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Introduction

This issue of the journal presents a broad range of articles addressing important themes in different branches of design practice as well as in different modes of design inquiry. As always, the editors seek to bring to the design community a mixture of writing styles and intellectual perspectives that demonstrate the lively nature of design and the rich pluralism of approaches in the field today, while also advancing discussion of many key issues that bear on our understanding of design. The first article, Paul Atkinson's "A Bitter Pill to Swallow: The Rise and Fall of the Tablet Computer," presents an intriguing history of the development of pen input devices and personal computer products that have failed in the marketplace. It is a story of the complex relationship of design, technology, and marketing that is not far removed from the currents of contemporary product development. In contrast to the historical approach of Atkinson, the next author, Massimo Negrotti, presents a more philosophical or theoretical discussion of the concept of "naturoids," seeking a general framework for understanding and methodological development of products that attempt to approximate natural systems. Negrotti offers a useful set of distinctions that contribute to our effort to frame an adequate theory of the artificial—an effort as old as Aristotle and as contemporary as the design of computers and robots.

The nature of design thinking is the subject of the next article, by Rahah Bousbaci. In "'Models of Man' in Design Thinking," he focuses attention on the role of bounded rationality in design, as developed by Herbert Simon, and on the so-called "generational evolution" of design thinking. Bousbaci is representative of a small group of design investigators who are beginning to review and analyze the development of design theory and methodology in the middle and late twentieth century. A critical reassessment of that work is needed today, and Bousbaci offers a useful analysis that will contribute to a more sophisticated level of discussion. While theoretical discussions have a welcome place in *Design Issues,* the journal is deeply committed to discussions of the concrete work of designers, in whichever branch they may practice. Critical discussions of the work of excellent designers make an important contribution to the field and help to keep students and scholars, alike, sensitive to the bedrock reality of design. In this issue of the journal, Humberto Valdivieso presents a brief but insightful discussion of the posters of Venezuelan designer Santiago Pol. We are pleased to show some of the work of this leading designer.

The next three articles develop connections between the field of design and other relevant disciplines, focusing on useful concepts or methods that illuminate design or offer ways to strengthen its foundations. Kjetil Fallen turns toward the work in Science and Technology Studies (also sometimes known as Science, Technology, and Society, or STS) for the idea of script analysis and its potential application to design history. In "The Policy of Design: A Capabilities Approach," Andy Dong discusses how a "capabilities approach" may bear on the formation of design policy in many countries. As Dong explains, "The capabilities approach is a normative theory of social justice developed primarily by the economist Amartya Sen and legal ethics philosopher Martha Nussbaum." Dong offers very useful ideas that help in the understanding of the goals of design policy as something more than merely a tool of economic development. Finally, Gavin Melles discusses how the concepts of neo-pragmatism, particularly as presented by philosopher Richard Rorty, may have a useful bearing on the development of design research. John Dewey's importance for design research is well known to some in the field, but many have only a passing awareness of how deep his influence extends. Melles helps to build the connection to Dewey while focusing on the later work of Richard Rorty, a former student of the philosopher Richard McKeon, who, himself, was a student of Dewey at Columbia.

This issue concludes with book reviews by Allison, Gorman, and Margolin, who discuss *Designerly Ways of Knowing* by Nigel Cross, *20th Century Design History* by Sarah Teasly and Chiharu Watabe, and the *Phaidon Design Classics.*

Bruce Brown
Richard Buchanan
Dennis Doordan
Victor Margolin

A Bitter Pill to Swallow: The Rise and Fall of the Tablet Computer

Paul Atkinson

Footnotes begin on page 24.

Tablet computers (or tablet PCs) are a form of mobile personal computer with large, touch-sensitive screens operated using a pen, stylus, or finger; and the ability to recognize a user's handwriting—a process known as "pen computing."

The first of these devices, which appeared at the end of the 1980s, generated a huge amount of interest in the computer industry, and serious amounts of investment money from venture capitalists. Pen computing was seen as the next wave of the silicon revolution, and the tablet computer was seen as a device everyone would want to use. It was reported in 1991 that "Nearly every major maker of computers has some type of pen-based machine in the works." [1]

Yet in the space of just a few years, the tablet computer and the notion of pen computing sank almost without a trace.[2] Following a series of disastrous product launches and the failure of a number of promising start-up companies, the tablet computer was discredited as an unfulfilled promise. It no longer represented the future of mobile computing, but instead was derided as an expensive folly—an irrelevant sideline in the history of the computer.

This article traces the early development of pen computing, the appearance, proliferation, and disappearance of the tablet computer, and explores possible reasons for the demise of this particular class of product.

Product Failures in the History of Computing

This article is concerned with the design, production, and consumption of artifacts, and the numerous factors which can affect their success or failure in the marketplace. For any company bringing a product to market, the amount of time and money invested in the research, design, and development of the product itself and in the market research, promotion, packaging, distribution, and retailing of a product means that an unsuccessful product launch is an extremely serious but unfortunately all too real prospect. The risk perhaps is understandably more common when the artifacts are complex technological products in a fiercely competitive field, and where the technology itself is still relatively young, not yet stable, and in a constant state of flux. Consequently, the historical development of the personal computer is (quite literally) littered with examples of products that have failed in the marketplace.

Occasionally, because of poor manufacture, misdirected marketing or promotion, and software not meeting consumer expectations, some of these products could be said to have "deserved" to fail. However, advances in production technologies and quality control in recent years have reduced manufacturing failures (notwithstanding some very well publicized events such as the poor battery life of earlier "iPods," the cracked screens of the first iPod "Nano," and exploding batteries in some Sony laptops[3]). But despite advances in manufacturing quality, there still are numerous examples of well-designed products (often winning design awards) which were heavily promoted and performed as promised, yet still failed in the marketplace. Obviously, merely solving pragmatic problems is no guarantee of success.

Product Failures and Theories of Technological Change

A great deal has been written from a number of different perspectives about why technological products fail in the marketplace. These include economic and business analyses, marketing critiques, design critiques, and sociological enquiries. This body of work is far too large to describe in any depth here, but concludes that there are multiple reasons in each case for product failure in the marketplace.

In *The Invisible Computer*, Donald A. Norman refers to the notion of "disruptive technologies"—technologies which have the ability to change people's lives and the entire course of the industry.[4] It is Norman's contention that this ability to disrupt inherently produces products to which there initially is a large amount of resistance. Norman also believes that company attitudes, including internal politics, the preference for an existing, tried and tested market over the need to develop a new one, and the need to produce profits quickly rather than investing in new products which may take a number of years to reach maturity means that new technologies are not taken seriously enough.[5]

Norman's argument is that, in order to be accepted in the marketplace, three factors have to be right: the technology, the marketing, and user experience. As an example, he quotes the well-known story of the Xerox "Star" computer designed at Xerox PARC in the early 1980s. The Star was a product well ahead of its time, having the first commercially available graphical user interface (GUI), and a design philosophy of user interaction that set the standard for an entire generation of PCs. Unfortunately, it was a consumer product before the consumer existed. The product had not gone through the process of exposure to the marketplace, which normally occurs when a new technology appears, is accepted by "early adopters" of technology, and then is refined for the mass market. The same thing happened a few years later when Apple introduced the "Lisa"—a larger, more expensive precursor to the Macintosh. In both cases, the technology wasn't quite ready. They both were painfully slow, had limited functionality because no one had written applications for them, and were extremely expensive. Therefore, there was no benefit for "early adopters" of technology in using these products, despite the novelty of the GUI , as the lack of application software meant that they didn't do anything other computers couldn't already do. The fate of the Star and the Lisa would have been shared by the Macintosh, had it not been saved by the advent of a "killer application," making it indispensable to specific groups of users. This was desktop publishing software and the invention of the laser printer.[6] Norman's view is that the Star and the Lisa both had superb user experiences, but insufficient technology and marketing.[7] Not having all three was the reason for failure.

This underscores the fact that the reasons for failure in the marketplace of any product are more complex than at first might be imagined. We will explore this notion in other theories that address the same issues.

The theory of the social construction of technology takes the view that a complex range of factors are involved in the success of products, and that social factors have precedence in the process. As a counterpoint to a physical reality affecting outcomes (i.e., the technology itself), social constructionists see a web of relationships between people and between institutions that share beliefs and meanings as a collective product of a society, and that these relationships are the basis for subjective interpretations rather than physical or objective facts. The notion of the "truth" of a socially constructed interpretation or piece of knowledge is irrelevant—it remains merely an interpretation.[8] It is an interpretation, though, which has significant agency.

This is in direct contrast to the theory of technological determinism—the view that technology and technological change are independent factors, impacting on society from the outside of that society—and that technology changes as a matter of course, following its own path, and in doing so changes the society on which it impacts. (A good example is the notion of "Moore's Law," which states that the power of a microchip doubles every year as if it were a "natural" phenomenon). There is an element of truth contained within this, in that technological products do affect and can change our lives, but it is simplistic to imagine that other factors are not at play. Put more simply as "interpretive flexibility," the argument of social constructionism is that different groups of people (i.e., different relevant social groups of users) can have differing views and understandings of a technology and its characteristics, and so will have different views on whether or not a particular technology "works" for them. Thus, it is not enough for a manufacturer to speak of a product that "works": it may or may not work, depending on the perspective of the user.[9]

The above arguments on social constructionism perhaps have been most widely promoted by the sociologists Trevor Pinch and Wiebe Bijker,[10] who use examples such as the developmental history of the bicycle to show how a linear, technological history fails to show the reasons for the success or failure of different models, and that a more complex, relational social model is required.

A slightly different view is held by others, such as the historian of technology Thomas Hughes, who sees technological, social, economic, and political factors as parts of an interconnected "system." In this instance, different but interconnected elements of products, the institutions by or in which they are created, and the environments in which they operate or are consumed are seen as a complete, interdependent network. However, a technological system remains a socially constructed one: "Because they are invented and developed by system builders and their associates, the components of technological systems are socially constructed artifacts." [11] There still is a distinction here between the human and nonhuman components of a system: "Inventors, industrial scientists, engineers, managers, financiers, and workers are components of but not artefacts in the system." [12]

By comparison, Actor Network Theory, associated with the sociologists Bruno Latour, John Law, and Michael Callon, breaks down "the distinction between human actors and natural phenomena. Both are treated as elements in "actor networks." [13] In Actor Network Theory (ANT), all parts of a system or network are equally empowered as actors having an influence on technology—there is no distinction between small or large elements, animate or inanimate, or real or virtual. Technology is conceived of as a growing system or network. The actors (and the relationships between the actors) "shape and support the technical object." [14] An important aspect of the theory is that:

> The actor network is reducible neither to an actor or a network alone nor to a network. Like networks it is composed of a series of heterogeneous elements, animate and inanimate, that have been linked to one another for a certain period of time. The actor network can thus be distinguished from the traditional actors of sociology, a category generally excluding any nonhuman component and whose internal structure should not, on the other hand, be confused with a network linking in some predictable fashion elements that are perfectly well defined and stable, for the entities it is composed of, whether natural or social, could at any moment redefine their identity and mutual relationships in some new way and bring new elements into the network. An actor network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of.[15]

In other words, the role of any particular actor in a network is not fixed, but indeterminate and changeable, being at times dominant or, at other times, insignificant in its agency.

These theories are useful in the analysis of the introduction of complex new technologies, and the tablet computer is an excellent case in point, having a particular level of complexity. As a product, the tablet computer brought together a number of discrete technological advances, each having its own history of development: pen interfaces, handwriting recognition, and touchscreen technology.

The History of Pen Computing:
Early Developments in Pen Interfaces

The principle of using a pen device rather than a keyboard to interact with a computer may appear to be a relatively recent development. As a matter of fact, pens were one of the earliest devices to be used in this way, many years before the invention of the computer mouse. Light pens (or light guns) were used in the experimental "Whirlwind" computer built at MIT between 1946 and 1949, when it became operational, for analyzing aircraft stability for the U.S. Navy. In this system, a light pen pointed at a symbol of an aircraft on a display screen produced identifying text about that aircraft. This machine formed the basis of the later TX-0 machine started in 1953 and the SAGE (Semi-Automatic Ground Environment) air defense system (Figure 1) started in 1958; both developed at MIT's Lincoln Laboratories. In the SAGE system, the light gun was used to convert the "blip" on a cathode ray tube (CRT) showing the location of an aircraft or missile into X-Y coordinates. When a blip appeared, a "light gun" was pointed at that point on the screen, and an inter-

Figure 1
The SAGE Air Defense System of 1961 used a light pen on a radar display screen to register the position of aircraft and missiles. Image courtesy of Computer History Museum.

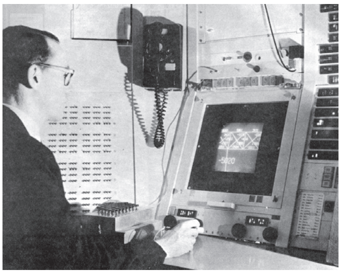

Figure 2
Ivan Sutherland's 1963 "Sketchpad" software was the first computer drawing package, and used a light pen as the principal input/output device. Courtesy of Ivan Sutherland.

nal photocell registered the blip. Since the time taken for the screen display to be refreshed was a known quantity, the time difference between the start of the screen refresh and the light gun registering a blip could be translated into an accurate X-Y position, and a trajectory then could be predicted.

The TX-0 machine was the first in a series of experimental digital computers built at MIT, which included the 1958 TX-2—notably used by Ivan Sutherland in 1963 to develop "Sketchpad"—the first computer drawing software, in which a light pen was used as the principal input/output device, initiating the "direct manipulation" of computer data (Figure 2). The abstract for Ivan Sutherland's Ph.D. thesis describes the use of a pen to interact with a computer:

> The Sketchpad system uses drawing as a novel communication medium for a computer. The system contains input, output, and computation programs which enable it to interpret information drawn directly on a computer display. … A Sketchpad user sketches directly on a computer display with a light pen. The light pen is used both to position parts of the drawing on the display and to point to them to change them. A set of push buttons control the changes to be made such as erase, or move. Except for legends, no written language is used.[16]

Figure 3
A RAND Tablet being used to interpret handwritten commands.
Image courtesy of Computer History Museum.

The Development of Handwriting Recognition

Concurrent with Sutherland's development of the technology needed to draw items directly on a computer screen, others had been working on methods to enable computer users to directly write commands that could be interpreted by the computer as instructions. An early example of a device which could read stylus movements accurately enough to interpret handwriting was the RAND Tablet (Figure 3). After years of development, a 1964 memorandum booklet titled "The RAND Tablet: A Man-Machine Graphical Communication Device" prepared by the RAND Corporation for the Advanced Research Projects Agency (ARPA) stated:

> Early in the development of man-machine studies at RAND, it was felt that exploration of man's existent dexterity with a free, pen-like instrument on a horizontal surface, like a pad of paper, would be fruitful. The concept of generating hand-directed, two-dimensional information on a surface not coincident with the display device (versus a "light pen") is not new and has been examined by others in the field. It is felt, however, that the stylus-tablet device developed at RAND is a highly practical instrument, allowing further investigation of new freedoms of expression in direct communications with computers.[17]

An example of an actual RAND Tablet in the archives of the Computer History Museum in Mountain View, California is, accompanied by an entry which reads:

> The Rand Corporation produced one of the first devices permitting the input of freehand drawings. Also called the Grafacon, the original Rand Tablet cost $18,000. The attached stylus sensed electrical pulses relayed through a fine grid of conductors housed beneath the drawing surface, fixing its position to within one one-hundredth of an inch. Many experimental systems were developed to recognize handwritten letters or gestures drawn on the tablet, such as Tom Ellis' GRAphic Input Language (GRAIL) method of programming by drawing flowcharts.[18]

Tom Ellis was the author of a number of RAND reports describing the development, beginning with Ivan Sutherland's "Sketchpad" research, of a system in which an operator could write instructional commands for a computer directly on the RAND Tablet:

> One fundamental facility of the man-computer interface is automatic recognition of appropriate symbols. The GRAIL system allows the man to print text and draw flowchart symbols naturally; the system recognizes them accurately in real-time. The recognizable symbol set includes the upper-case English alphabet, the numerals, seventeen special symbols, a scrubbing motion [a hand-drawn squiggle] used as an erasure and six flowchart symbols—circle, rectangle, triangle, trapezoid, ellipse, and lozenge.[19]

Ellis's GRAIL system was the beginning of handwriting recognition technology. Not only that, but since the system also contained text-editing facilities such as "character placement and replacement, character-string insertions, line insertions, character and character-string deletions, and line deletions" it formed the basis of word processing technology without the use of a keyboard.[20]

Touchscreen Technology

Touchscreen technology was first developed by Dr. Samuel Hurst while on leave from the Oak Ridge National Laboratory to teach at the University of Kentucky.[21] His initial idea came in 1969, when he was looking for a way to digitize large sets of strip charts. Hurst and a graduate student (Jim Parks) made a two-dimensional digitizer by using two sheets of electrically conductive paper with a sheet of ordinary paper between as an insulator to create a sensor. By connecting two voltmeters—one to each conductor—a needle prick through the strip chart and the sensor supplied an x-coordinate to one voltmeter and, independently, a y-coordinate to the other. This initial invention became the "Elograph," patented in 1972 (Figures 4 and 5). Returning to Oak Ridge and founding the company "Elographics" in 1971, Hurst went on to lead the development of transparent touchscreens, with the first produced in 1978, and five-wire resistive technology, the most commonly used form of touchscreen technology.[22]

> The first instruments were intended for the scientific market, and it was not a significant product because the "digital online" era had arrived and there was not a need for strip charts. It is amazing, in retrospect, that we survived long enough to take a poor product for the wrong market to an excellent product for a good (consumer) market. In a discussion with our patent agent, Martin Skinner, the idea emerged of a transparent touch screen for use with computers, and we were stimulated by Siemens when they paid some of the development costs for early units, but we did not have the insight to think that the touchscreen market would become so important.[23]

Although they had some way to go until they were suitable for use in consumer products, these cutting-edge advances in human/computer interaction meant that, by the end of the 1970s, all of the relevant technologies were in place and thoroughly documented to enable the development of the "tablet computer." It actually took almost a decade until the appearance of the first tablet computer, although this requires some clarification of the definition of the product, as well as the acceptance of various streams of parallel development.

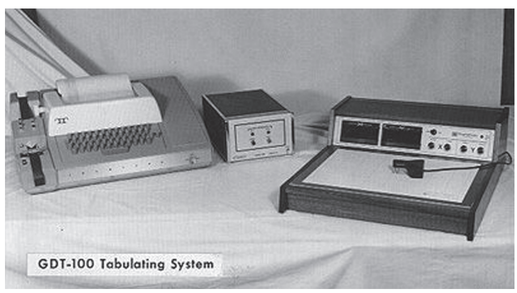

Figure 4
The "Elograph" electronic graphing device, 1971. Courtesy of Tyco Electronics, Elo TouchSystems.

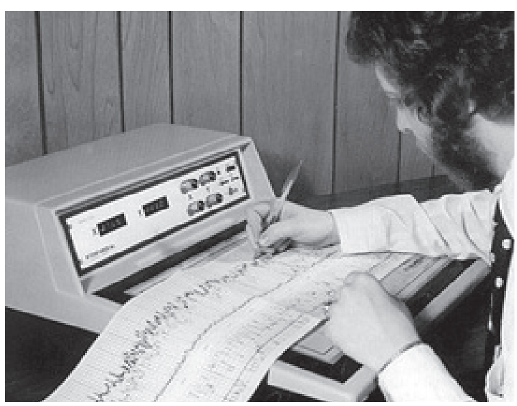

Figure 5
A later version of the "Elograph" being used to analyze strip chart data, circa 1973. Courtesy of Tyco Electronics, Elo TouchSystems.

Tablet Computers

Tablet computers as revolutionary new products experienced a rapid rise in popularity and were the center of industry attention for a few years in the early 1990s. Even though their popularity then underwent a massive decline, they did not disappear altogether, and still are manufactured today in limited quantities. Over the years, they have appeared in a number of forms but can be grouped into some general categories.

Tablet computers that essentially are a large touchscreen covering a processor unit are referred to as "slates." The input is purely through the screen via a stylus or finger, although external keyboards may be attached. The onboard processor allows a full range of computing capabilities. Where portability is a key concern, wireless versions with no onboard processors (called "thin-client slates") also are available. These utilize applications stored on remote servers. The lack of keyboard input is associated with the main use of these tablets in specialized, "vertical" markets such as the healthcare industry or in sales and insurance field work, where the tendency is for standardized forms to be filled in rather than entering large amounts of text.

"Convertibles" attempt to achieve the best features of tablet computers and laptop computers. The large touchscreens are movable, so that they can either act as a normal laptop with the keyboard in front of the screen, or be arranged so that the screen covers the keyboard completely, only allowing pen input. These have been more successful than slates, yet they remain a compromised product. The keyboard means that they inevitably are thicker and heavier than slates, and the touchscreen capability means they are more expensive than normal laptops. There also is a more expensive subset of convertibles known as "hybrids," which have keyboards that can be completely detached, restoring the thin cross-section of slates. In this instance, the "tablet" part of the computer is the screen and processing unit, and the detachable keyboard can be seen as a peripheral component. The distinction might be an important one because, to be termed a true "tablet computer," the screen input (the "tablet") and processing unit (the computer), it could be argued, have to be contained within the same product rather than being a portable computer which, through an additional component, has screen-based input capability.

