the terms feel, touch and hold, [ ] 4. Kinesthetic – I prefer to jump right in and try things without instructions

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Question 24
The best thing about this online course was:
Answer

Question 25
The worst thing about this online course was:
Answer

Question 26
What information about this course would you have preferred be posted on the website which would have helped you make a better decision about taking this course online or taking it in a traditional classroom?
Answer

Question 27
What information or actions would have made your experience in this online course better?
Answer

Question 28
My expectations about this online course before taking this course were different from what actually occurred in the following ways:
Answer

Question 29
How would you describe the interaction between the students in this online course?
Answer

Question 30
How would you describe the interaction between the students and the instructor in this online course?
Answer

Question 31
What influenced you to take this course online rather than in a traditional classroom?
Answer

Question 32
I would have had more success in this course if I had understood that Microsoft Office XP Professional version software was REQUIRED to take this course before I registered.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 33
I would have had more success in this course if I had understood what text was required PRIOR to registration.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 34
I would have more success in this course if I had understood how much lead time was required to purchase and receive the text and software BEFORE class began.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 35
I would have had more success in this course if the course began the first day or, at latest, by the 3rd day of classes.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 36
I would have had more success in this online course if I had understood how much time was required to perform "A" level work in an online course.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 37
I would have had more success in this course if I had received the text prior to the first day of class and the PowerPoint lectures and homework exercise files had been sent to me on CD prior to the class beginning.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

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Question 38
I was able to meet most of the assignment deadlines.
[ ] 1. Strongly Disagree, [ ] 2. Disagree, [ ] 3. Undecided, [ ] 4. Agree, [ ] 5. Strongly Agree

Clicking Toward Development: Understanding the Role of ICTs for Civil Society

Evan S. Michelson

Abstract

The purpose of this article is to analyze, discuss, and assess some of the competing viewpoints and factors regarding the role of new information and communication technologies (ICTs) within civil society. By outlining the various actions that civil society organizations (CSOs) need to take in order to maximize the positive impacts and mitigate the negative consequences that these revolutionary technologies will bring, it will become clear that the employment and utilization of ICTs by civil society has yet to reach an optimal point. However, over the next few decades, while these technologies will inevitably come to transform the development landscape, the hope is that CSOs will fully integrate ICTs into the development process and will come do so with realistic expectations. By adopting an ICT "plan of action," CSOs could better harness the power of these new technologies and, in turn, will be able to more successfully apply them towards the promotion of improved human development.

Introduction: A Light in the Dark?

It should not be surprising that over the past few years a certain number of civil society organizations (CSOs) may have begun to feel as if their long, arduous, uphill battle for making inroads toward improving the lives of individuals in developing countries was being given an unexpected, yet invaluable, boost. With the advent of new information and communication technologies (ICTs)—including personal, networked computers, mobile telephones, fiber optic cables, the Internet, and email—CSOs could not help but think that the general worldwide information, communication, and knowledge revolution would come to trickle down and positively affect the specific goals they were trying to accomplish in the realm of human development. This optimism compelled CSOs to design their own websites, make policy documents available on-line, and initiate the formation of virtual communities—constituted by individuals with similar interests—by way of email and chat rooms. Additionally, the excitement over the potential uses of ICTs encouraged CSOs to integrate these technologies into the fabric of development programs and projects as well. Not only would it become *de rigueur* to provide poor, rural communities with computer workstations and laptops, but the power of connectivity led to the hope that solutions to the problems of poverty, poor health education, and lack of political involvement might just be a few clicks away.

Nevertheless, over the very same time span, this rosy picture has sobered quite a bit. CSOs, and, more importantly donors, have begun to understand that the mere provision of a few iMacs and Dell laptops cannot undo years of marginalization and oppression. In some areas, it is difficult enough to predict when the electricity and power will function, let alone when a high-speed cable modem connection will be installed. Moreover, the potential of using ICTs in political activism—an application that was supposed to act as the "great equalizer" for those individuals previously unable to participate in government and, therefore, usher in a new wave of democracy—has yet to be fully realized. In fact, as Leslie David Simon (2002a) notes in his introduction to *Democracy and the Internet*, some authoritarian governments, such as those formerly in Afghanistan and Iraq, are working to restrict the use of these technologies, thereby suppressing democratic movements and reasserting their power to block civil society's employment of ICTs in promoting free speech and political involvement. Simon describes how these governments have engaged in a number of subterfuge attempts, including a wholesale banning of the Internet, the filtering and censorship of on-line material, requiring the registration of websites, regulating encryption devices, and even criminalizing certain kinds of Internet or email use.[1] The point here is that a number of unintended, negative consequences, along with a number of undesirable barriers, have arisen that have hindered the use of ICTs by CSOs and have come to force a reconceptualization of how these new technologies fit into future development schemes.

Because of these growing concerns, the purpose of this article is to analyze, discuss, assess, and clarify competing viewpoints and factors regarding the role of ICTs within civil society and to determine various actions that CSOs might be able to take that will mitigate some of the negative consequences that I have started to sketch out above. To start, I will begin by detailing the reasons why ICTs became so attractive to civil society actors in the first place and to evaluate some of the more positive and useful aspects of ICTs for improving human development. Second, I will consider the real pitfalls that have blocked civil society's ability to capture some of the advantages of ICTs and, in turn, have come to reduce their potential for improving development projects and programs. Finally, I will lay out an ICT "plan of action" for civil society and propose a variety of measures that should be undertaken so that additional benefits from these new technologies can be realized. Though I will draw upon a number of examples, I will focus mostly on how these new capabilities affect political involvement, local participation in government, and the push for democracy around the world. In the end, it will become clear that the employment and utilization of ICTs by civil society has yet to reach an optimal point, and it remains to be seen how a number of key variables and unknowns will mature and play themselves out in the coming years.