So for clarification, the defining characteristics of the tablet PC are taken here as being a self-contained personal computer having a large, touch-sensitive screen and handwriting recognition capabilities to allow input by a stylus. With respect to size, tablet PCs have a screen size large enough to allow significant pen input (usually approaching that of a piece of A4 paper), and require both hands to operate if not rested on a stable surface. Although tablets may have the same organizational capabilities of "personal digital assistants"

(PDAs), they have computing capabilities similar to desktop computers. The use of organizing software such as electronic calendars and alarms is not their primary function.

The quote cited earlier in this article—that "Nearly every major maker of computers has some type of pen-based machine in the works."—points to a serious problem for historians of the technology of this period, and requires the inclusion of a caveat. Researching the exact chronology of product releases in the field of portable computing from the late 1970s to early 1990s is fraught with difficulties, and not just because of the sheer amount of competing products that were available. Many products, especially those from smaller start-up companies (which in many cases essentially were one-man bands), were not promoted as widely as those from major manufacturers, and information concerning them is hard to find and even harder to accurately verify. In addition, major manufacturers in desperate competition at a time of rapid technological progress raced to launch short-lived products to such an extent that many of them were outdated as soon as they hit the market—and almost immediately replaced by updated versions. Moreover, in an attempt to gain a head start on competitors, products were routinely announced and promoted sometimes up to a year before their launch, by which time many already had been dropped in favor of a more advanced model, or failed to materialize because of technical, financial, or other problems. These products are known in the industry as "vaporware"—intended products that may have been prototyped but never actually were sold. There also is the issue of parallel development to take into account. Many of the features of these products were first developed in isolation at research institutes and universities, and widely disseminated as actual or theoretical possibilities that then were simultaneously adopted by different companies in their product development. So the issue who was "first" is a complicated one. Finally, many of the accounts of this period, as in this article, include oral histories from the individuals involved at the time. These individuals more often than not were simultaneously involved in numerous projects and, because of the fluidity of the market, often changed employers or started new companies without keeping detailed records. (They are, after all, largely engineers and entrepreneurs—not academics and historians.) It is quite common to discuss the same issues of product chronology and attribution with different people who were involved with the same project, at the same time, and obtain completely different versions of events. As Friedrich von Hayek said:

> The knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess.[24]

For all the above reasons, it is practically impossible to be absolutely certain of all details, so the accuracy of dates and the completeness of chronologies of these products often are questionable. Therefore, the following chronology includes many of the key products, but certainly not all that appeared, especially if there was little difference between competing products launched simultaneously.

Early Products

Historically, the conceptual roots of the portable tablet computer as a discrete product are the same as those for the laptop computer, both arising from original interactive computer concepts proposed by Alan Kay as part of his doctoral thesis,[25] and later developed by the Learning Research Group as the "Dynabook" at the Xerox Palo Alto Research Center (PARC) in the early 1970s (Figure 6).

In 1968, while studying at Utah, Kay conceptualized a computer which brought together his work on interactive computing, the emerging technologies of flat-screen displays and handwriting recognition, and programming developments aimed at children. Kay explains:

> Ed Cheadle and I had been working on a desktop personal computer (the FLEX machine) since early 1967, and in the summer of 1968 I gave a presentation of this machine and software at the first ARPA grad students conference. One of the highlights was a visit to Don Bitzer's lab where the first plasma panel flat screen display was being invented (with Owens Illinois). We saw a one-inch-square display that could light up a few pixels. Flat-screen displays were not a new idea either in fiction, semi-fiction (like *Popular Science* mag), and in the real technological world. Still, it was galvanizing to actually see the start of one!

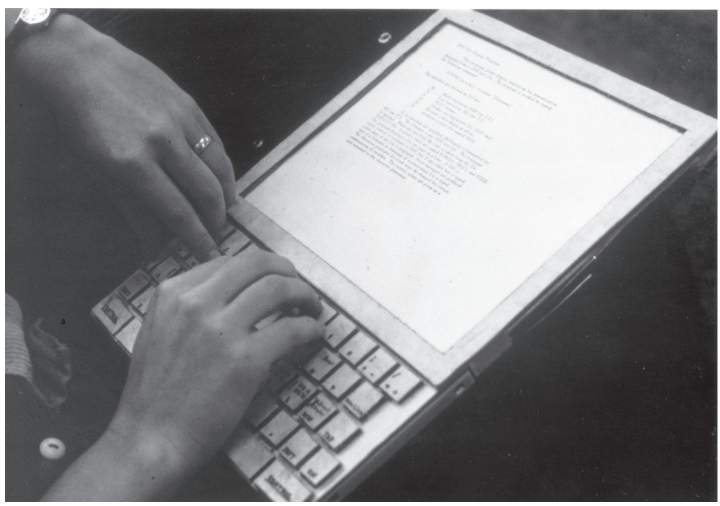

Figure 6
Alan Kay's "Dynabook" concept model, 1968.
Courtesy of Palo Alto Research Center, Inc.

> We knew the transistor count in the FLEX machine and some of the grad students and I sat around one afternoon estimating when those transistors could be put on the back of a big enough plasma panel. (Moore had announced the first version of his law in 1965.) Our estimate was about ten years.… At the same time, Peter Brodie at Westinghouse was also working on a flat panel using liquid crystals.[26]

Later the same summer, Kay visited researchers working on computers for nonprofessional users, including RAND, where Tom Ellis had developed his GRAIL system, and Seymour Papert (a pioneer in artificial intelligence) at a school in Lexington, where he was using his LOGO programming language developed for children.

> This was a transformative experience and on the plane back to Utah I started to think about making a computer for children that could combine some of the LOGO ideas, those of the FLEX machine, and the GRAIL tablet-based system. The ten-years-out problem became a non-problem because I realized there was at least ten years worth of user interface, software, and curriculum development that would have to be done.
>
> When I got to Utah I made a cardboard model of what such a machine would be like. (It was made hollow so we could load it up with lead pellets to see how heavy it could be made before it became a pain, etc.) It had slots on the side for the removable memory and the stylus.[27]

This concept became one of the most radical product proposals of the time. In a paper produced by the Learning Research Group, Alan Kay and Adele Goldberg promoted the concept of the Dynabook as "A Dynamic Medium for Creative Thought":

> Imagine having your own self-contained knowledge manipulator in a portable package the size and shape of an ordinary notebook. Suppose it had enough power to outrace your senses of sight and hearing, enough capacity to store for later retrieval thousands of page-equivalents of reference materials, poems, letters, recipes, records, drawings, animations, musical scores, waveforms, dynamic simulations, and anything else you would like to remember and change. We envision a device as small and portable as possible which could both take in and give out information in quantities approaching that of human sensory systems.[28]

Quite clearly, such a computer was not technically possible at the time (Kay still thinks this is true[29]), and yet his vision of the Dynabook was so powerful that it drove the development of computing technology inexorably towards truly portable computing. Even the name has been inspirational and much emulated. A company called "Dynabook Technologies" was set up in 1987 to develop such a computer, and gained $37 million in financial backing yet never managed to overcome technical problems and went bankrupt in 1990,[30] and Toshiba appropriated the name for its early pen tablets, marketed as "Dynapads."[31]

A number of products have laid claim to being or have been hailed as "the first tablet computer." However, with respect to the definition laid out above, many of these have one or another characteristic missing. Some products had character recognition rather than full handwriting recognition; while others were not self-contained products, but had to be connected either directly by cable or by radio signals to remote processing units or servers. This is an important distinction in design terms because in a unit where the touchscreen is a separate component connected by a cable, it can act as a peripheral input device rather than an intrinsic part of the product form. These factors are important in charting the development of tablet computers as a discrete class of products.

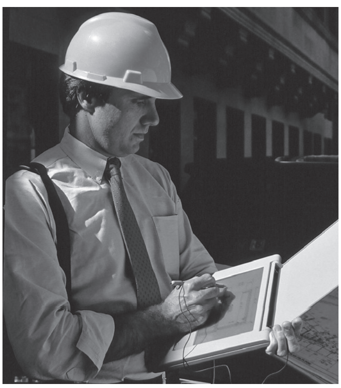

Figure 7
Linus Technologies Write-Top, 1987.
Courtesy of Inter4m.

The first to bring together the three technologies of pen interfaces, handwriting recognition, and touchscreens into a consumer product was Dr. Ralph Sklarew. His product, the "Write-Top" (Figure 7), built in 1987 by Linus Technologies, was "arguably the first portable computer with handwriting recognition."[32] It certainly had all the capabilities of a tablet computer, although it was not termed as such at the time. However, even though it was prototyped as a self-contained unit, the production version (designed by Peter H. Muller of Inter4m) "was a two-part design tethered via a cable."[33] It came close to being a self-contained unit since the touchscreen element could be "latched" onto the base unit to create a "grey sandwich."[34]

Sklarew founded Linus Technologies in 1985 with $11 million in venture capital. They demonstrated their first version to a number of interested parties, including GRiD Systems (see below).[35] He and his partners received patents for a "Handwritten keyboardless entry computer system," and sold approximately 1,500 units before closing in 1990.[36]

Self-contained Tablet Computers

The first successful attempt at a self-contained tablet computer appeared in the form of the GRiDPad from GRiD Systems, conceived by Jeff Hawkins (Figure 8). GRiD Systems was the company that produced the first true laptop computer, the GRiD Compass, launched in 1982.[37] Hawkins states that he came up with the idea of a tablet computer with a stylus interface in 1987, while studying neuroscience at UC Berkeley during a two-year leave of absence from GRiD. "During a neural networking conference, a company called 'Nestor'[38] demonstrated their handwriting recognition software which was based on pattern recognition algorithms. I realized that this could best be put to use in a mobile computer."[39] In the fall of

1987, Hawkins went to an interview with GO Corporation, a promising start-up company, to see if this was the best place to take the idea forward. GO saw itself as a pen-computing business, which worried Hawkins: "There's no such thing as a 'pen-computing' business—you just need a PC with an additional stylus. You don't have 'mouse computing' as a core business. The point is mobile computing, not pen computing." [40] Hawkins believed that GO would fail. Instead, he took the idea with him to GRiD in 1988, and managed the GRiDPad project there; employing IDEO to do the industrial design.[41] The GRiDPad was deliberately targeted at specialist, vertical markets such as the medical profession because this is where Hawkins saw market opportunities. "I never saw pen computers as a replacement for a full PC as GO did. GO was really pushing pens—they lost all sense of reality. They never shipped, whereas the GRiDPad turned over in excess of $30 million in its best year." [42]

The GO computer is a significant piece of "vaporware" if only for the sheer size of the endeavor and amount of publicity that accompanied it. The idea for the product arose during a business flight shared by Mitchell Kapor (founder of Lotus Development Corporation) and Jerry Kaplan, when they had the equivalent of a "religious epiphany" [43] that a portable pen-driven computer could solve all the traveling executive's information- handling problems. Kaplan went on to found GO Corporation in August 1987.

The product was developed to the stage of a working but deskbound prototype of connected components by 1988, yet despite having received in total more than $75 million in financial back-

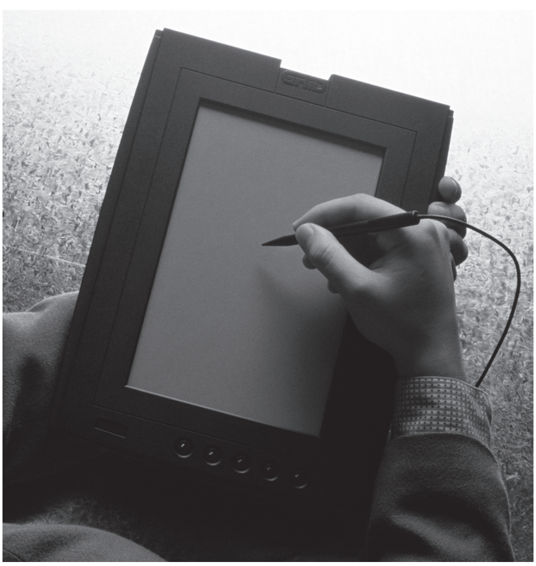

Figure 8 (left)
The GRiDPad, 1989. Courtesy of IDEO.

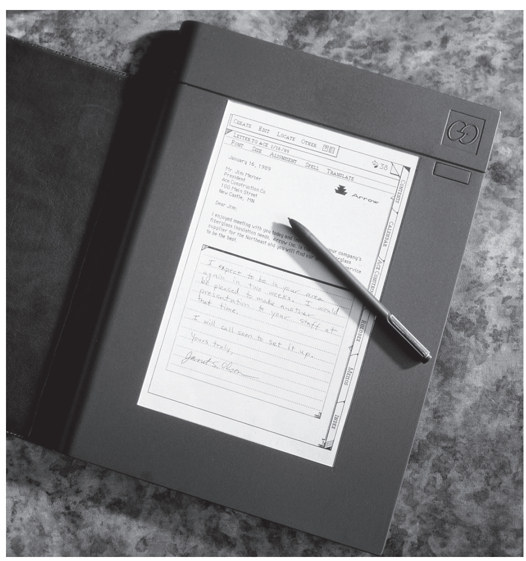

Figure 9 (right)
The prototype GO computer, 1991.
Photo by Rick English, courtesy of IDEO.

ing and the enthusiastic support of IBM and AT&T, it suffered all kinds of engineering setbacks. A working preproduction version was not assembled until June 1989 [44] (Figure 9). The final product, with industrial design work by Paul Bradley of Matrix Design and mechanical engineering by David Kelly Design (both later to become IDEO) was done in 1991, by which time the company had changed direction to concentrate on their handwriting recognition interface software called "PenPoint." This put them in direct competition with Microsoft, and when Microsoft launched "Windows for Pen Computing," a huge public relations battle ensued.[45] Not surprisingly, GO lost. Kaplan went on to write an autobiography in which he said: "The real question is not why the project died, but why it survived as long as it did." [46] GO was taken over by AT&T in 1994, and eventually shut down.

GO wasn't the only company that thought the ideal pen-computing operating system was yet to be created. In 1991, the computer magazine *BYTE* ran a review article on yet another new product (Figure 10) aiming to set the standard:

> Many players in the nascent pen-based computing market see the transition from conventional notebooks to pen systems as a chance to bypass the DOS standard and start afresh with more modern technology. Although the era of pen-based systems has barely begun, there are already three competing operating environments. This mad scramble to set new software to norms for pen computers may be a rude shock to users comfortable with the uniformity of DOS.

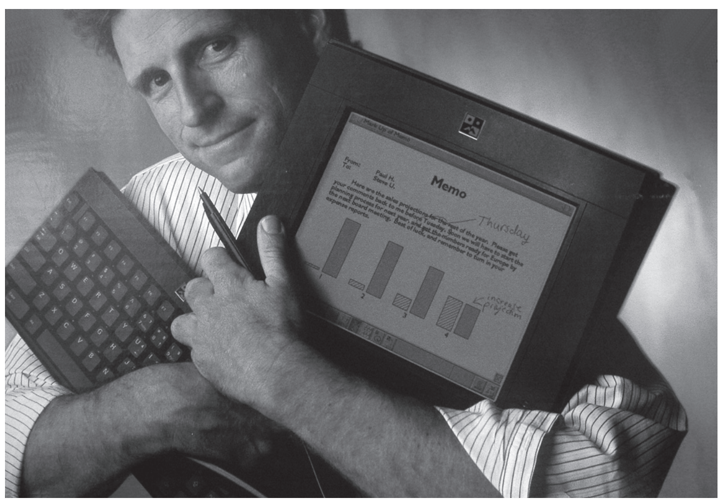

Figure 10
The 1991 Momenta Pentop computer (a contraction of "pen computer" and "desktop") attempted to move the target audience of tablet computers to mobile executives. Photograph of original packaging by author.

> In the midst of all this uncertainty, a fourth environment has arrived from start-up Momenta. One of the most widely anticipated entrants to the market, Momenta's pen-based laptop sports a new GUI that represents yet another effort to define the look and feel of pen computing.
>
> The Momenta computer is different in other ways, too. The company is aiming it at mobile executives, not at the blue-collar and field workers who have until now been the target audience for pen-based PCs. Perhaps most surprising, Momenta is playing down the role of handwriting recognition in the system, saying that the technology is too immature to substitute for a keyboard in many cases. Instead, Momenta sees the pen, in conjunction with its new GUI, as a more intuitive substitute for a mouse.[47]

The competition was indeed tough. Although it was in many respects a radical product and had many innovative features leading to its appearance on the covers of twenty magazines, Momenta International ceased trading in 1992, less than a year after the Momenta Pentop's launch. In an article reflecting on his career, the company's founder, Kamran Elahian, said "We set out to create a computer that would be incredibly easy to use. I was absolutely convinced that we would revolutionize the PC industry." The same article concluded: "There was just one problem. No one bothered to build a market for pen-based computers. In three years, Momenta burned through $40 million.… For a while at least, Elahian held the Valley's title for burning the most capital in the shortest period of time. Momenta was a monumental flop." [48]

A spinoff from GO, called EO Inc. (also sold to AT&T), had some success with two versions of products called "Personal Communicators" in 1993. These units, with industrial design work by frog design, had a built-in modem to provide phone, fax, and electronic mail capabilities. The smaller-screened version, the EO 440 (Figure 11), sold around 10,000 units, but the company collapsed shortly after launching the larger-screened EO 880.[49] Before it collapsed, the company was working on various future possibilities, including a tablet computer with speech recognition.

After his success with the GRiDPad, Jeff Hawkins tried to develop a product "that offered the best of both the laptop and tablet."[50] The result, with industrial design work by IDEO, was the GRiD Convertible, launched in 1993 (Figure 12). This used a clever mechanism which allowed the screen to slide and pivot to cover the keyboard and convert the laptop into a tablet. "Bill Gates loved it. It failed in the market place. I learned at that time that people

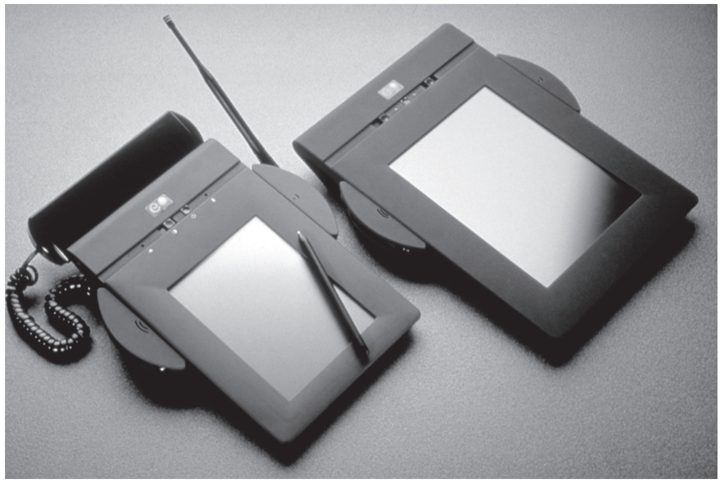

Figure 11
The EO 440 Personal Communicator, 1993.

Figure 12
The GRiD Convertible, 1993. Courtesy of IDEO.

didn't really want to write on their display." [51] Hawkins realized that "people wouldn't pay for or compromise the quality of a laptop for a pen interface." [52]

Divergence

Around 1993, the closely related products of tablet computers and Personal Digital Assistants began to move apart. Apple ran a whole series of projects during the late 1980s and early 1990s to develop tablet computers, most of which were cancelled.[53] These included a notebook-sized, slate-type computer concept codenamed "Figaro" between 1987 and 1991 (which evolved into the Newton), the PenMac, the Macintosh Folio, and SketchPad, all in 1992; and the WorkCase and Newton MessageSlate in 1993. Apple felt that a tablet computer might compete with and divert sales from the Macintosh, so the project was rethought as a PDA.[54]

Figure 13.
The Apple Newton MessagePad 2000, launched in 1997. Courtesy Apple Inc.

The Apple Newton MessagePad eventually was unveiled in May 1992 at the Consumer Electronics Show with a large-scale publicity drive claiming to have produced the "future of computing." It was released the following year, unfortunately to weak reviews. After a number of redesigns culminating in the MessagePad 2000 (Figure 13), the technology was placed into the Apple eMate laptop computer in 1997, and then discontinued altogether in 1998. Although it was produced for six years and won numerous design awards, the Newton was never the success Apple hoped for, and the goal of reinventing personal computing was never achieved. Although it was marketed as a PDA rather than a tablet computer, the unit itself was too large to fit into any pocket, was expensive (the final models costing $1,000), and initially suffered from poor handwriting recognition software, which many regard as the main reason for its failure.[55]

The End of the Line?

The Apple Newton would seem to mark the point at which the tablet computer developed into the Personal Digital Assistant. Some manufacturers did continue to produce true tablet computers, but with little success. The original IBM "ThinkPad" in 1993 was a tablet computer, and Sony produced a Pen Tablet PC in 2001, but it was discontinued due to low sales only a year later.[56] Despite this, a number of manufacturers including IBM and HP still produce a variety of models,[57] and Bill Gates openly defends them, predicting they soon will come into their own as products, and ensuring that the latest version of Windows, "Vista," supports pen computing.

The story of the tablet computer to date covers some fifty years from its conception, with real products being produced for twenty years. The sheer amount of money and effort involved in trying to bring the tablet computer to the marketplace is staggering. As a product group, they have swallowed billions of dollars in investment capital and thousand upon thousands of man-hours in R&D, design, and promotion. Sales remain pitifully low, and yet manufacturers and a small number of users still cling to the concept, convinced of its potential. At Microsoft, the tablet PC is most prominently promoted by one man, Bert Keely, who has the title "Architect, Mobile PCs & Tablet Technology." Keely constantly attends research seminars and computer shows, and appears in the news media demonstrating the advantages of pen computing. He admits that tablet technology has a number of flaws and a long way to go,[58] but remains convinced that the future of pen computing will be "astounding."[59]

Conclusions

So why has the tablet computer not been a successful product? In theory, it had it all—a computer that you could use as if it was a pad of paper. As proposed by the theories discussed earlier, there always will be more than one reason for any product failure. Yet many of the factors mentioned in the case study as to why certain individual tablet computers had failed are issues which subsequently have been resolved. Clearly, the technical problems which plagued early products such as slow processor speeds and software reliability have been overcome. The compatibility of software means that applications for such computers are far greater in number and, while still not perfect, issues of functionality such as the reliability and accuracy of handwriting recognition software have been greatly improved. The manufacturers currently involved are not start-up enterprises lacking in financial support or backing; and the products are now part of large ranges of computing equipment from well-known and respected companies, and have received marketing support of a suitably high level. Yet despite the sales predictions and assurances from Bill Gates, and the enthusiastic promotion of people such as Bill Keely, tablet computers still account for less than five percent of the personal computer market.[60]

Social constructionism suggests that a complex range of social factors are the most significant elements to take into account in the success or failure of technological products. Indeed, it would appear from the technical factors that have been resolved that the only possible barriers left to the acceptance of tablet computers are social ones. The concept of "interpretive flexibility" proposes that different groups of people have different views on the extent to which a particular technology "works" for them. However "natural" a form of communication writing may appear to be, perhaps, as Jeff Hawkins believes, people don't want to write on computer screens, and a pen on a large display is not a good user interface for a computer.[61] The feel of pen on paper is a difficult one to surpass.

> Some of the technology still isn't solved. Paper still has qualities screens don't have. Is the stylus active or passive? If it is active, then they are a problem. The screen resolution still isn't good enough, and there is still a parallax issue. Handwriting recognition still isn't good enough: text editing is still complex to use.[62]

According to Stuart Card, a research scientist at Palo Alto Research Center and an expert in human/computer interaction, the problem of pen computing is self-evident, and revolves around the difficulty of overcoming the physical keyboard:

> The reason pen computing doesn't work well is that the software it works with was designed to be used with a mouse and keyboard—the pen input was added later. PenPoint [the operating system developed by GO] was better as it was gesture-based. This means going back to recall rather than recognition [having to learn and remember how to execute a command rather than intuitively interpreting an icon] but that's okay as long as there are a limited number of gestures, say around five to ten, and the gestures are mimetic rather than symbolic. As an example, it's difficult to spreadsheet with a mouse. It could be easier with a pen if the design of the software works. Currently it is just as difficult to use a pen, or more so as you also have to include handwriting recognition errors. Another is writing URLs [Website addresses]. Handwriting recognition software has algorithms to ignore "nonsense" words, but URLs are random series of letters and no spaces, so that doesn't work. The pen clearly has an advantage if the input is a drawing, but how many people use that? And virtual keyboards are useless for typing—only one key at a time. You will always need a keyboard for bulk text input.[63]

Another factor could involve the complexity of a personal computer, which is clearly accepted if not desired in a desktop PC. This may not be acceptable in such a portable format as the tablet PC. Slow start-up times, large size and weight, and the compromises inevitable in multifunctional products such as a full computer do not cross over well to situations in which the computer is held and carried around by the user, and constantly turned on and off.

It is possible that the semantic associations of tablet computers and the body language employed when using them is an issue. In use, tablets tend to be carried in the cradle of one arm and written upon with the free hand in much the same manner people write on clipboards (indeed, some tablets such as those by "Aqcess" have been designed with detailing to specifically connote physical clipboards). The success of tablet computers in vertical markets suggests that this was not an issue for users carrying out specialized field work with "rugged" products, where the clipboard was and is a commonly used and accepted piece of equipment, but it may possibly have been an issue when attempts were made by companies such as Momenta to overtly move tablets into the executive market.[64]

Factors such as these, which may appear to be small problems, or even insignificant by some, are held by Actor Network Theory to have the potential to be highly significant in the successful take-up of new products. The interesting aspect of ANT, though, is the understanding that the significance of these factors is not seen as fixed, but fluid. At any moment, any factor can move from being a significant actor to an insignificant one, or vice versa, even as the result of forces outside of the network itself. With this level of uncertainty in mind, it must be recognized that the current public attitude toward tablet computers and to pen computing itself theoretically could change at any moment, however unlikely that may seem.[65]

While the tablet computer has failed to capture the public's imagination, the PDA has succeeded—but that's another story. The reasons for the failure of tablet computers, as for any complex technological product, are not straightforward. All or any one of the reasons above; or a combination of small details which together constitute the nature of the experience of using a tablet computer, could be equally responsible. As social construction theory would have it, the acid test of computing equipment is not the technology, but user acceptance. And as Actor Network Theory shows, however small or inconsequential an agent may appear to be in the overall scheme of things, it still can have the ability to make or break any product.

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60 Gartenberg's optimistic view of the future of tablets isn't shared by all analysts. "Handwriting recognition-based machines will comprise just one percent of the global notebook market in 2005, rising to a mere 2.4 percent by 2009," says Andy Brown, IDC's programming manager for European mobile computers and devices. (C. Everett, "Tablet PCs: Is the Writing on the Wall?," ZDNet UK. (Accessed online July 6, 2007 at: http://news.zdnet.co.uk/emergingtech/0,1000000183,39206429,00.htm).

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62 Interview with Jeff Hawkins at the offices of Numenta, Palo Alto, CA, May 10, 2007. ("Parallax" refers to the thickness of the glass screen creating a visible distance between the end of the pen and the electronic ink on the display surface.)

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Where the Future Doesn't Come From: On the Logic of Naturoids

Massimo Negrotti

The best qualification of a prophet is to have a good memory.
G. S. Halifax (1633–1695)

Towards a General Framework for the Design of Naturoids

Throughout the whole history of human technology, one of man's most persistent ambitions has been that of reproducing natural objects, systems, and processes. In order to understand the real possibility of such technological attempts to approximate natural systems, including the human body itself, we would need to discover what common construction rules, power, and constraints characterize them, irrespective of the technological fields within which they are designed. The term "naturoid" introduced here refers to all devices that are designed with natural objects in mind, by means of materials and building procedures that differ from those that nature adopts.

The field of naturoids includes humanoids, animoids, plantoids, and organoids, but also many other classes of objects or processes, such as artificial stones, grass, flavors, odors, light, landscapes, and so on.

The technological field of naturoids is sufficiently extensive to make interesting the search for the common features that underlie the very heterogeneous devices that arise within it. This becomes more important if one considers that, as a matter of fact, designers and scientists working in the several sub-fields of the whole field of naturoids generally do not communicate with one another. For example, bioengineers have no serious contact with artificial intelligence researchers; roboticists have no serious interest in the work of designers of, say, artificial skin; and designers working in fields devoted to emulating natural phenomena such as flavors, perfumes, snow, or landscapes relate only occasionally with the materials scientists; and so forth and so on.

This partially explains why, working in their more or less narrow field, designers of naturoids often tend to predict future scenarios for their products that are completely unfounded. Perhaps one of the reasons for this is that they neglect, or ignore, some of the constraints possibly already encountered by designers in other fields that are implied by a given naturoid design.

To state it differently, our assumption is that there are no fields in which the advancements in naturoid design can approximate nature more easily than in others, because the main difficulties are of a general methodological kind, and are not due to any special features of the natural objects that are to be reproduced. Therefore, the general strategies, bottlenecks, and constraints encountered in the more-advanced fields may light the way for the progress of less-advanced ones.

A particular and very well-known case is that of advanced artificial objects aimed at reproducing human abilities (e.g., artificial intelligence and anthropomorphic robotics). Naturoids in these fields often are said to have the intrinsic destiny of exceeding the role of humans in a wide range of situations—see the well-known theses by Hans Moravec,[1] Bill Joy,[2] and Raymond Kurzweil,[3] among others—or of setting up a sort of (rather vaguely defined) symbiosis with them. In other words, the story would run as follows: in the first phase, humans will design and build naturoids; then, in the second phase, these artificial devices, for a number of reasons—such as their intrinsic power (for instance, in reasoning or in self-regulating tasks), their complexity, their continuous enhancement, and so on—will develop, both as individuals and as a "community," characterized by an autonomous decision-making capacity, setting up a sort of superior social class that will dominate the world, and far exceeding human capabilities.

Such predictions assume, without any currently available evidence, that the advancements of naturoids will progress towards a growing similarity with natural objects or systems—that is to say, converging ever more closely towards their features.

This paper aims at presenting a framework capable of describing the methodological steps that, as a rule, any design of naturoids must follow. From this framework, it is possible to grasp the logical reasons that explain why a given naturoid is intrinsically unable to develop towards the natural object or system that inspires it. As a consequence, the same framework will make clear why, neither now nor in the future, there could not be any competition between natural systems, human beings included, and artificial ones.

For the reasons outlined above, the search for a common framework within the fields of naturoids cannot be pursued by placing ourselves in a particular field and staying there, but rather by trying to understand what is common to all the attempts at designing naturoids, which is an activity to which human beings have dedicated a great proportion of their technological history. Nevertheless, apart from Herbert Simon's well-known essay of 1969, *The Sciences of the Artificial*, which aimed to depict the process of design, and not to define the artificial in itself, there are no well-established schools of thought on this issue. Indeed, most scholars neglect this problem, being inclined to conceive as artificial everything that is made by man, although Simon himself reserves the adjective "synthetic" for referring to the cases in which technology tries to cope with nature.

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The Ancient Dream of Rebuilding Nature

From at least the time of the Renaissance, with the publication of Leon Battista Alberti and Piero della Francesca's *Artificial Perspective*, there has been a rather vague understanding of the dichotomy that underlies technology. Therefore, the term "naturoid" is intended to establish a standard meaning, referring to any "artificial" (in the traditional sense) object or device that is aimed at reproducing something natural by making use of materials and procedures that differ from those that nature adopts.

Historically, we may distinguish between a technology that aims at *producing* something *ex novo*, and another that aims at *reproducing* something already existing. A starting definition of a naturoid, therefore, should be based on a necessary condition (a naturoid should be made by man) and a sufficient one. (A naturoid must be intended to reproduce something existing in nature.)

These simple remarks justify a study of what artificial things—specifically naturoids—are, and particularly the logical and methodological steps and constraints involved in designing naturoids in a given field.

In following such a research path, it is possible to discover that the unavoidable result of the technology of naturoids is the *transfiguration* of the natural objects or systems it aims at reproducing, and not their more and more accurate reproduction. On the other hand, this does not mean in any way that the transfigured performances of naturoids necessarily will exceed those of the natural object, but only that the performances exhibited by a naturoid always will be different—often very different—being perhaps enhanced, or equivalent, or reduced, as compared to those of the natural object or system.

Moreover, there is a need for a clear understanding of the concepts at stake. In the history of the debate on artificial intelligence, for instance, both supporters and opponents have been engaged in defining and defending a suitable or "true" concept of "intelligence," while neglecting the adjective "artificial" and its possible universal features that need to be conceptualized. In fact, if one tries to examine every human attempt to reproduce natural things or events, one discovers that such an effort exhibits general rules and constraints that are independent of the field of application.

First of all, we should remember that the ambition to reproduce natural objects by following strategies that differ from natural ones is very ancient. Examples of naturoids, be they real or purely imagined, abound in history, from the culture of the ancient Greeks to the well-known automata of the eighteenth century and beyond. On the other hand, as stated by D. J. de Solla Price: "Our history, then, begins with the deep-rooted urge of man to simulate the world about him through the graphic and plastic arts. The almost magical, naturalistic rock paintings of prehistoric caves, the ancient grotesque figurines and other 'idols' found in burials, testify to the ancient origin of this urge in primitive religion." [4]

4 D. de Solla Price, *Automata and the Origin of Mechanism, Technology and Culture* 1 (1964): 8.

Therefore, the technology of naturoids is an extension of man's inclination to imitate nature; both for practical reasons and as a challenge to himself. This type of technology has developed along with conventional technology, which aims at controlling the world without any pretence of reproducing it—a technology that exploits scientific knowledge in order to build objects which have no examples in the natural world.

Man's ambition to reproduce the world has the function, presumably, of reinforcing his self-confidence and his desire to dominate nature by exhibiting the ability to obtain the same results via different means; that is to say through what rightly have been termed "alternative realizations." [5]

Designing Naturoids: Three Basic Steps

One major objective of a study of naturoids as a general class should be to outline both the methodological steps that every designer must follow, although often unconsciously, and the logical constraints he always will encounter during his work. The result of this analysis is a set of three processes of selection (or, in some cases, deliberate construction) that cannot be avoided. These are: (a) the selection of an *observation level*, (b) the selection of an *exemplar*, and (c) the selection of an *essential performance*.[6]

The "observation level" (OL) is a profile or a perspective of reality (for instance, microscopic or macroscopic, mechanical or electrical, chemical or biological, informational or physiological), which human beings unavoidably assume when they relate to reality, and still more so when they describe it. This term is, in some measure, similar to others, such as "description level" or "abstraction level," which are common in the scientific methodology, and to the philosophical concept of *abschattung* (profile) proposed in 1928 by E. Husserl in his *Vorlesungen*.

The preference for the term "observation" is due to the fact that, at least in principle, every attempt to artificially reproduce a natural object existing in nature requires, of course, an ability to observe it. In fact, even in the cases in which we cannot directly observe any corresponding objects, such as in the fields of artificial intelligence and artificial life, we try to find observable phenomena from which it might be possible to infer the features of the objects or processes that lie at the core of our research.

Needless to say, the observation process and the role of the observer are very crucial concepts which have been discussed frequently, particularly in the twentieth century, in almost all disciplines ranging from physics to sociology. However, for our purposes, it will be sufficient to assume the observation process in its most simple and classical sense: that is to say, in the sense it actually is interpreted by scientists and designers when they decide to look at something macroscopic in the natural world in order to give an empirical description of it.

5 R. Rosen, "Bionics Revisited" in *The Machine as Metaphor and Tool*, H. Haken, A. Karlqvist, and U. Svedin, eds. (Berlin and Heidelberg: Springer-Verlag, 1993), 94–95.

6 M. Negrotti *The Theory of the Artificial* (Exeter, UK: Intellect Books, 1999).

There is ample evidence to suggest that human beings cannot take into account more than one OL at any given time. The reductive role of adopting a certain OL, just by cutting away other levels, allows significant observations by enabling us to bring something to the foreground, while leaving all remaining levels of reality in the background. This is a useful and, at the same time unavoidable, strategy—and one that is due to our own nature—but, as such, it prevents us from considering all of the features of any given phenomenon.

It is worthy of note that the sciences themselves are built on the basis of separate OLs, and no serious success has yet been reached, either theoretically or practically, to synthesize them into a whole. Even when two sciences relate to each other in an interdisciplinary way, the final result—albeit an infrequent one—is the setting up of a new science based on a new OL. This happens, for instance, in biophysics, which nobody would expect to produce fundamental biological or physical discoveries but, rather, new knowledge on a properly defined biophysical OL. Therefore, the attempt to synthesize two OLs gives rise to a third one, which develops from a partial overlapping of the two OLs concerned, and then assumes its own conceptual, descriptive, and lexical autonomy.

When we apply the foregoing considerations to the design of naturoids, we discover a rather general rule: whatever the natural object to be reproduced, researchers and designers have some image or model of it in mind, strongly dependent on the adopted OL. In other words, models cannot capture the whole complex of the empirical reality they are intended to represent. Therefore, an expression such as: "Here we are trying to build an artificial flower" has little meaning until the designer declares at which OL the natural flower is conceptualized and described (physiological, anatomical, architectural, mechanical, chemical, aesthetical, etc.)—it being excluded right from the start that the flower could be rebuilt in its entirety; that is to say, according to all the possible OLs.

The "exemplar" (EM) must be understood as the natural object, system, or process that one aims to reproduce (e.g., heart, muscles, intelligence, snow, flavors, and so on). Even here, the human propensity to separate things induces us to see the world as a collection of EMs. In fact, a major methodological constraint is due to the arbitrariness of any given "definition" (in the early Latin sense of "fixing the boundaries") of an EM. For instance, an animal that lives symbiotically with another cannot easily be "defined," just as intelligence cannot easily be separated from other mental faculties, nor an organ from its organism, nor even a pond from its surrounding ground. Sciences themselves are very well "defined," and their boundaries, though not formal, usually are strongly defended against intruders from other fields and from the generic, "common-sense" environment.

To sum up, EMs are static or dynamic portions of the empirical reality, more or less accurately conceptualized, which we isolate from their context and give them a name and a set of features. Clearly, even here the designers of naturoids have to make serious decisions that largely depend upon the selected OL. Furthermore, given an OL, every definition of an EM—be it topological, anatomical, functional, systemic, or whatever—may cut off structures or relations whose exclusion from the model will not only reduce the power of the naturoid in emulating the EM but, more important, may introduce qualities or behavior in the naturoid that are quite nonexistent in the EM itself.

An "essential performance" (EP), finally, is the feature, function, property, or quality that, according to some more or less shared cultural or scientific OL and paradigm, unambiguously individuates a particular EM. The pumping of the heart, certain functions attributed to a gland, this or that faculty of intelligence: all are instances of performances that could be conceived as essential, perhaps according to different schools of thought or cultural models. The expression "essential performance" sometimes appears spontaneously even in scientific accounts, such as in the following report on the design of artificial joints: "It is assumed that the essential performance requirements for an artificial finger joint are: stability, ability to carry up to 30 lbs., ability to allow a deflection of at least 30 degrees, production of the minimum of wear debris." [7] A similar meaning is assumed in the following project for a skate simulating ski turns: "Essential performance characteristics are identified relating to six design requirements that are necessary to accurately reproduce a carved turn off-snow. The requirements include specifications to ensure a replication of pure carving, range of motion, turning relationship, balance, robustness, and safety." [8]

EPs, in turn, depend upon the selected OL and on the definition of the EM: an aspect that seems essential from a given OL may not seem to be so from another and a given aspect may be included or excluded according to the boundaries of the EM we have decided to establish. This also introduces a remarkable "relativity" in the final design of any naturoid, because its real configuration always will appear as one of the innumerable profiles of the natural instance.

This set of steps—that is to say, the selection of an OL, an EM, and an EP—cannot but apply to all naturoid-designing activity; and it involves a logic of self-including selection because the definition of an EP depends on the definition of an EM, and both depend on the selected OL. The arbitrariness of this funnel-like process is one of the reasons why no naturoid may be expected to reproduce the whole of even the seemingly simplest natural object or process.

7 Biomechanics, *Theoretical Design of Various Types of Joints* (http://biomed.brown.edu/Courses/BI108/BI108_1999_Groups/ Fingerprosth_Team/BiomechTheory.html), 1999. [Accessed, January 2002.]

8 J. Q. Campbell Conrad Technologies Inc., *Design and Development of a Skate That Simulates Carved Alpine Ski Turns Off-Snow* (Abstracts from the 4th International Conference on the Engineering of Sport, September 3–6, 2002, Kyoto, Japan).

Inside the Complexity of Naturoids

We also should point out that the need, by definition, to adopt different materials from those that nature adopts contributes to giving the naturoid its own "nature." Designers of naturoids are attracted by materials that, by virtue of some of their properties, appear to be the right ones for reproducing the EP of the selected EM. Thus, before and independent from the rise of a specialized "material science," Jacques de Vaucanson, concerned with the reproduction of the digestive tract of a duck in the eighteenth century, was attracted by the newly discovered Indian rubber. In the same way, a contemporary bioengineer has said that "life-saving heart surgery often relies on a polymer originally developed for women's fashions or a plastic meant for insulating electrical wires." [9]

However, the selected materials, in themselves, normally have nothing to do with the stuff of the natural EM, as generated by its own natural evolution. More important, the selected materials appear on the scene of the naturoid with *all* of their properties, and not just with the "right" ones, as designers tacitly and understandably are inclined to hope. In other words, reality is not tailored to our specific needs, and we cannot simply choose the properties we desire, as if they were individual packets on a supermarket shelf. This sort of "inheritance principle" explains why sudden events and side-effects characterize the life of almost all naturoids. Indeed, undesigned relations among the adopted materials, or between them and the hosting environment, can generate unexpected features or events that become part of the overall transfiguration of the EM and of its natural EPs.

We also must consider how problematic it would be, from both a logical and an operational point of view, to put to work together two or more "partial" naturoids, whose EMs have been drawn from a complete system (such as, for instance, two subsystems of a biological organism).