Potential Salvation: How ICTs Could Rescue the Developing World

The rise of ICTs has come to herald a new kind of world, a world in which individuals, companies, communities, and governments can become instantaneously, immediately, and directly linked to other individuals, companies, communities, and governments anywhere around the globe. Lying at the heart of globalization, ICTs can be broadly viewed and defined as facilitating "by electronic means the creation, storage, management and dissemination of information." [2] While, strictly speaking, the overall notion of ICTs does include older, more traditional forms of communication—television, radio, faxes, newspapers, and magazines—that have existed throughout most of the 20th century, the meaning of the term has changed and has begun to relate, more specifically, to the various kinds of new, "high" technologies that I listed earlier. Admittedly, as new technologies and modes of communication arise, the characterization of what is considered to be a progressive, advanced, and cutting-edge form of ICT will inevitably change, thereby requiring a continual updating regarding how this term is understood.

At first glance, what is so alluring about the mainstreaming of these modes of gathering and distributing information for civil society is that these technologies appear to emphasize and demonstrate a number of traits and values that mesh well with the development process. Along these lines, a report produced by the Digital Opportunity Initiative (DOI), which is sponsored by the United Nations Development Programme, notes that "ICT can be a powerful enabler of development goals because its unique characteristics dramatically improve communication and the exchange of information to strengthen and create new social and economic networks." [3] Evidently, one of the most central qualities that can bring ICTs inline with certain development goals is the notion that ICTs are "pervasive and cross-cutting," and, therefore, that they "can be applied to the full range of human activity… allowing for tailored solutions—based on personalization and localization—to meet diverse needs." [4] In short, the very idea that ICTs, and, in particular, the Internet and email, can be used for a number of functions—ranging from reading daily news stories to communicating with family members to distance learning—implies that developing communities and nations can have nearly instant, all-encompassing access to any kind of information they might ever want.

It is this ability to enter a flexible network of information and knowledge dissemination that was, and still remains, so encouraging to many members of civil society. In her paper "The Development Divide in a Digital Age," Cynthia Hewitt de Alcántara (2001) mentions possibilities that might interest CSOs: for example, she notes that mobile phones can allow for "minute-by-minute monitoring of local elections," thereby leading to the gathering of information that can then be reported over the radio and, in turn, make "a significant difference in the transparency of electoral processes." [5] Moreover, she demonstrates that certain technologies, including satellite television, voice over the Internet, and digital radio, have expanded "the range of programming available to inhabitants of countries whose governments, until recently, could limit television reception to a few state-run channels." [6] Furthermore, the DOI report describes similar potentials for knowledge sharing and dissemination in the realms of health, education, and economics, including the ability of local doctors to receive disease diagnosis and treatment advice on-line from experts in other countries, the ability of local teachers to receive technical and vocational training remotely, and the ability of local businesses to receive information regarding market conditions and best business practices by way of list-servs and electronic updates. Put together, all of these opportunities have led to a declaration by CSOs at the World Summit on the Information Society (WSIS), which notes that "we are conscious that information, knowledge and the means of communication [for developing nations] are available on a magnitude that humankind has never dreamt of in the past." [7]

In particular, ICTs have helped local communities and populations participate in government and become more active in pushing for political change. For instance, with respect to direct participation in democracy, Simon (2002a) claims in "Democracy and the Net" that a number of governments are "putting their voting systems online and permitting citizens to communicate directly with legislators." [8] He illustrates this point with the example of Costa Rica, which is attempting to reach 100% voter turnout by offering on-line balloting by way of computers based in the nation's various schools. Moreover, in addition to allowing CSOs and local citizens to vote, monitor elections, and procure timely news items, Simon also notes that these technologies can allow a government to become more involved with its citizens. In short, Simon claims that "the Net has the power to change the way governments operate—forcing them to become more democratic [and responsible] in the process." [9] For example, as more and more government documents and proceedings are placed on-line, information regarding how the government works is being "made more easily available to citizens," thereby implying that it "does not have to pass through the filter of a civil servant," which, in turn, reduces the risk that such data could be altered or deleted by a corrupt official. [10]

The increased presence of ICTs in the developing world has also initiated a significant trend toward coalition building among CSOs and individuals, on both domestic and international levels. For instance, consider the Kubatana Project of Zimbabwe, which supports "a website portal that provides Zimbabwean civil society organizations with an online presence and a platform to voice their concerns about human rights abuses in their country." [11] Even though all of the participating CSOs are located within Zimbabwe, without the use of ICTs, these disparate, yet ideologically connected, groups would have had little chance of working together, pooling their strengths, and uniting under a common cause. Since the website is hosted outside of the country, www.kubatana.net has allowed over 200 Zimbabwean CSOs to bypass government control of the media and, subsequently, has provided timely and accurate information about the state of human rights abuses in Zimbabwe by way of fact sheets, website links, and even the posting of the diaries of political prisoners.