We are led to support the hypothesis that, if one aimed to reproduce a larger natural system than previously designed naturoids had been able to reproduce as standalone devices, such an attempt would result in an unmanageable project. This is due to the fact that each of the standalone naturoids is built in its own area on the basis of its own OL, and, furthermore, by adopting ad hoc materials. This would imply that, in order to functionally connect two partial naturoids, we must decide which "language" they will adopt in relating each other. When designers do so, they are much more orientated towards obtaining the final result at any cost, rather than discovering what "language" is adopted by the natural system.

In contrast, a natural system that includes two natural subsystems is the result of a combination of at least two distinct OLs—possibly giving rise to a new, third level, with its own rules and properties. Such rules and properties, although they are needed to bring about the particular behavior of the system, are not easily

9 The Whitaker Foundation, *Annual Report: Tissue Engineering,* (http://fairway.ecn.purdue.edu/bme/whitaker/95_annual_report/ tissue95.html), 1995.

recognizable in the standalone EMs, precisely because these EMs, both as objects and as models, are the result of a sort of extraction of a part from the whole system at some OLs. The very complex relationship between touch and sight, and between the related coordinating structures and processes, illustrates this point.

On the other hand, trying to reproduce the larger system by entering a third OL would entail giving up the work done at the previous ones, and setting up a whole new project; with a new OL, EM, and EP. Objecting to this point would entail relying on a bottom-up strategy, which is very difficult to defend in the field of naturoids as well as in other areas. The same could be said for so-called "reverse engineering,"[10] because, sooner or later, this involves deciding what is relevant.

For the designers of naturoids, the difficulty is due to the ever-decreasing probability of getting a reliable and natural behavior from a cumulative structure of partial naturoids, which are unlikely devices in themselves. In turn, the inherited properties and performances of the adopted materials—which would include undesigned relationships between the materials themselves, and between the materials and the context—would grow exponentially with the addition of new materials.

An interesting corollary to this argument is that the concept of "replication" (the tacit dream of every designer of naturoids) is the exact opposite of the concept of "naturoid"—that is to say, of an artificially reconstructed natural EM. Indeed, a replication would be possible if, and only if, one were able to reproduce an EM according to all of its possible OLs, and capturing all of its EPs without privileging any of them, while adopting, of course, the same materials that nature adopts. Only nature is able to do this, since it is completely self-sufficient ("autopoietic") in generating its own structures. For man—with the exception of genetic cloning, which is a quite different matter—replication is possible only when, as in the case of software development, we must deal with formal realities whose particularity is to exhibit just one, intentionally constructed OL—namely, in the case of software, information.

A different, very insightful strategy is that of the so-called bio-artificial technology, which provides artificial scaffolds that are able to help the natural structures (e.g., cells) perform correctly. This strategy does not necessarily aim at designing naturoids that are able to replace a system as a whole, but to provide an artificial assistance device to enable it to perform its natural function. Nevertheless, advancements in this field may lead to a new sub-field of true naturoid technology particularly at a microscopic OL.[11]

In principle, both for a standalone naturoid and, *a fortiori*, for a cumulative one, we must expect a range of potential performances that is far from that exhibited by the natural EM. In other words, the

10 D. Dennett, *Brainchildren: Essays on Designing Minds* (Cambridge, MA: MIT Press and Penguin, 1998).

11 A. Prokop, "Bioartificial Organs in the Twenty-first Century: Nanobiological Devices," *Annals of the New York Academy of Sciences* 944:1 (2001): 472–490.

fact that the naturoid is made of materials that are not those of the natural EM does not imply, as such, that it will be a less complex portion of reality: its richness may well be on a par with, or superior to, that of the EM although different in quality.

The "principle of emergence" [12] often is invoked by designers in the hope that the right EP of the naturoid—the one that was selected as essential from the natural EM—might appear spontaneously from the right architecture; that is to say, just by putting together partial artificial devices. Surely, such a principle always will be active, because something new always emerges when putting separate things together. Nevertheless, there is a high probability of finding completely new performances that are far from those exhibited by the natural EM as it has evolved. Ultimately, a transfiguration of the EM and of its performances, as generated by every naturoid, is unavoidable.

More formally, we could say that the advances in the reproduction of the EP of a given EM—normally achieved with further refinements of models, but also with the addition of conventional techniques and materials—implies the emergence of an ever-increasing set of actual or potential performances that are not matched in the EM. This, in turn, implies that, as the sum of the nature-like performances of a naturoid increases in its range, it is destined to represent an *ever-decreasing proportion* of the set of its possible *new and undesigned performances*.

This fact may involve further and serious transfigurations of the EPs themselves. Incidentally, the above considerations outline the roots of the so-called incompatibility that a naturoid usually exhibits, not only at a bioengineering level, but whenever it has to work in a natural environment. Rather than engaging in further theoretical considerations, it seems meaningful at this point to quote from a report on the building of artificial wetlands, which states: "Concerns revolve around such issues as the complexity of reproducing natural systems, the difficulty of measuring the success of man-made wetlands, the ability to mimic wetland functions such as flood control or water quality improvement, the extent that aquatic life will utilize the sites, and long-term success." [13]

The Welcome Deceit of Naturoids

As far as the success of a naturoid is concerned, another general rule almost always applies. Putting to work the key concepts we have introduced here, we may say that a naturoid will be accepted as a success if and only if those who judge it:

A. Place themselves at the same OL as that selected by the designers
B. Establish the boundaries of the EM in the same way that designers did, and,
C. Agree on the EP that the designers have attributed to the EM.

12 C. L. Morgan, *Emergent Evolution* (London: Williams and Norgate, 1923); and *Self-Organizing Systems: The Emergence of Order,* F. E. Yates, ed. (New York: Plenum Press, 1987).

13 *Texas Water Resources* 18:1 (Spring 1992). Also found at: http://twri.tamu.edu/twripubs/WtrResrc/v18n1/text-4.html). [Accessed, March 2005.]

After all, this is a very well-known limit in bioengineering, robotics, artificial intelligence, and all the other fields of naturoids. In a way that is somewhat similar to the classical intellectual expedient of scientists when they adopt the *ceteris paribus* clause, artificialists, too, must rely upon the possibility that "all things remain equal" when they put a naturoid to work in the real world.

In the case of pharmacology, which is among the most developed of artificialistic fields, is very instructive in this regard. In fact, sudden events and side-effects are the greatest challenge for pharmacologists—much more so, probably, than for other scientists and conventional technologists in general.

It is important to note that the success of a naturoid has two faces. One, as mentioned above, regards the scientific community or, in many cases, the general public: but another always will be the "organism," or the context or the environment within which the naturoid will be placed. In the end, it is the real judge of the replacement of one of its components by means of the naturoid because it "knows all the things" involved and needed for its correct functioning.

In fact, sudden events or side-effects coming from naturoids reveal the nature of the "deceit" (hopefully a good one, of course), so to speak, which is intrinsic to the naturoid. One of the leading pioneers of the artificial kidney and artificial heart, Professor Willem Kolff of the Kolff Labs in Salt Lake City, emphasized in a personal communication in 1995 that the function of an artificial heart is essentially to "cheat the body" in the sense that the body has to be persuaded that blood comes from a natural heart. This is the real aim of all naturoids: they are projects based on a sort of generalized Turing test.

This is not entirely a novelty of the twentieth century. For example, Cornelio Agrippa reported in the sixteenth century that, in a match between the two Greek painters Zeusi and Parrasio, "Zeusi draws grapes which deceive the sparrows … Parrasio draws a drapery which simulates so carefully a breadth of cloth, spread to cover a painting, that he cheated his competitor."[14] Similarly, Nicolas Negroponte has reported that, in the 1970s, when one of the first teleconferencing systems was designed to improve United States Government emergency procedures, a mechanism was added to reinforce the realism of the message given by the model system: an animated plastic head representing a speaker (for instance, the President). The result was that the "video recordings generated in this way provided so realistic a reproduction that an admiral told me that the 'talking heads' gave him nightmares."[15]

We should note that the above examples and the many others we could mention describe the story of the "natural effects" of naturoids. Of course, this is a matter of study to be carried out not only in the field of engineering, but also in the natural and social sciences.

14 G. Anceschi, *Monogrammi e figure, teorie e storie della progettazione di artefatti comunicativi* (Firenze, Italy: La Casa Husher, 1988), 128.

15 N. Negroponte, *Being Digital* (It. transl., *Essere Digitali*) (Milan: Sperling & Kupfer, 1995), 123.

Again, we cannot expect to obtain from such a study any evidence of a coming supremacy of machines, or proof of a more-than-metaphorical "autonomous development" or "symbiosis" with humans. Rather, we might obtain knowledge regarding the new path to follow for adapting ourselves to technology designed to meet (and in part to dictate) our needs. In so doing, we should clearly keep in mind that machines—and machine systems all the more—need to be governed because they lack any genetic teleology. Therefore, they always tend to degenerate, following purely physical laws and constraints, without any meta-rule capable of allowing the self-regulation of their individual and collective development.

Conclusions: Knowledge over Fear

As far as a teleological viewpoint is concerned, human technology follows two, apparently independent paths. Along the first, it is very creative, when, as in the case of conventional technology, it tries to control nature by *producing* objects, processes, or machines *ex nihilo*. Along the second, technology tries to *reproduce* natural EMs and their EPs, by basing the projects on the tools and knowledge provided by conventional technology.

Thus, in the field of naturoids, although conventional technology and materials are forced to mimic something natural, they are accompanied by their own intrinsic diversity with respect to nature's means of generating its objects and processes. This fact, along with the selective character of our way of defining natural EMs and EPs—due to the constraints imposed by the selected OLs—always makes naturoids something unavoidably new and different from nature.

Nevertheless, no evidence or theoretically well-founded reason can justify a prediction according to which, in the foreseeable future, artificial devices—such as robots, AI programs, bio-artificial devices, and so on—are destined to exceed the whole range of human abilities. Yet this might come to pass if, and only if, current advancements in the field of naturoids were to exhibit capacities *converging* towards more and more *intrinsically*, human-like features; up to and including an autonomous construction of a sort of artificial DNA which might be considered an artificial species, potentially superior to man.

Instead, what really happens is that naturoids develop only according to our ability to find technological solutions to the problems they face in understanding what we need from them. As the foregoing analysis has tried to show, even the most "intelligent" artificial device that exhibits growing autonomous capacity bases this skill on strategies and expedients which, the more they develop, the more they differ from our own, and furthermore without any possibility of establishing a new species. This implies that we should learn how to manage our relationships with naturoids when they begin to exhibit behavior for which they were *not designed*, and instead interact with each other or with nature according to some unexpected properties.

However, among the supposedly possible systemic outcomes of naturoid development, any "joining forces" against human beings has about the same likelihood as a sudden, undesigned act of jealousy by a robot; or of a spontaneous self-reproduction process in artificial grass. On the other hand, something new surely will arise from the technology of naturoids. This has happened throughout the whole history of conventional technology, although it may be imperceptible to us because our cultures are coevolving with the technologies we develop.

Therefore, as in any case of technological modification of the environment, we should prepare ourselves to carefully study the changes that we are bringing about. After all, the fear of the supremacy of machines over human beings, arising from human-like motivations, is not a new issue even though it has never happened in the past. At the most, it might occur in the form of a dependency that has nothing to do with an intrinsic "will to power" on the part of the various devices we have designed and adopted. Thus, the above supremacy has an unquantifiable probability if we conceive it as a coordinated and motivated outcome. Rather, in the near future, thanks to the unprecedented, highly developed, and complex technological systems we are building, we could find ourselves facing a world "apart" and only partially understandable without new, specific theoretical and empirical studies. In the end, we shall accept or reject the outcomes of this "new world" according to its degree of usefulness for our needs, and also, equally important, according to the degree of "beauty" that emerges from the architecture we are able to impose upon it.

Acknowledgments

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"Models of Man" in Design Thinking: The "Bounded Rationality" Episode

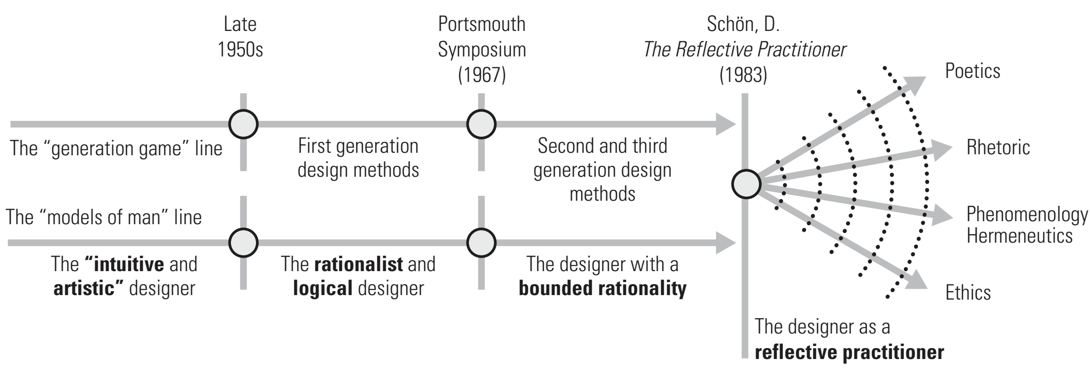
Rabah Bousbaci

Footnotes for this article begin on page 51

The "Generation Game" in Design Thinking

Design thinking—"the study of the cognitive processes that are manifested in design action" [1]—has been mostly described, from the late 1950s to the early 1980s, in terms of what is largely accepted today as the "generation game" (i.e., first-, second-, and third-generation design methods).[2] Proponents of the first generation; based on a strong reaction against the intuitive, artistic, and "beaux-arts" vision of the design process, which was largely diffused since the nineteenth century in design professional education; have supported, between the late 1950s and 1967,[3] a very logical, systematic, and rationalist[4] view of design activities (see figure 1). However, difficulties and a huge resistance met by this rationalist and logical trend led some major proponents of the design methods movement to fundamentally change their theoretical perspective from 1967 to the early 1980s. Horst Rittel proposed the idea of second- generation design methods[5] oriented towards more participatory and argumentative design and planning processes. In a similar participatory perspective, Christopher Alexander also experimented with a new approach to design based on the idea of the "pattern language."[6] But according to Nigel Cross, "…it has to be admitted that, like the first-generation methods, these second-generation methods have also met with only moderate success." [7] Therefore, simultaneous to this period, a third-generation view emerged whose proponents[8] were devoted to studying and acquiring an increased understanding of designers' cognitive behaviors as they simply occurred in the traditional ways of their practice.

Figure 1
Some landmarks in the evolution of design thinking.



Finally, in an attempt to go beyond this "generational" evolution of design thinking, Nigel Cross, in his 1981 paper, introduced arguments to encourage a paradigmatic shift with the intention of helping design thinking inquiries move towards what he called a "post-industrial" design paradigm. However, what is known today as the "reflective turn" suddenly emerged. It was introduced at the same time by Donald Schön (1983), who proposed a more comprehensive vision. This would help scholars, particularly in design thinking, to position their research on a more global perspective; an epistemology of the "reflective practice." [9] Therefore, since the early 1980s, research in design thinking tried to embrace a wide range of issues (poetical, rhetorical, phenomenological, hermeneutical, and ethical)[10] in order to obtain greater insights and an improved understanding of the design phenomenon.

The Idea of "Models of Man"

The teaching of design theories, especially at the graduate level, increasingly imposes the need for professors to explain some of the underlying philosophical roots and assumptions of the theoretical discourses to their students. Therefore, it is recommended that, as an academic discipline, design and its philosophy (i.e., the knowledge that leads to the degree of Ph.D. in Design) deal with these issues in a suitable and precise manner. This paper is an attempt in this direction. I would like to propose in the following sections a more "philosophical" approach to describing the phenomenon of the "generation game" and the other theoretical shifts that have structured the evolution of design thinking. My arguments will be based on the philosophical idea of "models of man"; models which are implicit or postulated in any design discourse. In order to clarify the issue, I will take an example from Herbert Simon's work in the field of economics; the field in which he received the Nobel Prize:

> Traditional economic theory postulates an "economic man," who, in the course of being "economic," is also "rational." This man is assumed to have knowledge of the relevant aspects of his environment?? He is assumed also to have a well-organized and stable system of preferences, and a skill in computation that enables him to calculate, for the alternative courses of action that are available to him, which of these will permit him to reach the highest attainable point on his preference scale.[11]

As does economic theory which postulates an "economic man," each design theory, unless it puts forward its philosophical assumptions, assumes as well a particular view (i.e., a model of the designer). Some other theoretical discourses in the field of design are more concerned with the users of design results. In the same way, these theories assume an implicit view (i.e., a model of the user).[12] I will argue, therefore, that each shift in the evolution of design thinking in fact corresponds to a major shift in the implicit models of the designer included within the analogous theoretical discourses.

The "first-generation" design methods had accomplished a shift from the romantic, intuitive, and artistic model of the designer in order to embrace a very logical and rationalist one (i.e., the "analysis/synthesis" model, of which Alexander's *Notes on the Synthesis of Form* is a good example). This logical and rationalist view has its obvious and deep origins in the mechanical world of René Descartes's philosophy. This was exposed in his *Discourse on Method* (1637), especially the very well-known statements of the second and third precepts of Descartes's method:

> The second was to divide each of the problems I was examining in as many parts as I could, as many as should be necessary to solve them.
>
> The third, to develop my thoughts in order, beginning with the simplest and easiest to understand matters, in order to reach by degrees, little by little, to the most complex knowledge, assuming an orderliness among them which did not at all naturally seem to follow one from the other.

In design thinking, this shift gained more importance during the period which Herbert Lindinger characterizes as the "fourth phase" of the reestablishment of the Bauhaus tradition in Ulm, Germany after the Second World War (from 1953 to 1968). This specific phase took place between 1958 and 1962; and Lindinger introduced it with the very symptomatic title of "Planning Mania." During this short phase, the school program witnessed a strong thrust towards scientific topics and planning methodologies:

> Planning methodology took such a hold that some students made it almost a religion. It seemed only a matter of time before scientific precision, system, and the computer … would free design of all its irksome, irrational weaknesses.[13]

Since the early 1980s, design thinking had entered a more complex view in which designers, according to Donald Schön, should be seen more as reflective practitioners.[14] The reflective practitioner is indeed a post-rationalist model of the designer.[15] The reflective turn was the last paradigmatic shift, and it also has been described by Donald Schön as a move from the realm of "technical rationality" to a rationality of reflection-in-action.[16] Furthermore, at a methodological level, this shift leads design theorists to gradually abandon the very rationalist and logical concept of "problem" (and the entire instrumental view of design as a "problem-solving process") in order to adopt the more pragmatic and phenomenological concept of "situation."[17]

We now are faced with the remaining question: how had the gap between the rationalist and the reflective view of the designer (i.e., the entire period occupied by the second- and third-generation design methods) been bridged in design thinking? What was the implicit model of the designer during this specific period in design thinking? This intermediate period, between the mid-1960s and the early 1980s, was central in the history and evolution of design thinking for two reasons. First, before embracing the reflective paradigm of the 1980s, research in design thinking had explored a "median" position which can be appropriately labeled as "the wicked problems theory of design."[18] This characterization can be extended to embrace all of the major theoretical works of the second- and third-generation design methods. Second, these two generations have brought to design knowledge some remarkable concepts that are still used with great relevance in design discourses—concepts such as "wicked problems" by Rittel and Webber; "solution-focused strategy" design by Lawson; design "conjectures" by Hillier, Musgrove, and O'Sullivan; design "primary generator" by Darke;[19] and, finally, even though they were not considered as members of the entire movement of design methods, Simon's concept of "ill-structured problems," and Newell and Simon's concepts of "problem space" and "generative processes."[20]

The design thinking delivered by these two generations mainly was recognized as one which moved away from the very rationalist and systematic ambitions of the first generation, in which researchers tried to give a complete account of the designer's operations. However, the main underlying idea of all these works is based on their common view of design as predominantly a "problem-solving process," and to this extent one notices that all of these authors continued to use the concepts of "problem" and "solution" to describe design activities.[21] As a consequence of the intrinsic nature of seeing design as a problem-solving process, the authors of the two generations somehow maintained some shared beliefs in a certain degree of rationality, logics, and objectivity which fundamentally characterize the design process. However, such a process cannot be totally rational and logical due to the accepted high complexity of design problems. As a result, they may implicitly assume a particular idea of a designer armed with what Simon has conceptualized more precisely as a "bounded rationality." Such a view of the designer therefore can be considered as the main "model of man" of the second- and third-generation design methods. I propose to call this period the "bounded rationality episode" in design thinking.

The following sections are principally related to the concept of "bounded rationality." This concept originates from Herbert Simon's theoretical works in the field of psychology. It was developed in one of his several distinguished works, *Administrative Behavior.* I will first present some of the important historical and theoretical elements which describe the coming of this idea. After this historical overview, I will attempt to show how the idea of "bounded rationality" appears in Newell and Simon's concepts of "problem space" and "generative processes." This will lead directly to an interpretation of two key concepts introduced by researchers of the second- and third-generation design methods: the concept of wicked problems conveyed by Horst W. J. Rittel, and the concept of primary generator developed by Jane Darke. I will conclude this paper by revealing two points of view considered as very critical of Simon's conception of rationality.

The Concept of "Bounded Rationality": A Historical and Theoretical Overview[22]

In *Administrative Behavior,* Simon developed the foundations of his theory about the rationality and the psychology of decision making, especially in administrative organizations.[23] But, in more general terms, Simon perceives decision making and some other complex cognitive behaviors as problem-solving activities in which the human brain plays the role of an information-processing system. Therefore, he later developed with a colleague a comprehensive theory in another seminal work entitled *Human Problem Solving.* Generally, the idea of bounded rationality arises in this context of psychological and cognitive investigations. It took place mainly within the large area of interest left behind by traditional psychology (i.e., behaviorism), especially its inability to describe, in an acceptable manner, some complex cognitive behaviors such as rational choices, games, decision making, and problem solving in general.[24] Peter Rowe gives us an interesting description of some assumptions of behaviorism:

> The behaviorist position began as a reaction to what proponents termed the mentalism of earlier doctrines. It was a fundamental rejection of all attempts to study inner mental processes in which distinctions were made between a concept of mind and a concept of body. Instead, the behaviorists postulated that human behavior, including problem solving, could only be adequately explained in nonmentalistic, concrete terms. By concrete terms they meant observable, measurable, and replicable patterns of physical behavior. Investigations within the position quickly gave rise to the now familiar stimulus-response, or S-R models of behavior, founded on the assumption that given a particular external stimulus, one could predict a certain response with complete assurance.[25]

This static and deterministic orientation of behaviorism, which is commonly expressed in terms of direct correlations between environmental stimulus and human response (i.e., the behavior), has in fact a hidden assumption which resides within the idea of the "empty organism."[26] This concept expresses the functional void or emptiness, in terms of information processing, between the two poles S and R. This means a fundamental incapability for the organism to process the information brought by the stimulus in order to satisfy its own goals. In other words, such a view of human beings allows no place for purposive behaviors or rational behaviors which can require the processing of that information:

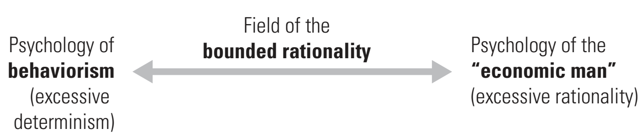
> The behaviors commonly elicited when people (or animals) are placed in problem-solving situations (and are motivated toward a goal) are called *adaptive,* or *rational.* These terms denote that the behavior is appropriate to the goal in the light of the problem environment: it is the behavior demanded by the situation.[27]

On the other hand, before 1945, the year that the first edition of *Administrative Behavior* was published, there have been numerous theoretical accounts of rational behaviors provided by social sciences, especially sociology and economics, in which Simon could find some philosophical foundations to support his theoretical enterprise about human rationality. Unfortunately, this was not the case:

> The social sciences suffer from a case of acute schizophrenia in their treatment of rationality. At one extreme we have the economists, who attribute to economic man a preposterously omniscient rationality. Economic man has a complete and consistent system of preferences that allows him always to choose among the alternatives open to him…. At the other extreme, we have those tendencies in social psychology traceable to Freud that try to reduce all cognition to affect…. The past generation of behavioral scientists has been busy, following Freud, showing that people aren't nearly as rational as they thought themselves to be. Perhaps the next generation is going to have to show that they are far more rational than we now describe them as being—but with a rationality less grandiose than that proclaimed by economics.[28]

So when the time came to understand and acquire insights into the field of individuals' behavior within an administrative environment, Simon was simply not satisfied with these two extreme positions (see figure 2). There was a sort of a "fallow land" between them that comprised a great number of human behaviors of which these theories gave no accounts. Therefore, Simon proposed the concepts of "bounded rationality" and "satisficing" with which he endorsed an "intermediate" position.

Figure 2
Herbert Simon's concept of bounded rationality.



Indeed, whoever has observed these types of behavior will notice that the rationality which underlies them has no close relationship to the total rational behavior of the "economic man." However, if the administrative behavior is not totally rational, it is obvious that although it contains some rationality in its intentions, this rationality is limited. This is what can be described as an "intended rational behavior," or a "behavior of limited rationality":

> Administrative theory is peculiarly the theory of intended and bounded rationality—of the behavior of human beings who *satisfice* because they have not the wits to *maximize.*[29]

Therefore, the concept of bounded rationality will be particularly suited to describe human actions in situations that endure some degree of uncertainty. The uncertainty, in Simon's view, is principally due to the inability of the human mind to acquire all of the necessary information required by a totally rationalist decision-making activity:

> The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world…[30]

It was this theory of behaviors with a bounded rationality, initially developed to describe decision making in administrative organizations, which later was extended to become a general theory of human problem solving.

Yet one question remains unanswered: if none of the social sciences theories have brought any satisfaction for Simon's investigations, where will he find the necessary and adequate philosophical elements to build and secure the foundations of his own theory? It is a difficult question which undoubtedly can provide the motivation for developing a research paper of its own. The answering of it, however, can hardly escape the idea that some influences stemmed from the philosophy of pragmatism. Therefore, some of the foundations of the psychological side of Simon's model of "man with a bounded rationality" are based on the philosophy of pragmatism. Pragmatism is a philosophical school of thought initiated in the United States in the second half of the nineteenth century. It used to be described as an empirical theory of knowledge in which action, and especially its practical consequences, plays a fundamental role. In order to put forward their ideas, each of the most important pragmatist philosophers (Charles S. Peirce, Williams James, John Dewey, and F. C. S. Schiller) have introduced a psychological view of the human condition in which action and a great number of related concepts (such as intention, situation, meaning, end, habit, conduct, etc.) play a significant role. Therefore, some of the principal insights that Simon was searching for, and could not find within the psychology of behaviorism and the other social sciences in order to develop his own psychology of human rational problem solving, were later found within the psychological parts of the pragmatist philosophers works.[31] We will see now how two specific methodological concepts have emerged from this philosophical view of human rationality.

Newell and Simon's Concepts of "Problem Space" and "Generative Processes"

We will begin with the central concept which is used regularly and instinctively in design discourses: the concept of "problem." Newell and Simon give this description:

> A person is confronted with a problem when he wants something and does not know immediately what series of actions he can perform to get it. The desired object may be very tangible (an apple to eat) or abstract (an elegant proof for a theorem). It may be specific (that particular apple over there) or quite general (something to appease hunger). It may be a physical object (an apple) or a set of symbols (the proof of a theorem).[32]

This characterization of the idea of problem may be considered as a very instrumental one, and it reminds us of the frequent mathematical modeling: $A \rightarrow B$, where A represents an initial state, B a desired state, and the arrow ($\rightarrow$) represents the process of problem solving; that is how to get from A to B.[33] But the significance of this simplistic mathematical model becomes evident only when we understand that the state of knowledge we acquire about A and B is "not problematic": the problem indeed lies in the path from A to B. However, if we consider in a much closer way the main methodological concepts to which Simon's theory of bounded rationality gave birth, we will notice a certain hidden complexity. Peter Rowe summarized it in these words:

> First, there is a problem space whose elements are knowledge states, some of which represent solutions to a problem. Second, there are one or more generative processes, or operations, that allow one to take knowledge states as inputs, or as starting positions, and produce new knowledge states as output… Third, there are one or more test procedures that allow the problem solver to compare those knowledge states that are presumed to incorporate solution properties with a specification of the solution state.[34]

"Problem space" and "Generative processes" are two key methodological concepts of Newell and Simon's problem-solving model, and each of them expresses the bounded rationality of the designer who can use this model. The idea of problem space expresses the problematic state to be changed and corrected. The solution, on the other hand, is delivered by the means of one or more generative processes:

> Every problem-solving effort must begin with creating a representation for the problem—a *problem space* in which the search for the solution can take place.[35]

The significance here is the fact that a problem space is, above all, a matter of knowledge (i.e., the state of knowledge the problem solver (the designer) has about the problematic state). Therefore, the first sign of the designer's bounded rationality appears here. Since such knowledge cannot be complete and comprehensive, the problem space then is described by Newell and Simon simply as a "representation"[36] (not the total and objective reality) of the problematic state. Thus, one can imagine that there can be more than just one representation for the same problematic state. This is very important because in another seminal work, *The Sciences of the Artificial,* Simon will give a definition of a designer as everyone "who devises courses of action aimed at changing existing situations into preferred ones."[37] The idea of the "existing situation" is equivalent to the concept of "problem space," and the two are similar to cognitive constructed realities (i.e., cognitive representations), which help the problem solver to frame an existing state and attain it intelligibly. This implies that the solution is strongly dependant on the way in which the existing state has been framed as a problem. This last element was a compelling insight of second- and third- generation design methods, and Simon had emphasized this in one section of the chapter devoted to "the science of design" in *The Sciences of the Artificial.* That section's title is: "Problem Solving as Change in Representation."

> …solving a problem simply means representing it so as to make [its] solution transparent. If the problem solving could actually be organized in these terms, the issue of representation would indeed become central. But even if it cannot if this is too exaggerated a view? a deeper understanding of how representations are created and how they contribute to the solution of problems will become an essential component in the future theory of design.[38]

The second indication of the designer's bounded rationality lies in the concept of generative processes. Basically, the generative processes include different instrumental methods suited to tackle specific problems: methods such as trial-and-error procedures, means-ends analysis, heuristic searches, and the generator-test cycle.[39] Once the designer has chosen and created an adequate representation of the problem (a problem space), he then selects one or more generative processes that lead him not to the single and true solution, but to the most satisfying one. Therefore, one can argue that it was the misunderstanding of this fundamental characteristic of the problem space concept (i.e., as a created representation) which frequently led to the reduction of the inherently complex design process to a simple matter of generative processes; and Peter Rowe, once again, had aptly noticed this trend:

> Those who study problem-solving behavior generally make comparisons among problem solvers according to differences in their methods of problems representation, solution generation, and solution evaluation. Clearly these three sub-classes of activity are interdependent. The choice of solution generation strategy may markedly affect the manner in which a problem is represented and the manner in which solutions are evaluated. It is generally in terms of solution generation strategy that problem-solving procedures are described.[40]

Some "Bounded Rationality" Ingredients in Second- and Third-Generation Design Methods

In order to illustrate the dissemination of the bounded rationality current in design thinking, I will briefly deal with two major theoretical works which I consider very representative of the two generations of design methods: Horst Rittel's concept of wicked problems, and Jane Darke's concept of primary generator.

According to Richard Buchanan,[41] the phrase "wicked problems" was borrowed by Rittel from the philosopher Karl Popper.[42] Ten important, related characteristics of this concept were reported by Rittel and Webber,[43] and it was very interesting to notice the several occurrences of the adverb "no" in some of them. This can be considered as a clear indication of what Buchanan depicts as the indeterminacy of design problems[44] and, ultimately, the bounded character of the rationality which underlies design realities and objects. The first several characteristics express the idea that wicked problems have *no* definitive formulation—"the formulation of a wicked problem *is* the problem!"[45]—and the fact that they have *no* stopping rule—"there are no criteria for sufficient understanding."[46] Consequently, "the choice of an explanation (i.e., a representation) to the problem determines the nature of the resolution."[47] Herbert Simon probably would say here: "Since the search for a solution occurs in a problem space, the creation of a representation for the problem therefore *is* the problem." Furthermore, solutions to wicked problems are *not* true-or-false but good-or-bad—"Assessments of proposed solutions are expressed as 'good' or 'bad' or, more likely, as 'better or worse' or 'satisfying' or 'good enough.'"[48] Finally, every wicked problem is essentially unique—"there are no classes of wicked problems."[49] In an epistemological sense, this last characteristic clearly means that a general science of problems, in which design problems are just a subclass, cannot exist. Such a statement then is very close to Donald Schön's idea that every design situation is essentially unique. The logical or rationalist approaches are not completely suited to understand such problems. This is why Schön recommends a *dia*-logical conversation with the materials of the situation.

The Cartesian and rationalist method, as we have mentioned above,[50] was a great influence on the philosophy of the first generation design methods. With the introduction of Rittel's concept of wicked problems, the Popperian philosophy and thoughts—especially the idea of conjecture—emerged as important philosophical arguments to replace the Cartesian model. It was Brian Lawson who launched in his doctoral thesis of 1972[51] the idea that architects' strategies of the design process are solution-focused ones; in opposition to scientists' approaches, which are problem-focused. Such orientation seems to be very analogous to the role of the Popperian idea of conjecture in the growth of scientific knowledge and discovery; and on which Hillier et al. also have based their arguments in their 1972 paper.[52]

As a representative of third-generation design methods, Jane Darke's paper, "The Primary Generator and the Design Process"[53] was significant since, in some sense, it completed Lawson's and Hillier's previous theoretical works on the same topic. For Hillier et al., and also for Darke, the idea of conjecture refers to an important characteristic of design which "is seen as a process of 'variety reduction' with the very large number of potential solutions." [54] In addition to this, Darke conveys the insightful suggestion that this "greatest variety reduction or narrowing down of the range of solutions occurs early in the process." [55] Darke proposes, therefore, the concept of the primary generator to summarize this phenomenon, which basically consists of the use of a few simple objectives in architects' approaches to design in order to attain an initial concept.[56] Jane Darke refers clearly to the bounded character of the rationality with which architects engage in the resolution of design problems, especially when she tries to describe what causes the emergence of what she calls the "visual concept":

> In other cases it appears that a certain amount of preliminary analysis takes place before the visual concept arises. It seems normal, however, for there to be a "rationality gap": either the visual concept springs to mind *before* the rational justifications for such a form, or the analysis does not dictate *this particular* concept rather than others.[57]
>
> …any particular primary generator may be *capable* of justification on rational grounds, but at the point when it enters the design process it is usually more of an article of faith on the part of the architect.[58]

In the second section of this paper, I mentioned that each design theory assumes a particular view or a model of the designer. Also, each design theory may assume a certain view of the people to whom the design result or product is intended (i.e., the users). I will end this section by showing that it was remarkable how, in the conclusion of her paper, Darke raises these two critical issues, and proposes some orientation for future research in this field:

> The author [Darke] feels that the most interesting direction for design research to take now is to find further ways of "looking inside the designer's head," of exploring subjectivity. The denial of the value of the subjective and the hope that the building would "design itself" now seem to be products of a scientistic rather than a scientific way of thinking.[59]
>
> The image of the user implied by this attitude was a mechanistic one, an anthropometric manikin with certain environmental needs but no emotional responses…. A revaluation of subjectivity in design can lead to a revaluation of the subjective responses of the user, and hopefully to a more responsive architecture. Such an architecture will reflect the diversity and anarchy of human life, just as research on design methods should reflect the diversity in approaches to design.[60]

Conclusion

I would like to conclude this paper by emphasizing some elements of two authors' critiques of Simon's view of rationality. These authors address, in particular, two main issues in Simon's intellectual approach to decision making, problem solving, and design. The first is Simon's perspective of "cognitive" orientation of these complex human behaviors, especially the subject of uncertainty. Cognitive orientation here means that design activity has its *raison d'être* in the existence of a problem, which is essentially a problem of knowledge. Carolyn R. Miller, in a paper entitled "The Rhetoric of Decision Science, or Herbert A. Simon Says,"[61] criticizes Simon's cognitive approach on the issue of uncertainty. She brings some theoretical elements from the discipline of rhetoric (especially the Aristotelian *Rhetoric* in order to deal more adequately with this issue:

> Simon's definition of bounded rationality in terms of the disparity between the capacity of the human mind and the size of the problems implies that uncertainty lies in the discrepancy between information available and information needed; that is, uncertainty is wholly a problem of knowledge…. By contrast, Aristotle observes that uncertainty concerns not knowledge but human actions. Our imperfect knowledge, of course, makes deliberation about our actions

> more difficult, but, as Aristotle says, we do not waste time deliberating about questions with only one possible answer…. Problems of knowledge presuppose no real conflict—except between people and the limits of available information. Problems of action involve conflict between people…. Problems of action are "essentially contestable"; problems of knowledge are not…. The task in solving a problem of action is not to acquire more information or to modify a calculus; it is, rather, to exercise what Aristotle called practical reason….[62]

Beyond the topic of uncertainty, the second issue which raises criticism in Simon's approach; specifically his attitude to design; was brought by Donald Schön. The author detects in Simon's view a clear expression of what he calls technical rationality—or the instrumental view of human reason and human action—which, according to him, underlies the epistemology of a great number of professional disciplines since their establishment in the nineteenth century:

> He (Simon) saw designing as instrumental problem solving: in its best and purest form, a process of optimization. This view ignores the most important functions of designing in situations of uncertainty, uniqueness, and conflict where instrumental problem solving—and certainly optimization—occupy a secondary place, if they have a place at all.[63]

As we can see from these two critiques, it was the dominant role Simon assigned to rational knowledge in human action which is questioned. Miller sets a place for rhetoric in human action; and Schön, on the other hand, argues that human action is not just a matter of scientific and technical rationality. In Simon's concept of "bounded rationality," I rather see an opportunity for a wise and careful use of rationality, especially in design practice. Rationality, whether scientific or technical, has to play a role, but it must be moderate. Thus, from a phenomenological perspective, I prefer to focus not on the concept of "bounded rationality" itself, but on what really "bounds" rationality within human action. The great danger then is to restrict the bounding factors to simply a matter of knowledge. Rationality is one part of all human faculties and condition. Therefore, what really bounds rationality in human action is nothing more than all the other parts which comprise the human existence as a whole: poetics, rhetoric, hermeneutics, and ethics; because, when humans act, they act as whole humans.

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1 Nigel Cross, Kees Dorst, and Norbert N. Roozenburg, Preface to *Research in Design Thinking,* Nigel Cross, Kees Dorst, and Norbert N Roozenburg, eds. (Delft: Delft University Press, 1992), 1. See also Peter Rowe, *Design Thinking* (Cambridge: MIT Press, 1987).

2 I borrow the phrase "generation game" from Nigel Cross, "The Coming of Post-industrial Design," *Design Studies* 2:1 (1981). See also Geoffrey Broadbent, "The Developments of Design Methods" in *Developments in Design Methodology,* Nigel Cross, ed. (New York: Wiley, 1984).

3 1967 is the year in which the Design Methods in Architecture Symposium was held in Portsmouth, UK. For more on this symposium, see *Design Methods in Architecture,* Geoffrey Broadbent and Anthony Ward, eds. (London: Lund Humphries, 1969).

4 See especially the introduction of Christopher Alexander's *Notes on the Synthesis of Form* (Cambridge, MA: Harvard University Press, 1964), whose subtitle is: "The Need for Rationality." For more on the proponents of this first generation, see the proceedings of the 1962 first conference on design methods published in *Conference on Design Methods,* John Christopher Jones and D.G. Thornley, eds. (New York: Pergamon Press, 1963).

5 Horst Rittel, "Second-Generation Design Methods" in *The DMG 5th Anniversary Report: DMG Occasional Paper* 1 (1972): 5–10. Also reproduced in *Developments in Design Methodology,* Nigel Cross, ed. (New York: Wiley, 1984).

6 Christopher Alexander et al., *A Pattern Language: Towns, Buildings, Construction* (New York: Oxford University Press, 1977).

7 Nigel Cross, "The Coming of Post-industrial Design," *Design Studies* 2:1 (1981), 4.

8 See the following authors in "Part Three: The Nature of Design Activity" in *Developments in Design Methodology,* Nigel Cross, ed. (New York: Wiley, 1984): Jane Darke, "The Primary Generator and the Design Process"; Omer Akin, "An Exploration of the Design Process"; and Bryan Lawson, "Cognitive Strategies in Architectural Design."

9 Donald Schön, *The Reflective Practitioner: How Professionals Think in Action?* (New York: Basic Books, 1983); *Educating the Reflective Practitioner* (San Francisco: Jossey-Bass, 1990).

10 For more on this topic, see Rabah Bousbaci and Alain Findeli, "More Acting and Less Making: A Place for Ethics in Architecture's Epistemology," *Design Philosophy Papers* 4 (2005); www.desphilosophy.com/dpp/home.html (accessed April 29, 2007); Alain Findeli and Rabah Bousbaci, "The Eclipse of the Object in Design Project Theories," *The Design Journal* 8:3 (2005): 35–49.

11 Herbert. A. Simon, *Models of Man: Social and Rational* (New York: Willey and Sons, 1957), 241.

12 Some insights about this issue are well developed by Aren Kortguzu, "From Function to Emotion: A Critical Essay on the History of Design Arguments," *The Design Journal* 6:2 (2003): 49–59.

13 *Ulm Design,* Herbert Lindinger, ed. (Cambridge, MA: MIT Press, 1991), 11.

14 Donald Schön, *The Reflective Practitioner* (1983).

15 See especially Chapter 3 in Schön (1983).

16 See especially Donald Schön, "Towards a New Epistemology of Practice: A Response to the Crisis of Professional Knowledge" in *Learning and Development: A Global Perspective,* Alan Thomas and Edward W. Ploman, eds. (Toronto: OISE Press, 1986).

17 Donald Schön, "Designing as Reflective Conversation with the Materials of a Design Situation," *Research in Engineering Design* 3:3 (1992): 131–148.

18 See Richard Buchanan, "Wicked Problems in Design Thinking" in *The Idea of Design,* Victor Margolin and Richard Buchanan, eds. (Cambridge, MA: The MIT Press, 1995), 12.