Along these lines, in "Lessons from Latin America," Javier Corrales (2002) describes how informal social movements banded together by way of e-petitions and web-based networking during the financial crisis in Argentina in 2001-2002. Corrales notes that "when the [Argentine] government froze bank deposits, hundreds of neighborhood assemblies (*asambles barriales*) emerged in protest. They created their own website (www.cacerolazo.com), which allowed approximately 180 assemblies to coordinate their activities and post their demands." [12] Apparently, this effort was so successful that city officials in Buenos Aires received, and responded, to nearly four hundred emails a day, all of which complained about or demanded the restoration of a previously canceled service.

Similarly, on an international level, by allowing individuals and groups to communicate with increasing ease across national lines, ICTs are breaking down geographical boundaries and spawning transborder coalitions that can unite under a common, mutual cause. In short, ICTs are able to link different individuals and communities around the world to one another, individuals and communities sharing similar mindsets, beliefs, and value systems. Specifically, the DOI report reinforces this point that new methods of communication will continue to allow democratically inclined CSOs to begin working under a broader perspective and to undertake a more global approach with respect to advocating for democracy, free speech, and human rights. In this regard, DOI claims that "ICT can transcend cultural and linguistic barriers by providing individuals and groups the ability" to integrate their activities with each other and, therefore, coordinate more targeted responses against tyrannical or repressive regimes. [13]

Pippa Norris (2004), in "Giving Voice to the Voiceless," supports this notion that "the rise of the Internet may be a particularly important development for the process of democratization" worldwide. [14] In other words, she claims that in "breaking down the traditional boundaries of space and time," CSOs are able to mobilize ICTs and use them to bring about a diverse range of "oppositional voices, new social movements, and transnational advocacy networks." [15] One well-known use of ICTs in this fashion is how antiglobalization activists around the world were able to coordinate, manage, and plan protests and demonstrations against the World Trade Organization during their meetings in Seattle in 1999 by way of mobile phone text messaging systems. Additionally, Corrales (2002) describes a similar situation by which the labor leaders of the Chiapas rebellion in Mexico have created an international coalition that "routinely conducts e-mail campaigns against [foreign] employers and government agencies" that support companies contributing to the degradation of workers' quality of life in that country. [16] Finally, Hewitt de Alcántara describes how ICTs, by way of on-line videos and chat room discussions, can be used simply to garner support and raise international consciousness about human rights abuses in countries such as China, Myanmar (Burma), and Saudi Arabia. [17]

Overall, it should not be surprising that, ever increasingly, CSOs are encouraged to employ ICTs in some form, whether it be maintaining and preserving international advocacy coalitions, registering complaints with local officials, or participating in democratic change. By opening civic discourse to a wider population and providing transparent, unencumbered access to the inner workings of government, ICTs have assisted in transforming the way previously voiceless, marginalized groups and individuals have come to speak out in support of their own rights and demands. Specifically, the Internet's openness, pervasiveness, and ability to create social networks has allowed, and will continue to allow, for the possibility of achieving human, economic, and political development at an ever-increasingly rapid, quickened pace. However, as I will discuss below, the shining promise of ICTs to reach such staggering heights has been tempered in recent years by a number of factors, factors that are inherent not just to ICTs themselves but to the development process as a whole.

Blocking the Path: Barring the Way for ICTs in Development

"The world's poorest two billion people desperately need healthcare, not laptops." [18]
Bill Gates

As the above quotation from Bill Gates demonstrates, it is too simplistic to believe that ICTs will solve all of the problems in the developing world. In fact, while providing an individual with access to a website or an email account might go a long way in raising them out of poverty, supplying them with good health, and helping them choose their governmental representatives, it remains the case that a significant fraction of the world's population does not have the opportunity to engage with and utilize these new forms of technology *at all*. Recent statistics regarding worldwide Internet use depict that this technology has only penetrated 11.5% of the total population, with the majority of users located in North America, Europe, East Asia, Australia, and New Zealand. [19] In Africa, barely 1% of the population has access to the Internet, and while Internet access has grown the fastest in Latin America, the Caribbean, and the Middle East, these regions account only for about 9% of worldwide Internet users. [20]

These indicators demonstrate that the development divide between the North and the South is being matched—and, in many cases, exacerbated by—a similar digital divide. As the Civil Society Declaration of the WSIS notes, these "new asymmetries" are being mapped onto "the existing grid of social divides," including "the divide between the North and South, rich and poor, men and women, urban and rural populations," and, most important in the case of ICTs, "those with access to information and those without." [21] In short, even as ICTs become more pervasive, open, and easily accessible, "the vast majority of humankind has no access to the public domain of global knowledge, a situation that is contributing to the growth of inequality and exploitation of the poorest peoples and communities." [22] Throughout this section, I will analyze a number of reasons for this increasingly severe digital divide, and it will turn out that, not surprisingly, many of these rationales relate, once again, directly to broader issues pertaining to human development.

To start, it should be noted that a main reason why ICTs have yet to reach their full potential for assisting in development is that the infrastructure for their use in developing countries is either weak or nonexistent. As I mentioned earlier, most communities lack access to a power supply for simple telephone calls, let alone for a high-speed internet connection. Impoverished individuals can barely afford to buy enough food for their own sustenance, let alone a computer or personal digital assistant. Moreover, even if a village *does* possess a communal laptop or mobile phone, many individuals do not have enough education or training regarding how to use these technologies, let alone have the time to engage with these devices if this means skipping work, missing a day of harvest, or ignoring a sick family member.

As a report by Robert Curtain (2004) for the Australian Agency for International Development contends, this problem remains pressing when one begins to focus on how organizations—let alone individuals—that are based in developing countries use ICTs. He points out that even Southern CSOs are rarely able to access these kinds of technologies for their own organizational needs. In turn, this inability for organizations in the developing world to engage effectively with ICTs comes to handcuff the ability of CSOs in the developed world to employ these technologies, even though Northern-based organizations generally have access to as many variations of technology as they wish. In fact, Curtain notes that the "main reasons given by development agencies for low use of ICT by agencies in developing countries" range from the somewhat simple, including "lack of equipment, poor infrastructure and limited access to Internet services," to the complex, including constraints of gender roles, rigid managerial control over ICT access, and inhibitions about … written … communication." [23]

As Curtain identifies, it can be difficult enough for individuals, CSOs, governments, and corporations from developed countries to use ICTs—where issues such as reliable power supplies, infrastructure robustness, and social constraints are less pressing—let alone in developing countries, where these more basic, fundamental concerns are chronic and ever-present.

Clearly, these technical obstacles that arise in developing countries can greatly affect the success or failure of a civil society initiative aimed at using ICTs for the purpose of political activism or participation in government. For example, even though the Kubatana project appears to have effectively helped CSOs in Zimbabwe organize and coordinate a response to the government's human rights abuses, it is unclear how much voice and impact such a project could have internally, within the country, when barely 3.5% of the Zimbabwean population has Internet access, let alone the fact that political pressure and lack of suitable infrastructure requires that the website be hosted in a more developed nation. [24] Similarly, while the Cacerolazo project in Argentina appears to have pressed the government to respond to individual concerns and demands, that the Internet has penetrated only 10.9% of the Argentine population implies that there are a number of groups and individuals that cannot participate, even if participation only means the sending of an email or the logging of an on-line complaint. [25]

In addition, these numbers mask the trend that only those financially well-off in a country have access to ICT sources, thereby further indicating that already impoverished, marginalized individuals and communities are shut out of the benefits of these new technologies. As Peter Levine (2000) argues in "The Internet and Civil Society," "People cannot use computers [and ICT in general] effectively unless they have money, skills," and other capabilities that lie at the foundations of human development. [26]

In addition to these structural barriers blocking an enhanced position for ICTs in helping to achieve improved development, there are additional ideological critiques that question whether these new technologies and modes of communication are really able to strengthen democracy and improve local political participation. One argument is put forth by the Platform for Communication Rights, "an umbrella group of international nongovernmental organizations and local networks active in media and communications," who contend that the growth of ICTs within an increasingly interconnected, worldwide "information society" are just "another invention of the globalization needs of capital and their supporting governments." [27] This organization has initiated a campaign, entitled Communication Rights in the Information Society (CRIS), in support of the notion that current attempts to spread ICTs and employ them as a central aspect in the development process is simply "window-dressing on the most recent drive to impose a neo-liberal model of communication in every corner of the globe, …

driven by the needs of transnational corporations with little more than lip service to real human needs and ever-growing inequities." [28]

While CRIS's point is that the push for employing ICTs in development should be viewed as just another seductive method for international conglomerates and their respective governments to further co-opt, control, and deepen the already stark development divide, I am not fully convinced that the exacerbation of the power dynamic between the "haves" and the "have-nots" is the only way ICT involvement in development will play itself out. Clearly, there are a number of corporate and national Goliaths that have, do, and will continue to use ICTs for means of repression and subversion. As mentioned earlier, governments have, do, and will continue to try to ban the Internet or restrict communication with the outside world and, evidently, a number of transnational corporations will resist lowering their prices to help developing communities enjoy the benefits of ICTs, let alone loosen their financial and legal claims to copyrighted and patented material. However, I argue, as the examples of Kubatana, Cacerolazo, and the Chiapas rebellion have demonstrated, that there is at least *some* "leveling" and equalizing aspect inherent to ICTs, the nature of which will make it increasingly difficult for these corporate and governmental forces to co-opt social and political resistance and participatory movements in the future. Admittedly, it is unclear whether ICTs will ever have the ability to make the Davids of the world *fully* and *completely* equal to the Goliaths, but I claim that, to a certain degree, these technologies have slowly begun to help initiate this evening-out process.

However, one of the more subtle and prescient critiques arising out of CRIS's position is the notion that, in many cases, civil society incorrectly views these new technologies "as ends in themselves rather than as enabling tools." [29] Again, the idea here is that ICTs should rightly be deemed as *tools* to help the development process and *not* as the end state or goal. In other words, ICTs should be regarded as ways of helping people attain health, money, education, and democracy and not as the overriding purpose of a program or project that then comes to subsume these more vital and essential objectives.

Clearly, it could be quite easy for civil society to fall into this trap of mistaking means with ends. For instance, a project that provides twenty computers for a village with the hope that these machines will reform the lives of the individual inhabitants is bound to fail if more foundational issues, such as transportation access to the center of town, personal security, and basic energy infrastructure, are not addressed as well. The difficulty is that the products of ICTs—computers, mobile phones, and even fax machines and copiers—can be used to provide attractive, alluring photography and publicity opportunities for donors without truly addressing more substantial, long-term problems. These material objects will be able to accomplish little if other issues in development are not addressed in conjunction, issues concerning whether individuals will be able to read or write, whether women will be allowed to use the equipment, and whether regular maintenance will be performed.