19 For more about these authors and their concepts, see their texts in Cross (1984).

20 Allan Newell and Herbert A. Simon, *Human Problem Solving* (Englewood Cliffs, NJ: Prentice-Hall, 1972).

21 "Once again we confront the attempt to turn the incalculable into the calculable. But there can be no 'solution' to a state of affairs that never had the structure of a 'problem' in the first place" in Wilson C. St John, *Architectural Reflections: Studies in the Philosophy and Practice of Architecture* (Oxford: Butterworth, 1992), 45.

22 This section and the next one were adapted (and translated) from Rabah Bousbaci, Les modèles théoriques de l'architecture: de l'exaltation du faire à la réhabilitation de l'agir dans le bâtir (Ph.D. thesis, University of Montreal, 2002). This thesis was directed by Professor Alain Findeli.

23 Herbert A. Simon, *Administrative Behavior. A Study of Decision-Making Processes in Administrative Organizations* (New York: The Free Press, MacMillan, 2nd edition, 1957). See particularly chapter 4: "Rationality in Administrative Behavior" and chapter 5: "The Psychology of Administrative Decisions," which represent the heart of this book.

24 For more about the behaviorist school of thought's inability to describe some of the human and animal complex behaviors, see Rowe, *Design Thinking,* 50, and Newell and Simon, *Human Problem Solving* For a more historical overview about this issue, see the chapter entitled "Historical Addendum" in Newell and Simon, *Human Problem Solving,* 873.

25 Rowe, *Design Thinking,* 44.

26 See Newell and Simon, *Human Problem Solving,* 875.

27 Ibid., 53.

28 Herbert A. Simon, *Administrative Behavior,* xxiii.

29 Ibid., xxiv.

30 Herbert A. Simon, *Models of Man, Social and Rational* (New York: Wiley, 1957), 198.

31 In *Administrative Behavior,* 80, Simon refers explicitly to Williams James's *The Principles of Psychology;* to John Dewey's *Human Nature and Conduct* and to some analysis of E. C. Tolman in *Purposive Behavior in Animals and Men.*

32 Newell and Simon, *Human Problem Solving,* 72.

33 For more about this model, see Tom Heath's analysis in *Method in Architecture* (Toronto: Wiley, 1984), 126–127.

34 Rowe, *Design Thinking,* 51–52.

35 Herbert A. Simon, *The Sciences of the Artificial* (Cambridge, MA: The MIT Press, 3rd edition, 1996), 108.

36 See Newell and Simon, *Human Problem Solving,* 59.

37 Simon *The Sciences of the Artificial*, 111.

38 Ibid., 132.

39 For more, see Newell and Simon, *Human Problem Solving,* 87; Rowe, *Design Thinking,* 56; and Simon, *The Sciences of the Artificial,* 121 and 128.

40 Rowe, *Design Thinking,* 56.

41 See footnote 36 in Buchanan, "Wicked Problems in Design Thinking": 14.

42 Karl Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge* (London: Routledge and Kegan Paul, 1963). Hillier, Musgrove, and O'Sullivan also borrow from this philosopher's thinking the idea of design *conjecture.* See Hillier, Musgrove, and O'Sullivan in *Developments in Design Methodology,* Nigel Cross, ed.

43 For all the references here, I will use the 1984 edition. See Rittel, Horst, and Webber, "Planning Problems Are Wicked Problems" in *Developments in Design Methodology,* Nigel Cross, ed. Originally published as part of "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973).

44 Buchanan, "Wicked Problems in Design Thinking," 14.

45 Rittel and Webber, "Planning Problems Are Wicked Problems," 137.

46 Ibid., 138.

47 Ibid., 142.

48 Ibid., 139.

49 Ibid., 141.

50 See the statements of the 2nd and 3rd precepts of Descartes's *Discourse on Method* in section 2.

51 See Bryan R. Lawson, "Cognitive Strategies in Architectural Design" in *Developments in Design Methodology,* Nigel Cross, ed.

52 Bill Hillier, John Musgrove, and Pat O'Sullivan, "Knowledge and Design" in *Developments in Design Methodology,* Nigel Cross, ed. Originally published in *Environmental Design: Research and Practice,* W. J. Mitchell, ed. (Los Angeles: University of California, 1972).

53 For all the references here, I will use the 1984 edition. See Jane Darke, "The Primary Generator and the Design Process" in Developments in Design Methodology, Nigel Cross, ed. Originally published in *Design Studies* 1:1 (1979).

54 Darke, "The Primary Generator and the Design Process," 180.

55 Ibid., 180.

56 Ibid.

57 Ibid., 180–181.

58 Ibid., 181.

59 Ibid., 187.

60 Ibid.

61 Carolyn R. Miller, "The Rhetoric of Decision Science, or Herbert A. Simon Says" in *The Rhetorical Turn: Invention and Persuasion in the Conduct of Inquiry,* Herbert W. Simons, ed. (Chicago: University of Chicago Press, 1990).

62 Ibid., 175–176. On the idea of "practical reason," which means "ethics" in Aristotelian philosophy, see Bousbaci and Findeli, "More Acting and Less Making: A Place for Ethics in Architecture's Epistemology."

63 Donald Schön, *Educating the Reflective Practitioner,* 41.

Slap: The Posters of Santiago Pol

Humberto Valdivieso

Figure 1
"*Semana del INCIBA*" [Institute of Culture and Belles Arts (INCIBA) Week], 1968.

The poster is a sign inserted in the complex semiotic systems that characterize contemporary cities. Aware of this fact, Santiago Pol designs his work considering both the paper and the context in which the poster will be placed. He researches the connections between forms, colors, and typography in graphic and urban spaces. Plus, he considers the guidelines given by the person creating the message, and analyzes the communicative effectiveness of every idea, as well as the possible environmental, emotional, and social circumstances of his audience. Pol collects the opinions and customs of the city. He views the creative process as a competitive risk, and pursues ideas to stir up passersby psyches; a complex task, since most people are bewildered by the saturation of icons along streets. Every graphic work that Santiago Pol creates comes from an observation process and intense study. Nevertheless, his graphic designs are a product of a creative praxis matured over a forty-year period. Therefore, when we look at the entirety of his posters, we find a coherent work of art with a unique condition that defines its existence as a delivered message.

Pol finished his first poster in 1968, called "Semana del INCIBA" [Institute of Culture and Belles Arts (INCIBA) Week] (Figure 1). Over the last few decades, he has created countless corporate and editorial designs. However, it is his work as poster designer that has given him a significant position inside and outside of Venezuela. Pol is the author of many logotypes, illustrations, and publications that the Venezuelan public remembers. Some of his remarkable pieces include the emblems of the National Election Council (*Consejo Nacional Electoral*) of Venezuela, and the Direction of Culture (*Dirección de Cultura*) of the Universidad Central de Venezuela; the sets of posters for the International Theater Festival of Caracas; the original system map for the Metro of Caracas (Caracas Subway System); and twenty popular Venezuelan stamps. A good portion of Pol's designs are well known at the international level, and some of his posters are in the collections of the Museum of Modern Art of New York and the Louvre. Recently, he was asked to design one of the posters for the 2008 Beijing Olympic Games (Figure 2). Pol is an honorary member of Mexico City Biennial of Posters, and the Alliance Graphique Internationale (AGI). Besides winning several prizes, he was the leading designer of Venezuela in the 51st Venice Biennale in 2005.

Figure 2
2008 Beijing Olympic Games poster, 2004.

A Goldfish: From Art to Design

Pol's works lie on the borderline of the struggle between the incisive spirit of the plastic artist and the graphic designer in which the first pursues the dissolution of conventional formulae, while the second emphasizes the messages' regulations and the researching of functional problems of image representation.

Santiago Pol attended The School of Plastic Arts Cristobal Rojas of Caracas and The National School of Fine Arts in Paris. In the 1960s, he joined several of the avant-garde groups in Caracas such as the Círculo del Pez Dorado (Goldfish Circle). Later, in France, he met and joined Venezuelan kinetic artists Jesús Soto and Carlos Cruz-Diez. He also worked with the Argentinean artist Hugo de Marco, doing some projects for Victor Vasarely. For Pol, that was a time for searching and influences, a time when different aesthetics trends joined together to keep him engaged in research. These influences included Magritte, Warhol, the kinetic art movement, and Japanese prints.

When Pol returned to Venezuela, he abandoned the plastic arts and decided to devote himself exclusively to the creation of posters. From that moment on, he replaced the freedom of creating art with the discipline and commitment of graphic design. Nevertheless, Paris, together with the avant-garde and the schools of plastic arts became solid aesthetic antecedents in Santiago Pol's art and in the same way as the visual influences. A physical and conceptual example is found in a 1995 poster for an exhibit in the Universidad

Central de Venezuela titled "The 1990s in 30" (Figure 3), in which Pol synthesizes the constructing and chromatic graphic elements of Roy Lichtenstein, Alexander Calder, and Andy Warhol.

A Visual Hound Dog: The Poster in Pol

As an instrument for social communication, the poster lacks a unique style. Its effectiveness depends on a capability for surprising the audience. But because of the fierce visual competition found in urban environments, the poster has to constantly change its concepts and designing strategies to test, tenaciously, the aesthetic, communicative, and social tendencies of every artistic period. This process has turned the poster into a living language that has survived the arrival of all new communication technologies. It seems that the openness and the popularity of the poster have been the keys to its capability in adapting to several different trends, looks, and techniques. The same way it occurred with the painting before the nineteenth-century, the aesthetic value of the poster does not quarrel with its social purpose. The poster is intended to place readers—not spectators—in a referential context. It always is committed within a determined cultural, or political, discourse. The poster itself represents a social point of view, and nobody expects the poster to capture the personal views of his or her designer. None of us would have expected that Michelangelo would change the iconographic program of the Sistine Chapel to offer his intimate perspective of Christian doctrines. Very much aware of this, Santiago Pol gives precedence to the visual impact over the conceptual content in his posters. He knows that at a distance of seventy to one-hundred feet any piece of denotative information ceases to have any effect. For Pol, the few seconds that a human eye rests on a poster on a subway car, some wall, or column must be sufficient for attracting people's interest. In summary, it can be said that Pol's creative process is framed upon limitless and restless sensorial curiosity.

Pol often has addressed his personal style as one filled with a sort of "visual sense of smell," something that makes possible knowing what is happening just by sniffing the air and identifying the clues to be represented graphically. In general, Pol's way is a metaphor for the human being who is always enriched by the senses of smell, taste, touch, hearing, and sight. Pol's style encloses a manner of expression that enhances instincts trained not to lose track of the footprints of shape, color, typography, and composition. He creates from the sensory experiences collected on the streets without excluding the aesthetic influences he carries with him and, additionally, the client's needs. Pol has a graphic sensibility trained in the native land of memorable aromas, flavors, and landscapes. There is no abstraction of ideas when Pol starts the investigation leading to the creation of a poster. As a designer, he favors sensory, empirical, and direct knowledge, which is why he stays closely attached to ordinary people, thus making almost impossible any chance for discrimina-

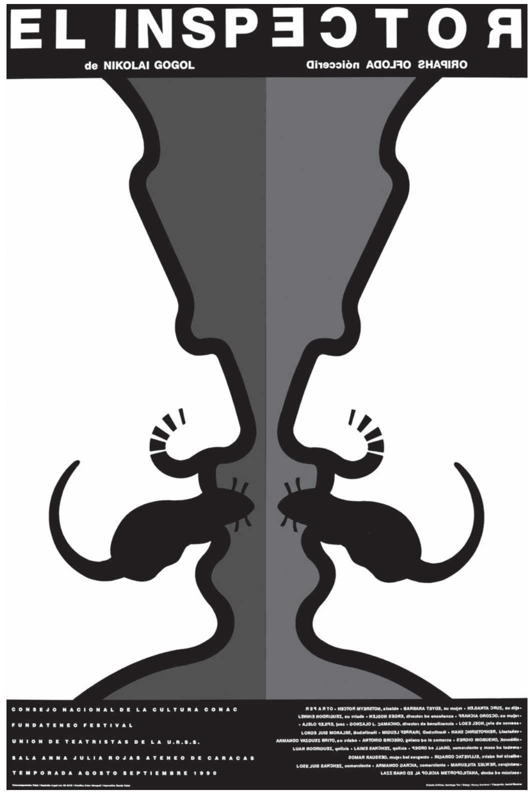


Figure 3 (left)
"The 1990s in 30" for Universidad Central de Venezuela exhibit, 1990.

Figure 4 (right)
"*El inspector es una rata*" ("The Inspector Is a Rat Fink") a poster for a play by Nikolai Gogol, 1990.

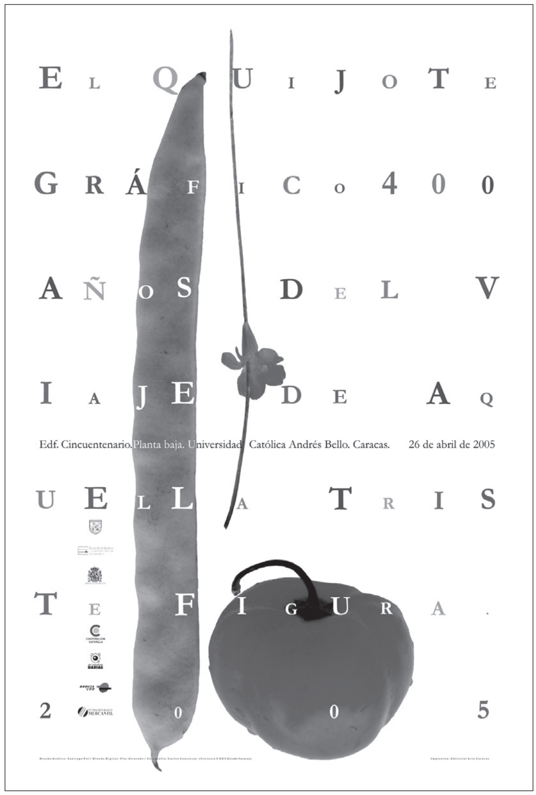
tion. From this point of view, the discourse in his posters is intended for the masses that do not stop to think. And still his ultimate goal is to produce a commotion in each individual among the streams of people inundating the streets of contemporary cities.

Bewilderment and remembrance are precisely the effects that Pol's work aims to achieve. He believes, as he has expounded in every conference and every interview, that the poster is like a thief who will take your house by surprise, and leave you wondering how he did it. In the same way, Pol argues that the image required to reach the masses must be "like a punch in the eyes so powerful that it bruises the brain."

As a communicator, Pol has felt obliged to pay attention to the voices of his surroundings before drawing even the first line of any new work. Pol's products do not begin inside him, but outside where noise, desires, and speed compete to reach a place in history. However, Pol's resulting creations leave out concessions, and always overflow the limits of information. Once the stumbling block of the "immediate effect" is surmounted, Pol's creation does not fade; on the contrary, it remains in time as an autonomous expression.

From his theoretical work as an educator and from his practice as a designing artist, Santiago Pol has researched color as a concept, as a cultural discourse, and as a carrier of emotions. He has built a personal iconography based on paradoxical and ambivalent objects; and based on the artistic sign considered as a structure open

Figure 5
“El Quijote es una vainita” poster for the eighteenth anniversary of the School of Cinema and Television.



to multiple meanings. Always from differing orientations, Pol has used diverse techniques such as photomontage, illustration, collage, sculpture, and digitalizing. He confronts his designs in the manner of a visual challenge not pleasing, but instead pushing the aesthetics. The referent of Pol’s posters, objective or conceptual, is collective; he shares it with the majority of the people. This is due to the fact that Pol’s works are based on cultural values rather than on individual ones. For example, if he creates a poster for a theatrical play, his idea for it will not start from a character, a starring actor or actress, or the director. Pol will take advantage of the conflicts presented in the plot, and he will build a graphic expression of the dramatic tensions. This allows him to set aside individual or temporal views. And like Bosch, Brueghel, and some other painters of the sixteenth century, Pol will emphasize idiomatic expressions and other popular lexical items. This way, he reaches the collective groups and offers an easily digestible discourse. Some good examples are offered in such posters as “The Inspector Is a Rat Fink” (“*El inspector es una rata*”) (Figure 4) to advertise a play by Nikolai Gogol; or “The Quixote Is a Peapod/Geezer” (“*El Quijote es una vainita*”) (Figure 5), which might be understood either as “Quixote is as thin as a peapod” or “Quixote is an eccentric and odd-looking guy,” used for the exhibit “*El Quijote Gráfico*” or “This is a piece of cake” (the Venezuelan idiom “*Esto es un mango bajito*”) in the poster for the eighteenth anniversary

Figure 6
"*El paquete*" ("The Package") designed for a political party called *Movimiento al Socialismo* (Movement towards Socialism), 1989.

of the School of Cinema and Television. All of them are ideas that extend the posters' messages far beyond their mere role as a means of communication.

Pol has a graphic sensibility trained in Venezuela's own landscapes, aromas, and flavors. In addition to the educational background that he obtained during his school years, and the influences he admits in his work, he chases the image simmered on the sidewalks of Caracas, San Felipe, Maracaibo, and any of the cities in which he has lived. As in a gourmet dish, all of his posters require using condiments extracted from reality, but mixed without reducing or diluting their own essences. Pol's images are not strange or unknown to the real world, although his inherent syntax and rhetorical resources move these images close to fiction.

Both sensorial and conceptually, most people can see themselves in Pol's works because they speak of daily life, familiar ways, authentic landscape colors, and spontaneous emotions. Pol's posters never lead to absolute interpretations of the world: neither do they contain messianic stories nor prevailing voices; and they are not posters about political power. When he has chosen political subjects, he has preferred to listen to people's voices. His 1989 poster "The Package" ("*El paquete*") (Figure 6), designed for a political party called *Movimiento al Socialismo* (Movement towards Socialism), is a good example. The concept in this poster captures a popular slogan "*Nos estamos comiendo un cable*" (literally: "We are eating a cable"), which Venezuelan citizens use at the times when it is hard to buy basic goods given their high cost and the low salaries, and then a "bunch" (a package) of economic policies are put into effect by the government. As illustrated, Pol's referents are not those grouped under extraordinary histories or major conflicts of mankind. Rather, they are fragments of life grasped in the streets while walking along. Pol's images are realities transferred to self-explanatory aesthetic codes. For instance, the poster for the European Community film exhibit celebrated in Caracas, "*Euroscopio* 2005," left behind the glories, conflicts, conquests, and sorrows of the Old World, and avoided general explanations about European filming conditions at that moment. The Euroscospio 2005 poster turned around a 1€ (euro) bill, which then set up a connection between the exhibit and an object that is shared by all European citizens. The poster also paid homage—not to Bonaparte, or Julius Caesar, or Newton—but to Robert Kalina, the euro bill designer.

Santiago Pol's posters propose a semiotic game; a complex discursive space that takes to its limits the attributes of color, lines, textures, and frames, and, in fact, explores all the possibilities of the image. His posters are an open space for hesitations and whimsical impulses. How did that object get there? Why does Pol use all these graphic devices in such a particular fashion? Why is there such an intense chromaticism in the poster? Why are the figures grouped in such a manner? These are inquiries associated with the visual impact aimed at the first encounter of the eye with the image. Doubt is, in many cases, the automatic reaction of the surprised viewer looking at the poster. Then responses arrive once something similar to a visual digestion occurs, pondering over and over about the images seen.

Pol prefers to design ambiguous forms—fragmented and hybrid—intended for stimulating visual impact and emotional reactions. Icons and colors are the devices used for these purposes: otherwise, the viewer might turn his or her head, move on, and ignore the poster. This is the reason why Pol's shapes are both familiar and strange at the same time: they are impossible objects hanging on the walls of a possible physical world. They appear as deformed shapes screaming to people from their unconscious, appealing to their dreams and not to their reasoning.

Figure 7
3rd Damascus International Film Festival, 1983.

The audience of Pol’s posters is approached without consent. An intimidated subject, shocked and astonished by the power of a palette full of harmonious contrasts, and also by forms ranging from hybrid to unbelievable ones: a magic carpet-shaped clap stick, (Figure 7), a fist-shaped man, a firecracker- shaped pencil, a spinning top-shaped book, or a paint brush with an electrical plug. Pol’s ways of communicating are linked to snatching, to sudden screaming, and to powdering flashes. Contrary to the message function that McLuhan assigns to mass media, Pol`s posters as medium represent a graphic slap. The communication is surprising, and the content is digested afterwards in every memory or in every new apparition. The recurrent encounters with its images in streets, subway stations, and bus stops contribute to dissipate initial doubts, and help to reinforce the message. However, the initial impression remains sealed in the viewer’s psyche after the first encounter.

De-scribing Design: Appropriating Script Analysis to Design History

Kjetil Fallan

Footnotes for this article begin on page 72.

> *The designer of the gun had clearly not been instructed to beat about the bush. "Make it evil," he'd been told. "Make it totally clear that this gun has a right end and a wrong end. Make it totally clear to anyone standing at the wrong end that things are going badly for them. If that means sticking all sorts of spikes and prongs and blackened bits all over it then so be it. This is not a gun for hanging over the fireplace or sticking in the umbrella stand, it is a gun for going out and making people miserable with."* [1]

Staring down the barrel of the Kill-O-Zap gun, Douglas Adams's galactic hitchhiker offers an excellent introduction to understanding what a product's "script" is—as well as why it should interest design historians.