From personal experience, while working in a science education outreach project in rural, poor parts of South Africa, I witnessed many situations along these lines. In multiple schools, there were a number of locked storage closets filled with computer hard drives, monitors, and keyboards, all of which were products of some donor's desire to "connect" these institutions to the world at large. However, it was clear that a number of underlying factors were never considered. First, power irregularities in most schools ensured that not even the main, land-line telephones could work. Second, the machines themselves had broken down, and many were either outdated or unfixable. Third, the keyboards and printed instructions were presented solely in English, even though the students mainly spoke Afrikaans, Zulu, or Xhosa. Finally, and most telling, the main reason the hardware was kept locked away is that the teachers were worried that if the computers were left to remain unattended in the classrooms, then they would probably be stolen, damaged, or vandalized.

However, even if CSO projects and programs correctly find a way to use ICTs as tools in the development process, there remains a final barrier working to offset the possible positive impacts of ICTs in development. The complaint here is that these technologies reduce the incentive for individuals and communities to form strong social ties and, therefore, fail to encourage individuals to work together and strive for a common goal. While ICTs can help bridge geographical gaps and bring individuals and communities struggling for similar freedoms and possessing similar interests into contact with one another, Levine (2000) offers the counter-argument that ICTs might actually "replace robust, durable, and emotionally satisfying social bonds with superficial and contingent ones." [30] Levine contends that when engaging with ICTs, "we can withhold practically all information about ourselves…we can break off contact at will…and we can shield ourselves from the consequences of what we say," all of which distort one's ability to enter into satisfying relationships with other individuals and may weaken any sense of commonality and togetherness. [31]

If such an assessment holds, civil society's ability to effectively use ICTs to promote good governance and democratic change might be diminished, primarily because such an argument implies that community and capacity building are weakened by the presence of these new technologies. For example, if a CSO is trying to bring about a greater understanding of cultural differences and similarities in an ethnically diverse society, then an incessant reliance on ICTs by way of shared websites and chat groups might actually work *against* the stated goals since the use of these technologies might block the formation of strong interethnic ties. The idea here is that ICTs might not really promote social connection but that they simply create weak, fragile, and quite tenuous bonds that could splinter in times of great stress or duress. With respect to the Cacerolazo project in Argentina, one could argue that if the only outcry the city government of Buenos Aires received during the financial crisis was in the form of email, then it is quite conceivable that officials could simply delete most of these messages and ignore their content. Along these lines, ICTs might actually encourage governments to distance themselves from truly interacting with their citizens, especially since these technological links might only be able to generate superficial, digitally contingent relationships.

I admit that determining the validity of such an argument is challenging. Some might assert that if the best kind of connections CSOs can hope to create in these days of mass electronic communication are superficial, digitally contingent relationships, then perhaps the whole system needs to be dumped and our priorities need to be reevaluated. On the other hand, some might contend that these Internet and email links are better than nothing and should be pursued, regardless of the downfalls. Personally, I am still uncertain regarding how this debate will be settled, especially because it remains to be seen whether ICTs actually strengthen social ties, by encouraging previously unconnected individuals and communities to learn about one other, or weakens social ties, by allowing disinterested citizens or officials to exit any form of public discourse by simply clicking-off and shutting-down.

However, I do support the notion that ICTs alone cannot do the development trick. At some level, real interpersonal engagement by way of human-to-human interaction is necessary to address the development divide, which, in turn, will go a long way in addressing the digital divide. I contend that when making evaluations regarding the appropriateness of new technologies in the context of development, civil society must move away from the dogmatic extremes: while ICTs might not be magic potions to cure all of the world's ills, they are not pointless, useless enterprises that can be easily dismissed. Instead, I argue that ICTs as a group should be recognized as highly-valuable, though still highly-flawed, tools for achieving certain development goals, and, therefore, they must be critically analyzed so that their positive and negative traits can be teased out and better understood.

Changing the Landscape: What Should Civil Society Do?

Though I have already described a number of the benefits and pitfalls of using ICTs in development, there appear to be a few areas that civil society is capable of addressing so that improvements can be made in how these technologies are applied in the future. Obviously, the following "plan of action" is not a complete, comprehensive list, nor is it the case that these suggestions remain unproblematic. However, the ensuing recommendations could hopefully help civil society prioritize its actions and identify key areas of concern.

First, CSOs need to help improve and build basic technology infrastructure in developing countries prior to introducing high-speed, cutting-edge versions of ICTs to these regions. Simon (2002b) notes that this type of foundational development requires considerations as diverse as "training for professionals," developing "applications in critical areas such as health care, job placement, and food distribution," and providing "funding and expertise to build test-beds for public access systems." [32] To be sure, this advice might require CSOs to re-evaluate their already existing strategies and, quite possibly, lead them to understand that it might be beneficial, in a certain case, to help establish energy grids or basic telephone capabilities prior to a DSL Internet connection. Clearly, though a renewed focus on "the basics" of technology might imply that CSOs cannot move ahead with certain kinds of projects as quickly as they would like, it does mean that whatever technologies *are* employed will rest on a solid, stable infrastructure and, hopefully, will be sustainable and built to last over the long term.