Introduction

Over the last decade or so, there has been considerable interest in design studies within the theoretical framework and methodological concepts developed in the field of science and technology studies (STS). The dispersion and influence that STS theory enjoys in a wide range of disciplines and fields of study recently led Steve Woolgar to ask: "Has STS… settled down and moved out to the suburbs?" [2] His answer is that popularity *may* come at a high price, but that the spread of STS also is a potential source for reaffirming and even renovating its integrity and ability to provoke. So not only can STS invigorate design studies, but design studies—as one of the "new audiences" Woolgar requests—might even return the favor by supplying new testing grounds for STS's further development.

For some time now, design scholars have begun this work by exploring some of the major theoretical contributions from STS, such as the social construction of technology (SCOT), actor-network theory (ANT), and script analysis. However, while STS theory is making its mark on design *studies,*[3] it is little discussed within design *history*—with the partial exception of SCOT, which has inspired some very interesting design historical research. [4] The lack of discussion of the STS concepts' application to history is important because direct methodology transfer between the social sciences and the humanities can be rather problematic. Historians and sociologists have long since had a rather ambivalent relationship, and the former have often, and with good reason, been sceptical of the latter's ever new social theories and their value to historical research. Nevertheless, many historians have overcome their reluctance and written excellent histories, heavily influenced by social science, and the two domains might seem to adjoin each other more and more.[5]

This article will explore one of STS's most powerful and invigorating methodological concepts, script analysis, focusing particularly on how it can be appropriated from the sociology of technology to the history of design. While there have been some more or less sporadic references to script analysis in design studies in recent years, the concept rarely has been explored at length by design scholars. Furthermore, the opportunities and challenges script analysis might pose more specifically to historical studies of design seem to be largely uncharted waters.

Writing Scripts: Script Analysis and Design History

Although its "parent" concept actor-network theory probably would be best considered a conceptual framework if introduced to design history, the affiliated notion of a product script could be more of a methodological tool. ANT is concerned with how artifacts, or nonhumans (as well as human actors), act as mediators, transforming meaning as they form and move through networks. Some of the most articulate and provocative formulations of ANT can be found in the work of Bruno Latour.[6] Within this framework, the idea of product script has been developed as an effort to facilitate closer analysis of how products transport and transform meaning. The concept was coined by Madeleine Akrich, and much of its allure stems from the term's metaphoric character and etymological versatility.[7]

Akrich uses the term "script" as a metaphor for the "instruction manual" she claims is inscribed in an artifact. Any artifact contains a "message" (the script) from the producer/designer to the user describing the product's intended use and meaning. Product scripts thus seem to resemble the "affordances" developed by the psychologist James Gibson in his work on perception,[8] which were appropriated by Donald Norman, [9] but the script concept is more comprehensive. Douglas Adams's vivid science fiction account of the Kill-O-Zap gun is an exemplary case in point, but the principle applies to more mundane products as well. As Akrich explains in her own, somewhat less sanguine, idiom:

> Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science and economy will evolve in particular ways. A large part

> of the work of innovators is that of "*inscribing* " this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a "script" or a "scenario." [10]

However, the inscription of meaning in an artifact is not limited to its "technical content"—which is Akrich's main interest—but is equally the case regarding its design in general.

Introducing script analysis to design history can be seen as formalizing an already existing mode of thought. Philippa Goodall observed back in 1983 that "design *for* use is design *of* use"—which is a more general way of expressing one of the central tenets of the script concept.[11] Script analysis thus can be a highly valuable tool in the quest for better understanding of how a product's utilitarian functions, aesthetic expressions, social meanings, and cultural identities are constructed.

The materialization of the designer's more or less informed presumptions/visions/predictions about the relations between the artifact and the human actors surrounding it becomes an effort at ordaining the users' understanding of the product's use and meaning.[12] However, there always is the chance that the actors decide not to play the role ascribed to them by the designers, and also that the users misunderstand, ignore, discard, or reject the "instruction manual" and define their roles and the product's use and meaning at odds with the producer's/designer's intentions as conveyed through the script. The script thus is a key to understanding how producers/designers, products, and users negotiate and construct a sphere of action and meaning.

It is precisely this attention to what goes on between the sphere of production and the sphere of consumption and use that is so intriguing and promising about script analysis. The tendency to focus either on the sphere of production or the sphere of consumption has been criticized both in the history of technology and design history, and requests have been made for approaches that can bridge the two.[13] We should seek to constantly move between designer and user, between the designer's imagined user and the real user (as well as represented users),[14] between intention and interpretation, and between what is written into an artifact (inscription) and how it is read (subscription/de-inscription).[15] In short, mediation and translation should be core concerns; and script analysis can be an appropriate methodological tool in such an approach.

The concept is based on a series of metaphoric, analogical, and etymological modifications of the script theme. The relations to semiotics soon become clear, and because semiotics, due to its embedment in linguistics, has been accused of reducing everything to text and thus being ill-equipped to deal with materiality,[16] Akrich and Latour declare that "semiotics is not limited to signs: the key aspect of the semiotics of machines is its ability to move from signs to things and back."[17] Providing a guide to understanding this system, Akrich and Latour have come up with a vocabulary that explains various connoted terms and how they fit in a script analysis. Some of its most central terms merit a closer look:

> **Script, description, inscription, or transcription:** The aim of the academic written analysis of a setting is to put on paper the text of what the various actors in the settings are doing to one another. The de-scription, usually by the analyst, is the opposite movement of the in-scription by the engineer, inventor, manufacturer, or designer.
> **Prescription; proscription; affordances, allowances:** What a device allows or forbids from the actors—human and nonhuman—that it anticipates.
> **Subscription or the opposite, de-inscription:** The reaction of the anticipated actors—human and nonhuman—to what is prescribed or proscribed to them. According to their own anti-programs, they either underwrite it or try to extract themselves out of it or they adjust their behavior or the setting through some negotiations.
> **Re-inscription:** The same thing as inscription, but seen as a movement; as a feedback mechanism.[18]

By thinking along the lines suggested here, we are given a tool that connects some of the many and disparate aspects of the complex field of study that comprises design history. Introducing this methodological vocabulary also might make it easier to locate and analyze the intricate relations that make up "the seamless web of sociodesign."[19]

Analyzing Scripts: De-scribing Design

A feature of the script concept that is not discussed in Akrich and Latour's vocabulary, but that may clarify it, is the suggested distinction between a "physical script" and a "socio-technical script."[20] The physical script is embedded in the artifact's physical form, and consists of those properties of the product's physical form and interface that (or at least try to) tell the user about its intended use. It is this (not always particularly successful) phenomenon, understood as intrinsic constraints and affordances that Donald Norman discusses in his 1988 book *The Psychology of Everyday Things*.[21] Although Norman, in a more recent book, takes on the emotional aspects of design,[22] here he is concerned almost exclusively with products' utilitarian functions. He thus can be said to be in line with the notion of a physical script, but does not relate to the idea of a socio-technical script. To a large extent, the same also can be said about Ian Hutchby, who has discussed the concept of affordances as a "remedy" for the relativism he finds in a radical social constitutionalist view of the nature of technology and artifacts. And like Norman, Hutchby has borrowed the concept of affordances from Gibson.[23] In addition to Norman, Tom Fisher has explored the potential of Gibsonian affordances to design studies. Seen in light of Akrich's idea of the script, Fisher makes the important observation that "affordances cannot simply be 'built into' or 'read out of' artifacts, but are discovered by users through interaction with them."[24] Still, although he claims that "[o]ur exploration of the affordances of the material world resolves the objective and cultural aspects of our relationship to materials,"[25] Fisher's take on affordances is profoundly linked to the physical object and its (perceived) material properties; and thus is less dynamic and versatile than Akrich's notion of the (physical and socio-technical) script.

The socio-technical script has more to do with the transportation and transformation of a product's symbolic, emotional, social, and cultural meanings. This also is partly related to the artifact's physical, formal, aesthetic qualities, but the socio-technical script includes much more than the artifact itself. It involves all kinds of communication that surrounds and accompanies the product, such as the manufacturer's image, brand identity, market position, product reputation, user feedback, subcultural appropriation of the product, and—probably the most explicit expression of the socio-technical script—marketing, advertising, and general media coverage.

It is important, however, that this specification, or distinction between the two aspects of the script is not misread as a simplistic dualism. That would make the concept fall prey to the same kind of criticism Barry Katz has waged against Peter-Paul Verbeek's discernment between a product's "material utility" and its "social-cultural utility." Katz discredits this as "the old dichotomy between "*engineered function* and *designed meaning*" reminding us that "[t]echnology, too, is laden with referential signification, just as it is unwise to presume that aesthetic categories have no function."[26] This clarification recalls the observation by Mihaly Csikszentmihalyi and Eugene Rochberg-Halton that "it is extremely difficult to disentangle the use-related function from the symbolic meanings in even the most practical objects."[27] This entanglement of the symbolic and the utilitarian is surely reciprocal, making their assertion equally valid vice versa. Akrich is acutely aware of the problems caused by the momentum of etymological and ontological conventions, and stresses that "the links that concern us are necessarily *both* technical and social."[28] Thus the distinction between physical script and socio-technical script should not be understood as a conceptual dichotomy, but as one possible—and often rewarding—way of nuancing our conception of how things act, communicate, and transform meaning. In real life—and hence in empirical case studies—the physical script and the socio-technical script will be entangled and reciprocal.[29]

Marit Hubak has made use of script analysis in her study of how the identities of certain car makes and models were sought, constructed, and conveyed through newspaper advertisements.

She defines the socio-technical script as: "*ideas* about or views of users and attitudes and values connected to cars and motoring. Thus marketing is part of the socio-technical script, which is built on the physical script."[30] According to Hubak, marketing contains both types of communication, of which one is direct and one indirect. The physical script is seeking to exercise direct influence over users, since it is promoting the product's physical properties and utilitarian function. The socio-technical script, on the other hand, is seeking to exercise influence by way of indirect attraction. This attraction can be more or less related to utilitarian, symbolic, and emotional arguments.[31]

Although advertising and marketing are important components of an artifact's socio-technical script, it should be stressed that these aspects do not equal the socio-technical script. The world abounds with products that are no longer manufactured or marketed. Of course, no one knows this better than design historians, since normally it is among this inexhaustible, motley crew of material culture that we find the artifacts making up our subject matter and sources. These products nevertheless have socio-technical scripts, although they are likely to have changed since first inscribed by manufacturers, designers, and marketers. Sticking to cars, a case in point might be the Citroën 2CV launched in 1948. Designed by Pierre Boulanger, Henri Lefèvre, Flaminio Bertoni, and Jean Muraret from the late-1930s, this highly unconventional and very popular little car remained in production until 1990. The 2CV was intended as a people's car, with the notorious design specifications demanding it be "capable of transporting four people, or two farmers with … a bag of potatoes… across a ploughed field, without breaking the eggs they carried with them in a basket."[32] Looking at advertisements from the 1960s and 1970s, the farmer is absent, but the script is still geared towards the conventional car consumer, represented for example by the happy nuclear family on a camping trip. In stark contrast to these inscriptions by manufacturers, designers and marketers, the 2CV became, as we all know, a paramount icon of just about everything opposed to mainstream car culture.

This effectively demonstrates the many elements of uncertainty pertaining to the process of inscription, as well as the power of the users. In the case of the 2CV, it was the users and their constellations of subcultures who transformed the script over time. Manufacturers, designers, and marketers can react to such subcultural transformation of meaning in different ways. Peter Stanfield has shown how Harley-Davidson has appropriated the historic use—real, represented and fictitious—of its motorcycles in its product development: "Harley-Davidson… has literally *inscribed* the past within the design of its machines." [my italics][33]

An owner, user or consumer participates in the formation and transformation of an artifact's meaning and identity. It follows that a product should not be regarded as finished when it leaves the factory and is introduced into the market. As Latour put it: "The fate of facts and machines is in later users' hands." [34] This is where script analysis can help bridge the gap between the sphere of production and the sphere of consumption: by moving from studying how scripts are constructed and promoted by manufacturers, designers and marketers (inscribed) to how they are read and interpreted by users. Those reading a script can choose to—completely or partially—accept (subscribe) or reject (de-inscribe) it. Or, in cases of "illiteracy" (or poorly written scripts), the script might be misunderstood or not even detected. As described in the opening quote by Douglas Adams, Ford Prefect most decidedly both understood and subscribed to the menace inscribed in the Kill-O-Zap gun by its designer.

Users thus form their own interpretations of scripts. But as long as the ways in and circumstances under which the product is used, and the meanings formed by/around/ through it do not differ too much from those envisioned by the manufacturer/designer/marketer, script analysis will be an important instrument in understanding the interaction between product and user.[35] The concept is particularly enticing because it brings the artifacts we study alive, and does so irrespective of whether we approach them from the sphere of production or the sphere of consumption/use. By allowing us to trace the transformations through the object as it moves between different actors and arenas, it also can help to undermine the "Great Wall" that seems to have been erected between the two spheres.[36]

Reading and Re-writing Scripts: Domesticating Design

Both ANT and script analysis aim at moving back and forth between the sphere of production and the sphere of consumption/use in order to understand the coproduction of meaning. Still, at least in historical studies, much due to pragmatic limitations in resources and research methods as well as the availability of empirical evidence, users often remain "projected" users or "represented" users. The social sciences have been at the forefront of consumption studies, and might be a valuable source of inspiration. To historians, however, studying use and consumption poses many methodological challenges rendering direct methodology transfer difficult.

Traditionally, consumption has been regarded as a passive function in which the consumer conforms and adapts to directives issued by the producer. Newer research attributes both greater competencies as well as responsibilities to the consumer/user.[37] Consumer/users play active roles in forming their lives through the adaptation to and creative manipulation of objects, meanings, and social systems according to their needs, desires, and abilities. This reciprocal relationship between people and things is what Roger Silverstone et al. characterize as a process of "domestication." [38] The metaphoric term "domestication" is used to describe how we "tame" technology and artifacts. An essential point is that the taming process is characterized by *mutual* change and adaptation. As Knut Sørensen puts it: "Domestication … has wider implications than a socialization of technology: it is a coproduction of the social and the technical." [39] Explaining the metaphor, Silverstone asks: "Wild animals then, wild technologies now: what's the difference?" The point is that "[d]omestication … leaves nothing as it is." [40] Even common animal domestication processes, such as housetraining a puppy, is a question of give and take. Yes, the dog is coaxed or scared into adapting to the owner's rules of conduct, but the owner also has to adapt to the dog's requirements for exercise and nutrition. Much the same can be said of the relation between products/technologies and their users. Users modify their artifacts so that they suit their needs and desires in the best possible way but, at the same time, they and their behavior, feelings, and attitudes are transformed by the products. Artifacts are adapted to patterns of use, but they also create new patterns of use. Such transformations take place in the emotional and symbolic domains as well. Symbolic codes of various kinds are converted into something personal, and associated with questions of identity, emotions, and social relations. Domestication is the utilitarian and emotional adaptation to, and appropriation of, artifacts.[41]

The concept of domestication can be seen as complementing Akrich's script metaphor. This combination could have great potential for design history in analyzing the relation between intention and understanding in the design and use of products.[42] This is precisely in line with Sørensen's recommendation "to study domestication as a negotiated space of designers' views and users' needs and interests."[43] Is the artifact being understood and used as intended and inscribed? What is it about the script that ensures this? And what happens if the domestication process takes an unforeseen direction—in other words, when users do not subscribe? Normally, though, some kind of intermediate position arises, in which parts of the script are subscribed to and other parts rejected or misunderstood (de-inscribed), and a process of negotiation commences during which both product and user are adapted and transformed until a satisfactory degree of domestication is achieved.

An intriguing illustration of a most mundane example of this phenomenon can be found in a passage from Nicholson Baker's little novel *The Mezzanine*—a tribute to the hoards of unsung innovations in commonplace design and technology that tend to elude everyday consciousness, but nonetheless profoundly affect people's lives. Howie, the book's protagonist ponders why the toilet seats in his office bathroom are horseshoe-shaped as opposed to the complete ovals of those found in his and most other home bathrooms:

> I suppose the gap lessens the problems of low-energy drops of urine falling on the seat when some scofflaw thoughtlessly goes standing up without first lifting the seat. There

may be several other reasons for the horseshoe shape, having to do with accessibility, I'm not sure. But I am pleased that someone gave this subject thought, adopting what his company manufactured to deal with the realities of human behavior.[44]

What Howie in fact is suggesting here is how the horseshoe-shaped toilet seats in corporate bathrooms are the result of a redesign informed by the non-compliance (de-inscription) with some of the basic properties of the original, complete oval design by its users. And like Baker's protagonist, I take pleasure in the fact that someone has at least made an effort to respond to this most unpleasant instance of users' domestication of an artifact by redesigning it by factoring in undesired as well as desired use. Whether or not is has solved the problem or even can be considered a good attempt at doing so, is another question.

In keeping with the Citroën 2CV example above, the domestication of three other highly popular "people's cars" of the postwar era neatly illustrate how use and users matter; and how the domestication of a product can be fed back into design and product development. The archetype of the "people's car" is of course the Volkswagen Beetle (1938/1946), designed by Ferdinand Porsche and Erwin Komenda. The huge success of this product led other car manufacturers to develop equivalent concepts. Among the more successful were the 1957 Fiat 500, designed by Dante Giacosa, and the 1959 BMC Mini, designed by Alec Issigonis. All originally were developed as quintessential economic and pragmatic "people's cars." These scripts were, at least initially, largely subscribed to, but the cars underwent quite drastic domestication processes later in their long production lives during which the products took on new meanings and identities (e.g., Beetle, the hippie car; and Mini, the rally car).[45] Various aspects of these negotiated understandings that differed quite radically from the original scripts were then fed back as re-inscriptions into the design of the 1998 VW New Beetle, designed by J. Mays and Freeman Thomas, the 2001 BMW New Mini, and the 2007 Fiat Nuova 500—both designed by Frank Stephenson. Of course, these new cars have little or nothing in common with the originals, except for stylistic resemblances. They aspire to be trend icons, not "people's cars."[46] In short, the varying subscriptions and de-inscriptions of product scripts—their domestication—can result in re-inscription in new designs.

Like with script analysis, traces of the basic principles of domestication can be found in earlier design history literature. This is not to say that domestication brings nothing new to the table: only that design historians have long been aware of the fact that the meanings and forms of products are transformed through use. An early example, albeit from architectural history, is Philippe Boudon's

1972 study of how the inhabitants of Le Corbusier's row houses at Pessac near Bordeaux built in the 1920s radically transformed their homes.[47] As John Walker later wrote, citing Boudon's book; "[T]he issue is not only what design does to people, but what people do with design."[48]

Another good example can be found in a 1981 article by Tony Fry:

> [V]arious sub-cultures have appropriated the motorbike in order to convert it to an icon of antagonism towards the dominant culture. In technical and visual modification they have redesigned the appearance of the machines to alter their meaning in order to construct significations of opposition amongst an ensemble of such significations.[49]

Fry's example involves a very particular kind of user and a very physical transformation of the products in question—but there is nothing to indicate that the principle should not also apply to mainstream users of more mundane products and transformation less dependent on mechanical knowledge and tool equipment. Admittedly, he does not use the term "domestication," but writes about a process of appropriation involving conversion, modification, alteration, and construction. As it happens, "appropriation" and "conversion" are the first and last—enclosing "objectification" and "incorporation"—of the four stages Silverstone et al. identified in the process of domestication.[50]

Although the ideas behind the concept of domestication thus clearly should appeal to design historians, I have only come across one explicit reference in the design history literature to the article in which Silverstone et al. coined the term. In an article on the cultural transformations of the iconic "super-elliptical table" designed by Piet Hein and Bruno Mathsson, and manufactured by Fritz Hansen from 1968, Gertrud Øllgaard stated that:

> Processes of appropriation have been studied in recent analyses of practices of consumption which stress how consumers re-contextualize commodities by integrating them in their own worlds. These processes leave neither the significance of the object nor the social life and cultural identity of the consumer unaffected…. Processes of appropriation can include elements of objectification, incorporation, and finally conversion of the created into new regimes of value and new processes of objectification.[51]

Why she insists on omitting the term "domestication" altogether, and seems to replace it with "appropriation"—a term Silverstone et al. use as one of four stages in the process of domestication—is somewhat bewildering,[52] but her very introduction of the concept in a design history context is interesting.[53]

Conclusion

As script analysis stems from STS, it originally operates with a rather engineering-like notion of design as something pertaining to an artifact's "technical content." But to those more interested in sociodesign than in sociotechnology, this understanding seems unnecessarily narrow. In fact, as I hope to have shown in this article, the inscription of meaning in an artifact is by no means limited to its "technical content," but is equally the case regarding its design in general. Script analysis can be a highly valuable tool in the quest for a better understanding of how a product's utilitarian functions, aesthetic expressions, social meanings, and cultural identities are constructed. Thus, I would argue that, by appropriating script analysis, design history does not only gain methodological strength, but also may contribute to the improvement of the concept itself by expanding the conception of design that goes into the theoretical basis of script analysis.