A second role for CSOs in the realm of technology access in the developing world is to become involved, as Hewitt de Alcántara (2001) notes, in "international policy forums that play a major role in determining the likelihood that low-income countries and disadvantaged groups can use ICTs effectively." [33] In particular, CSOs need to fight the growing tendency in the developed world to comprehensively copyright and patent protect information, thereby blocking the free and open use of such innovations in lower income, less technologically advanced regions of the world. As the CRIS campaign argues, civil society needs to exert pressure "at local levels to ensure that IPR [intellectual property regime] legislations respond to social and cultural needs." [34] In addition, CSOs need to ensure that the traditional, indigenous knowledge present in developing communities is not somehow sold-off and copyrighted, thereby reassuring that this cultural heritage cannot be taken away and removed from the public domain. The hope is that CSOs—in addition to working with the World Trade Organization, the International Telecommunications Union, and the World Intellectual Property Organization to reform technology trade regulations, redistribute world-wide telephone revenues, and better organize the digital spectrum, respectively—will also be able to "nurture and promote *development-friendly* approaches to intellectual creativity, e.g., open source, copyleft, and collective ownership." [35]

Third, I contend that in order to reap the full benefits of ICTs in development, CSOs, even those from the developed North, need to become more ICT-literate themselves. This suggestion implies that a significant transformation in organizational culture needs to occur so that CSOs—which, historically, might have shied away from or have been afraid of using these technologies—are no longer intimidated by their presence. In his study on how CSOs attempt to capture the advantages of ICTs, Curtain (2004) discovered that while 90% of the organizations he consulted used email as a major form of communication, "only a . . . minority of the respondent organizations (10%) were making use of a database management application such as financial management software." [36] The point here is that if CSOs are not comfortable employing new forms of communication services, such as video conferencing and electronic newsgroups, internally, then it will be quite challenging for CSOs to promote the use of ICTs in developing communities. Along these lines, CSOs should ensure that their websites are not forums merely used for displaying basic contact information and their mission statements. Instead, CSOs must make certain that these Internet portals become truly interactive experiences, allowing the external world to post comments, access policy documents, and link to other information sites. Only such an improved, internal shift in thinking within CSOs of the developed world will allow for an associated improved, external shift in how these organizations are able to utilize ICTs in the developing world.

Finally, CSOs need to apply political pressure on the leaders of less democratic nations and advocate for the removal of heavy-handed government control and oversight of ICTs. As Norris (2004) claims, whether it be arguing in favor of freedom of the press or supporting the breakup of government-owned communication monopolies, CSOs need to help guarantee that populations in the developing world are offered "widespread access to the mass media" and that excessive legislative oversight of ICTs is not allowed to "reinforce the control of powerful interests and governing authorities." [37] Simon (2006) supports the notion that CSOs undertake an even stronger social advocacy role in this area and, in turn, help to "raise the international temperature to protect free expression and the natural openness of the global Net." [38] Though certain governments have and will continue to try to restrain Internet access, monitor email communication, and restrict chat-room use, CSOs must become committed to incorporating support for such deregulation into their wider mandate of promoting democracy and combating the oppression of free speech.

In conclusion, though I have analyzed the positive and negative aspects of various ICTs and weighed their promises versus their drawbacks, I still assert that these new technologies will inevitably transform the landscape of development in unknown ways over the next few decades. The idea here is that, hopefully, CSOs will come to not only use ICTs to help foster democracy but that they will do so with realistic expectations. However, the only way such a sensible, practical path can be chosen is if CSOs are wary of the critique that the means, the technologies themselves, cannot and must not be confused with the end state, namely, human development. What is so intriguing is that even newer, as-of-yet unknown varieties of ICTs may come along and offer currently inconceivable possibilities for the developing world. In turn, successive generations of these technologies may carry with them the ability to bridge the existing digital, development divide even quicker than we could ever hope for now. CSOs will play a critical role in helping us move in the direction of such a promising future. Even though, as a Michael Edwards (2004) notes in his book *Civil Society*, "the rapid expansion in access to information technology [by civil society]…has not yet been [fully] translated into the development of public spheres committed to resolving social and economic problems across societies," I argue that evolution in this direction has already begun.[39] In the end, the hope is that CSOs, by adopting some kind of ICT "plan of action," will be able to harness the power of these new technologies and, in turn, will be able to apply them toward the promotion of superior international human development.

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References

The Association for Progressive Communications and the Communication Rights in the Information Society, (2003) *Involving ICT in Civil Society: World Summit on the Information Society,* available at http://www.apc.org/books/policy_wsis_EN.pdf, September 2003, accessed April 17, 2004, pp. 39-40.

Bridges.org, (2004)"The Kubatana Project of Zimbabwe: Case Study Series on ICT-enable Development," available at http://www.bridges.org/iicd_casestudies/kubatana/index.html, accessed April 19, 2004.

Civil Society Declaration to the World Summit on the Information Society, (2003) "Shaping Information Societies for Human Needs," available at http://www.wsis2005.org/wsis/documents/summit/WSIS-CS-Decl-25-2-04-en.pdf, World Summit on the Information Society, Geneva, Switzerland, December 8, 2003, accessed April 20, 2004.

Corrales, J. (2002) "Lessons from Latin America," in Simon, Leslie David, *Democracy and the Internet: Allies or Adversaries?* Washington, D.C.: Woodrow Wilson Center Press, pp.30-66.

Curtain, R. (2004) "Information and Communications Technologies: Help or Hindrance?" available at http://www.developmentgateway.com.au/pdf/ict/CurtainICT4DJan04.pdf, Australian Development Gateway, January 13, 2004, accessed on April 19, 2004, p. 11.

de Alcántara, C.H. (2001) "The Development Divide in a Digital Age: An Issues Paper," available at http://www.unrisd.org/80256B3C005BCCF9/httpNetITFramePDF?ReadForm&parentunid=19B0B342A4F1CF5B80256B5E0036D99F&parentdoctype=paper&netitpath=80256B3C005BCCF9/(httpAuxPages)/19B0B342A4F1CF5B80256B5E0036D99F/$file/hewitt.pdf, Technology, Business, and Society Programme Paper Number 4, United Nations Research Institute for Social Development, August 2001, accessed April 21, 2004.

Digital Opportunity Initiative, (2001) "Creating a Development Dynamic," available at http://www.opt-init.org/framework/DOI-Final-Report.pdf, July 2001, accessed April 19, 2004.

Edwards, M. (2004) *Civil Society*, Cambridge, UK: Polity Press.

Helmore E. and McKie, R. (2000) "Gates Loses Faith in Computers," available at *The Observer Online*, http://observer.guardian.co.uk/print/0,3858,4086462-102275,00.html, published November 5, 2000, accessed April 22, 2004.

"Internet Usage Stats: The Big Picture," Internet World Stats: Usage and Population Statistics, (2004) available at http://www.internetworldstats.com/stats.htm, accessed April 18, 2004.

"Internet Usage Stats for Africa," Internet World Stats: Usages and Population Statistics, available at http://www.internetworldstats.com/stats1.htm, accessed April 18, 2004, p. 1.

"Internet Usage in South America," Internet World Stats: Usage and Population Statistics, available at, http://www.internetworldstats.com/stats2.htm#south, accessed April 18, 2004, p. 1.

Levine, P. (2000) "The Internet and Civil Society," in *Report from the Institute for Philosophy & Public Policy*, University of Maryland, 20 (4): 1-8.

Norris, P. (2004) "Giving Voice to the Voiceless: Good Governance, Human Development, & Mass Communication," available at http://ksghome.harvard.edu/~.pnorris.shorenstein.ksg/Acrobat/Pfetsch%20chapter.pdf, February 16, 2004, accessed April 21, 2004, p. 4.

Simon, L. D. (2002a) "Preface," in Simon, Leslie David, *Democracy and the Internet: Allies or Adversaries?* Washington, D.C.: Woodrow Wilson Center Press, pp. vii-xii.

Simon, L.D. (2002b) "Conclusion," in Simon, Leslie David, *Democracy and the Internet: Allies or Adversaries?* Washington, D.C.: Woodrow Wilson Center Press, pp. 96-102.

Notes

1 Leslie David Simon, "Preface," in Simon, Leslie David, *Democracy and the Internet: Allies or Adversaries?* Woodrow Wilson Center Press: Washington, D.C., 2002, pp. vii-xii, p. viii.

2 Richard Curtain, "Information and Communications Technologies: Help or Hindrance?" available at http://www.developmentgateway.com.au/pdf/ict/CurtainICT4DJan04.pdf, Australian Development Gateway, January 13, 2004, accessed on April 19, 2004, p. 11.

3 Digital Opportunity Initiative, "Creating a Development Dynamic," available at http://www.opt-init.org/framework/DOI-Final-Report.pdf, July 2001, accessed April 19, 2004, p. 9.

4 Digital Opportunity Initiative, p. 9.

5 Cynthia Hewitt de Alcántara, "The Development Divide in a Digital Age: An Issues Paper," available at http://www.unrisd.org/80256B3C005BCCF9/httpNetITFramePDF?ReadForm&parentunid=19B0B342A4F1CF5B80256B5E0036D99F&parentdoctype=paper&netitpath=80256B3C005BCCF9/(httpAuxPages)/19B0B342A4F1CF5B80256B5E0036D99F/$file/hewitt.pdf, Technology, Business, and Society Programme Paper Number 4, United Nations Research Institute for Social Development, August 2001, accessed April 21, 2004, p. vi.

6 Hewitt de Alcántara, p. vi.

7 Civil Society Declaration to the World Summit on the Information Society, "Shaping Information Societies for Human Needs," available at http://www.wsis2005.org/wsis/documents/summit/WSIS-CS-Decl-25-2-04-en.pdf, World Summit on the Information Society, Geneva, Switzerland, December 8, 2003, accessed April 20, 2004, p. 4.

8 Simon, "Democracy and the Net: A Virtuous Circle?" in *Democracy and the Internet*, pp. 1-29, p. 13.

9 Simon, "Democracy and the Net: A Virtuous Circle?" p. 12.

10 Simon, "Democracy and the Net: A Virtuous Circle?" p. 12.

11 Bridges.org, "The Kubatana Project of Zimbabwe: Case Study Series on ICT-enable Development," available at http://www.bridges.org/iicd_casestudies/kubatana/index.html, accessed April 19, 2004, p. 1.

12 Javier Corrales, "Lessons from Latin America," in *Democracy and the Internet*, pp. 30-66, pp. 39-40.

[13] Digital Opportunity Initiative, p. 10.

[14] Pippa Norris, "Giving Voice to the Voiceless: Good Governance, Human Development, & Mass Communication," available at http://ksghome.harvard.edu/~.pnorris.shorenstein.ksg/Acrobat/Pfetsch%20chapter.pdf, February 16, 2004, accessed April 21, 2004, p. 4.

[15] Norris, p. 4.

[16] Corrales, p. 40.

[17] Hewitt de Alcántara, p. 27.

[18] Edward Helmore and Robin McKie, "Gates Loses Faith in Computers," available at *The Observer Online*, http://observer.guardian.co.uk/print/0,3858,4086462-102275,00.html, published November 5, 2000, accessed April 22, 2004.

[19] "Internet Usage Stats: The Big Picture," Internet World Stats: Usage and Population Statistics, available at http://www.internetworldstats.com/stats.htm, accessed April 18, 2004, p. 1.

[20] "Internet Usage Stats: The Big Picture," p. 1.

[21] Civil Society Declaration, p. 6.

[22] Civil Society Declaration, p. 15.

[23] Curtain, p. 23.

[24] "Internet Usage Stats for Africa," Internet World Stats: Usages and Population Statistics, available at http://www.internetworldstats.com/stats1.htm, accessed April 18, 204, p. 1.

[25] "Internet Usage in South America," Internet World Stats: Usage and Population Statistics, available at, http://www.internetworldstats.com/stats2.htm#south, accessed April 18, 2004, p. 1.

[26] Peter Levine, "The Internet and Civil Society," in *Report from the Institute for Philosophy & Public Policy*, University of Maryland, Volume 20, Number 4, Fall 200, pp. 1-8, p. 1.

[27] The Association for Progressive Communications and the Communication Rights in the Information Society, *Involving ICT in Civil Society: World Summit on the Information Society,* available at http://www.apc.org/books/policy_wsis_EN.pdf, September 2003, accessed April 17, 2004, pp. 39-40.

[28] The Association for Progressive Communications, p. 40.

[29] The Association for Progressive Communications, p. 40.

[30] Levine, p. 2.

[31] Levine, p. 2.

[32] Simon, "Conclusion," in *Democracy and the Internet*, pp. 96-102, p. 100.

[33] Hewitt de Alcántara, p. 31.

[34] The Association for Progressive Communications, p. 43.

[35] The Association for Progressive Communications, p. 38.

[36] Curtain, p. 23.

[37] Norris, p. 13, 7.

[38] Simon, "Conclusion," p. 100.

[39] Michael Edwards, *Civil Society*, Polity Press: Cambridge, UK, 2004, p. 66.

Books Briefly Noted

Florida, Richard (2005). *Cities and the creative class*. New York: Routledge. ISBN 0-415-94887-8, pb, $19.95.

This book gathers in one place for the first time the research leading up to Richard Florida's theory on how the growth of the creative economy shapes the development of cities and regions. In a new introduction, Florida updates this theory and responds to the critics of his 2002 best-seller, *The Rise of the Creative Class*. The essays that make up *Cities* then spell out in full empirical detail and analysis the key premises on which the argument of *Rise* are based. He argues that people are the key economic growth asset, and that cities and regions can therefore no longer compete simply by attracting companies or by developing big-ticket venues like sports stadiums and downtown development districts. To truly prosper, they must tap and harness the full creative power of all people, basing their strategies on a comprehensive blend of the 3 T's of economic development: Technology, Talent, and Tolerance. Long-run success requires the reinvention of regions into the kind of open and diverse places that can attract and retain talent from across the social spectrum – by allowing people to validate their varied identities and to pursue the lifestyles and jobs they choose.

Frankel, Felice (2004). *Envisioning science: The design and craft of the science image*. Cambridge, MA: The MIT Press. ISBN 0-262-56205-7, pb, $35.00.

The hard cover publication of this book met with critical acclaim. Now available in a less expensive paper format, it beautifully conveys the importance of creating dynamic and compelling photographs for journal submissions and for scientific and technical presentations to funding agencies, investors, and the general public. The book is organized from the large to the small, from pictures of new material and biological structures made with a camera and lens, to images made with a stereomicroscope, compound microscope, and Scanning Electron Microscope. The text explains how to design, craft, and execute effective images, SEMs, and diagrams while maintaining scientific and technical integrity. Full-color illustrations, including many instructional side-by-side comparisons, provide examples from the physical and biological sciences, biotechnology, nanotechnology, electrical engineering, materials science, and mechanical engineering to encourage a new way to see and create images of science and technology.

Gee, Henry (2004). *Jacob's ladder: The history of the human genome*. New York: W. W. Norton. ISBN 0-393-05083-1, hc, $25.95.

This monograph delivers a lucid explanation of what the sequencing of the human genome tells us. Knowing the sequence is just the beginning. This evolutionary biologist explains that the next frontier is finding how genes interact to direct the growth of an organism. He speculates on what the new knowledge will mean for humanity as scientists increasing develop the capability to directly manipulate genes to serve human desires. The tone overall is upbeat and fast paced, with engagingly well-written prose that incorporates the history and science of developments in molecular biology. Gee does not fully consider the ethical issues that such capabilities raise.

Hashmi, Sohail H., Steven P. Lee, Eds. (2004). *Ethics and weapons of mass destruction: Religious and secular perspectives*. New York: Cambridge University Press. ISBN 0-521-54526-9, pb, $37.99.

This volume offers a unique perspective on the discussion of weapons of mass destruction (WMD) by broadening the terms of the debate to include both secular and religious viewpoints not normally considered. The contributors represent the following diverse ethical and religious traditions: Buddhism, Christianity, Confucianism, feminism, Hinduism, Islam, Judaism, liberalism, natural law, pacifism, and realism. The two introductory chapters outline the technical aspects of WMD and international agreements for controlling WMD. A concluding essay compares the different traditions.

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