As most methodological concepts, script analysis has its limitations. Here, the most apparent restriction pertains to the level of analysis. An extensive use of detailed script analysis seems to be best suited to rather neatly delimited case studies and micro histories. Nevertheless, it may be of value in studies of a broader scope as well, by informing our thinking in general of how products transport and transform meaning.

On a more general level, script analysis calls attention to what goes on between the sphere of production and the sphere of consumption and use. Such a perspective fits well with the increased focus on mediation and translation in recent design history. One great advantage of script analysis to design history in this respect is that it brings the artifacts we study alive and highlights their roles in the processes of mediation and translation— irrespective of whether we approach them from the sphere of production/design or the sphere of consumption/use.

The affiliated concept of domestication is a methodological tool devised to analyze how users turn commodities into functional things, meaningful objects, and expressive symbols. One of its most attractive qualities is that it follows the artifacts way past the purchase phase, and thus facilitates studies not only of consumption but also of use. This feature alone should reveal its potential value to design history. It is, however, a sociological concept, and as such not necessarily easy to apply to historical studies. Like most concepts from the social sciences, both script analysis and domestication were developed from studying contemporary situations, where use can be analyzed *in situ* and in real time. Historians are not that fortunate. In a critique of the recent vogue of consumption studies and its influence on design history, Jeffrey Meikle claimed that "We have no way of knowing with certainty how and why consumers at a given historical moment responded to particular products." [54] Paul Betts likewise observed that studying "how [consumers] understand and use [products] … effectively represents a sobering epistemological limit for all historians of material culture." [55]

I believe Meikle and Betts are mostly right, but I still think it is possible to achieve some understanding of how users matter in design history. Getting at the real users *in situ,* (e.g., by means of ethnomethodology), rarely will be the solution. Rather, empirical studies of historical use and consumption probably are better conducted by going after the imagined users or the represented users.[56] One way of doing this is by focusing on the arenas and actors of mediation, translation, and transformation discussed in this article.

1 Douglas Adams, *The Restaurant at the End of the Universe: The Hitchhiker's Guide to the Galaxy 2* (London: Pan Books, 1980), 134.

2 Steve Woolgar, "What Happened to Provocation in Science and Technology Studies?" *History and Technology* 20:4 (2004): 340.

3 For instance, a group of STS scholars put together a 2004 special issue of *Design Issues* on STS and design studies that contains valuable perspectives on the social complexity of the design process: Edward Woodhouse and Jason W. Patton, "Design by Society: Science and Technology Studies and the Social Shaping of Design," *Design Issues* 20:3 (2004): 1–12. See also, for example, Jack Ingram, Elizabeth Shove, and Matthew Watson, "Products and Practices: Selected Concepts from Science and Technology Studies and from Social Theories of Consumption and Practice," *Design Issues* 23:2 (2007): 3–16.

4 See Louise Purbrick, "The Dream Machine: Charles Babbage and His Imaginary Computers," *Journal of Design History* 6:1 (1991): 9–23; O. A. van Nierop, A. C. M. Blankendaal, and C. J. Overbeeke, "The Evolution of the Bicycle: A Dynamic Systems Approach," *Journal of Design History* 10:3 (1997): 253–267; Paul Atkinson, "The (In) Difference Engine—Explaining the Disappearance of Diversity in the Design of the Personal Computer," *Journal of Design History* 13:1 (2000): 59–72; Arwen P. Mohun, "Designed for Thrills and Safety: Amusement Parks and the Commodification of Risk, 1880–1929," *Journal of Design History* 14:4 (2001): 291–306; Douglas N. Lantry, "Dress for Egress: The Smithsonian National Air and Space Museum's Apollo Spacesuit Collection," *Journal of Design History* 14:4 (2001): 343–359; Paul Atkinson, "Man in a Briefcase: The Social Construction of the Laptop Computer and the Emergence of a Type Form," *Journal of Design History* 18:2 (2005): 191–205; and Paul Atkinson, "The Best Laid Plans of Mice and Men: The Computer Mouse in the History of Computing," *Design Issues* 23:3 (2007): 46–61. The potential of SCOT to design history also is mentioned in Raimonda Riccini, "Innovation as a Field of Historical Knowledge for Industrial Design," *Design Issues* 17:4 (2001): 30 and Raimonda Riccini, "History from Things: Notes on the History of Industrial Design," *Design Issues* 14:3 (1998): 54.

5 For a good example of this mutual influence of history and sociology, see: *Beyond the Cultural Turn—New Directions in the Study of Society and Culture,* Victoria E. Bonnell and Lynn Hunt, eds. (Berkeley: University of California Press, 1999).

6 His take on ANT was first laid out in Bruno Latour, *Science in Action* (Cambridge, MA: Harvard University Press, 1987). He reassessed the concept in Bruno Latour, "On recalling ANT" in *Actor Network Theory and After,* John Law and John Hassard, eds. (Oxford: Blackwell, 1999), 15–25; and recently revised it in Bruno Latour, *Reassembling the Social—An Introduction to Actor-Network Theory* (Oxford: Oxford University Press, 2005).

7 Madeleine Akrich, "The De-scription of Technological Objects" in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* Wiebe E. Bijker and John Law, eds. (Cambridge, MA: MIT Press, 1992), 205–224.

8 James. J. Gibson, "The Theory of Affordances" in *Perceiving, Acting, and Knowing,* Robert E. Shaw and John Bransford, eds. (Hillsdale, NJ: Erlbaum, 1977), 67–82; and James J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin).

9 Donald A. Norman, *The Psychology of Everyday Things* (New York: Basic Books, 1988).

10 Madeleine Akrich, "The De-scription of Technological Objects" in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* 208. It is interesting to note that another contributor to this publication, W. Bernard Carlson, made a somewhat similar point—although perhaps with a less terse conjunction between artifact and meaning than Akrich's script metaphor allows for—when he argued that "inventors invent both artifacts and frames of meanings that guide how they manufacture and market their creations … [I]ndividuals must make assumptions about who will use a technology and the meanings users might assign to it. These assumptions constitute a frame of meaning inventors and entrepreneurs use to guide their efforts at designing, manufacturing, and marketing their technological artifacts." W. Bernard Carlson, "Artifacts and Frames of Meaning: Thomas A. Edison, His Managers, and the Cultural Construction of Motion Pictures" in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* Wiebe E. Bijker and John Law, eds. (Cambridge, MA: MIT Press, 1992), 176–177.

11 Philippa Goodall, "Design and Gender," *Block* 9 (1983): 58.

12 Steve Woolgar, "Configuring the User—The Case of Usability Trials in *A Sociology of Monsters—Essays on Power, Technology and Domination*, John Law, ed. (London: Routledge, 1991), 58–99.

13 Bruno Latour has provided a nice image of the insufficiency of studying only one sphere: "Looking at the mechanism alone is like watching half the court during a tennis game; it appears as so many meaningless moves." Bruno Latour, "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts" in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* Wiebe E. Bijker and John Law, eds. (Cambridge, MA: MIT Press, 1992), 247.

14 Johan Schot and Adri Albert de la Bruheze, "The Mediated Design of Products, Consumption, and Consumers in the Twentieth Century" in *How Users Matter—The Co-Construction of Users and Technology,* Nelly Oudshoorn and Trevor Pinch, eds. (Cambridge, MA: MIT Press, 2003), 235; and Madeleine Akrich, "User Representations: Practices, Methods and Sociology" in *Managing Technology in Society: The Approach of Constructive Technology Assessment*, Arie Rip, Thomas J. Misa, and Johan Schot, eds. (London: Pinter Publishers, 1995), 167–184.

15 Madeleine Akrich, "The De-scription of Technological Objects" in *Shaping Technology/Building Society: Studies in Sociotechnical Change*, 208.

16 For instance, Mihaly Csikszentmihalyi and Eugene Rochberg-Halton have asserted that "Most accounts of how things signify tend to ignore the active contribution of the thing itself to the meaning process." Mihaly Csikszentmihalyi and Eugene Rochberg-Halton, *The Meaning of Things—Domestic Symbols and the Self* (Cambridge: Cambridge University Press, 1981), 43.

17 Madeleine Akrich and Bruno Latour, "A Summary of a Convenient Vocabulary for the Semiotics of Human and Nonhuman Assemblies" in *Shaping Technology/ Building Society: Studies in Sociotechnical Change,* Wiebe E. Bijker and John Law, eds. (Cambridge, MA: MIT Press, 1992), 259.

18 Ibid., 259–262.

19 Wiebe E. Bijker and John Law, "What Next? Technology, Theory, and Method" in *Shaping Technology/Building Society: Studies in Sociotechnical Change,* 202. Admittedly, Bijker and Law write about "The seamless web of sociotechnology"—a metaphoric phrase by now well-established in the history of technology and STS; coined in the moving away from the traditional distinctions between technical, social, economic, and political aspects of technological development. But this outlook, in my opinion, is equally true of design; hence my paraphrase "The seamless web of sociodesign." The phrase "The seamless web of sociotechnology" often is attributed to Thomas P. Hughes and his seminal work on sociotechnical systems, but to my knowledge he has never used this exact wording. He has, however, written that "the web is seamless," and that he believes "encompassing systems should be labeled sociotechnical systems rather than technological systems.": Thomas P. Hughes, "Edison and Electric Light" in *The Social Shaping of Technology,* Donald MacKenzie and Judy Wajcman, eds. (Maidenhead, Berkshire, UK: Open University Press, 2nd ed.—first published in 1985, 1999), 58; and Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore, MD: Johns Hopkins University Press, 1983), 465. His notion of the seamless web is most explicitly theoretically expressed in Thomas P. Hughes, "The Seamless Web: Technology, Science, Etcetera, Etcetera," *Social Studies of Science* 16:2 (1986), 281–292.

20 Marit Hubak, "The Car as a Cultural Statement" in *Making Technology Our Own?—Domesticating Technology into Everyday Life,* Merete Lie and Knut H. Sørensen, eds. (Oslo: Scandinavian University Press, 1996), 175.

21 Donald A. Norman, *The Psychology of Everyday Things* (New York: Basic Books, 1988). See especially 81–104.

22 Donald A. Norman, *Emotional Design—Why We Love (or Hate) Everyday Things* (New York: Basic Books, 2004).

23 Ian Hutchby, "Technologies, Texts and Affordances," *Sociology* 35:2 (2001): 441–456.

24 Tom H. Fisher, "What We Touch, Touches Us: Materials, Affects, and Affordances," *Design Issues* 20:4 (2004): 26.

25 Ibid., 31.

26 Barry M. Katz, "Intelligent Design," *Technology and Culture* 47:2 (2006): 388. His reference is to Peter-Paul Verbeek, *What Things Do—Philosophical Reflections on Technology, Agency, and Design* (University Park: Pennsylvania State University Press, 2005).

27 Mihaly Csikszentmihalyi and Eugene Rochberg-Halton, *The Meaning of Things—Domestic Symbols and the Self,* 20–21.

28 Madeleine Akrich, "The De-scription of Technological Objects" in *Shaping Technology/Building Society—Studies in Sociotechnical Change,* 206.

29 A classical example is Langdon Winner's study of how the bridges across the Long Island Expressway in the late-1930s allegedly were designed too low for busses to pass underneath them, thus effectively preventing poor people and blacks—who normally used public transport—to reach recreational areas popular among the white middle class. Langdon Winner, "Do Artifacts Have Politics?" in *Daedalus* 109:1 (1980): 121–136. Both the factual adequacy of Winner's study and his arguments were later criticized, but that is another story. For a discussion, see Steve Woolgar and Geoff Cooper, "Do Artefacts Have Ambivalence? Moses' Bridges, Winner's Bridges and Other Urban Legends in ST&S," *Social Studies of Science* 29:3 (1999): 433–449.

30 Marit Hubak, "The Car as a Cultural Statement" in *Making Technology Our Own?—Domesticating Technology into Everyday Life,* 175.

31 Ibid., 175–176.

32 Penny Sparke, *A Century of Car Design* (London: Mitchell Beazley, 2002), 102–105.

33 Peter Stanfield, "Heritage Design: The Harley-Davidson Motor Company," *Journal of Design History* 5:2 (1992): 154. Despite the wording, and because Stanfield's article was published about the same time as Akrich's first publications on the script concept, he make no reference to her work. However, he is clearly thinking along the same lines.

34 Bruno Latour, *Science in Action* (Cambridge, MA: Harvard University Press, 1987), 259.

35 Madeleine Akrich, "The De-scription of Technological Objects" in *Shaping Technology/Building Society—Studies in Sociotechnical Change,* 216.

36 A useful and inspiring survey of more general strategies for historians aiming to tear down the wall or bridging the gap between the spheres of production and consumption can be found in Sally Clarke, "Consumer Negotiations," *Business and Economic History* 26:1 (1997): 101–122.

37 See Pierre Bourdieu, *Distinction: A Social Critique of the Judgement of Taste* [original published in French, 1979] (London: Routledge & Kegan Paul, 1984); Jean Baudrillard, *The System of Objects* [original published in French, 1968] (London and New York: Verso, 1996); Jean Baudrillard, *The Consumer Society* [original published in French, 1970] (London: Sage, 1998); Jean Baudrillard, *For a Critique of the Political Economy of the Sign* [original published in French,1972] (Townsend, MT: Telos, 1981); Zygmunt Bauman, "Broken Lives—Broken Strategies" in Zygmunt Bauman, *Life in Fragments: Essays in Postmodern Morality* (Oxford, UK and Cambridge, MA: Blackwell, 1995), 72–104; Daniel Miller, *Material Culture and Mass Consumption* (Oxford: Blackwell, 1987); and Daniel Miller, "The Myths of Consumption" in *Acknowledging Consumption,* Daniel Miller, ed. (London: Routledge, 1995), 20–35.

38 Roger Silverstone, Eric Hirch, and David Morley, "Information and Communication Technologies and the Moral Economy of the Household" in *Consuming Technologies. Media and Information in Domestic Spaces,* Roger Silverstone and Eric Hirsch, eds. (London: Routledge, 1992), 15–31. For a survey and critical discussion of the concept, see *Domestication of Media and Technology*, Thomas Berker, Maren Hartmann, Yves Punie, and Katie J. Ward, eds. (Maidenhead, Berkshire, UK: Open University Press, 2006).

39 Knut H. Sørensen, "Domestication: The Enactment of Technology" in *Domestication of Media and Technology,* 46.

40 Roger Silverstone, "Domesticating Domestication: Reflections on the Life of a Concept" in *Domestication of Media and Technology,* 231.

41 Merete Lie and Knut H. Sørensen, "Making Technology Our Own?" in *Making Technology Our Own?—Domesticating Technology into Everyday Life,* Merete Lie and Knut H. Sørensen, eds. (Oslo: Scandinavian University Press, 1996), 8–17.

42 A good example is Ronald Kline and Trevor Pinch's study of how users through their interpretations, modifications, and feedback, influenced early car design: Ronald Kline and Trevor Pinch, "Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States," *Technology and Culture* 37:4 (1996): 763–795. Another illustrating example is Christina Lindsay's study of the co-production of an early personal computer in which "[T]he users … begin as somewhat stereotypically gendered representations constructed by the designers of the computer and end by becoming designers, producers, and retailers providing technical support for the technology and taking responsibility for its further development." Christina Lindsay, "From the Shadows: Users as Designers, Producers, Marketers, Distributors, and Technical Support" in *How Users Matter—The Co-Construction of Users and Technology,* Nelly Oudshoorn and Trevor Pinch, eds. (Cambridge, MA: MIT Press, 2003), 30.

43 Knut H. Sørensen, "Domestication: The Enactment of Technology" in *Domestication of Media and Technology,* 46.

44 Nicholson Baker, *The Mezzanine* [1988] (London: Granta, 1998), 74. For a brief account of how this particular work of fiction might stimulate design historians, see Jeffrey L. Meikle, "Material Virtues: On the Ideal and the Real in Design History," *Journal of Design History* 11:3 (1998): 197–199.

45 For an account of the multifaceted domestications or cultural appropriations of the VW Beetle, see Phil Patton, *Bug: The Strange Mutations of the World's Most Famous Automobile* (New York: Simon & Schuster, 2003).

46 J. Mays is now vice president of design for the Ford Motor Company, and is responsible for other "re-launched" cars in addition to the VW New Beetle, such as the 2002 Ford Thunderbird and the 2005 Ford Mustang—both of which draw heavily on the design of their 1950s and 1960s namesakes. This design trend was dubbed "Retrofuturism" and linked explicitly to Mays's name on the occasion of an exhibition of his work at the Geffen Contemporary of the Museum of Contemporary Art in Los Angeles in November 2002: Brooke Hodge and C. Edson Armi, *Retrofuturism— The Car Design of J. Mays* (New York: Universe, 2002). However catchy this label might be, though, Mays have been involved in many car designs that do not fit the bill, such as the 1983 Audi 100, the 1983 VW Golf, and the 1989 BMW 8 series.

47 Philippe Boudon, *Lived-In Architecture—Le Corbusier's Pessac Revisited* (London: Lund Humphries, 1972). Daniel Miller has made a similar point in showing how occupants of British council housing through interior decoration do their best to transform and domesticate a modernist architecture that "never reflected the people who had to live in [the estates]"—most of whom "had an entirely different aesthetic that positively valued ornament": Daniel Miller, "Possessions" in *Home Possessions—Material Culture behind Closed Doors,* Daniel Miller, ed. (Oxford: Berg, 2001), 117.

48 John A. Walker, *Design History and the History of Design* (London: Pluto, 1989), 183.

49 Tony Fry, "Design History: A Debate?" *Block* 5 (1981): 17.

50 Roger Silverstone, Eric Hirch, and David Morley, "Information and Communication Technologies and the Moral Economy of the Household" in *Consuming Technologies. Media and Information in Domestic Spaces,* Roger Silverstone and Eric Hirsch, eds. (London: Routledge, 1992), 15–31.

51 Gertrud Øllgaard, "A Super-Elliptical Moment in the Cultural Form of the Table: A Case Study of a Danish Table," *Journal of Design History* 12:2 (1999): 144. (See notes 4 and 5, 155 for references to Silverstone et al.)

52 It should be mentioned that Silverstone et al. themselves admit that from the "perspective [of anthropology] appropriation stands for the whole process of consumption as well as for that moment at which an object crosses the threshold between the formal and the moral economies.": Roger Silverstone, Eric Hirch, and David Morley, "Information and Communication Technologies and the Moral Economy of the Household" in *Consuming Technologies: Media and Information in Domestic Spaces,* 22.

53 Penny Sparke, in a study of how aluminium kitchen utensils were domesticated in early twentieth century USA, has used the term "domestication" to signify a dynamic process of reciprocal transformation in a manner very close to that indicated by the *concept* domestication as developed by Silverstone et al. However, she makes no mention of the concept and does not refer to any of its literature, and her use of the term thus must be said to be of a more generic kind. Penny Sparke, "Cookware to Cocktail Shakers: The Domestication of Aluminum in the United States, 1900–1939" in *Aluminum by Design,* Sarah Nicols, ed. (Pittsburgh/New York: Carnegie Museum of Art/Abrams, 2000), 112–139.

54 He continues: "How can we know how and why people responded to the products … that surrounded them? How do we know what the results of design mean to the people who negotiate them, often unselfconsciously, in their daily lives?" And, moreover: "These questions are all the more important now that most of us have abandoned a straightforward Frankfurt School-inspired assumption of passive consumers completely at the mercy of manipulative capitalists." Jeffrey L. Meikle, "Material Virtues: On the Ideal and the Real in Design History," *Journal of Design History* 11:3 (1998): 194–195.

55 Paul Betts, *The Authority of Everyday Objects: A Cultural History of West German Industrial Design* (Berkeley: University of California Press, 2004), 19.

56 A good example can be found in a recent cultural history of the Piaggio Vespa scooter in which the users are eminently present (e.g., through the owner's clubs). From a design and domestication perspective, it is particularly interesting the way in which the intricate relationship and communication between the users/clubs and the manufacturer is analyzed. Thomas Brandt, *Frie hjerter og små motorer: Kulturell produksjon, formidling og bruk av den italienske Vespa-scooteren, 1946–1969* (Doctoral dissertation, Trondheim: Norwegian University of Science and Technology, 2006).

The Policy of Design: A Capabilities Approach

Andy Dong

Introduction

In 2004 and 2005, a series of natural disasters on a scale unprecedented in modern times unfolded tragically. The Sumatra-Andaman earthquake and subsequent tsunami on the day after Christmas in 2004 killed and displaced more than 200,000 people. Hurricane Katrina battered the Gulf Coast of the United States, flooding more than eighty percent of the City of New Orleans, and leaving a swath of destruction across an estimated 90,000 square miles. The Pakistan earthquake in October 2005 is estimated to have left four million people homeless. Beyond the criticisms of international aid and government relief responses arises the question of the capacity of local communities to rebuild. However, their capacity to rebuild also hinges upon the precursor issue of their capability to design. The vividness of these disasters playing repeatedly on television screens around the world suddenly linked the citizens of Sri Lanka and New Orleans to the squatters as developers in Mumbai,[1] to the citizens as urban designers and planners in San Francisco's Octavia Boulevard Project, and to many other citizens around the world designing their local communities. Increasingly, at least in the space of public works, the ultimate responsibility for design is held by the people.

Citizens are actively engaged in designing housing, sanitation schemes, and cityscapes; and they are not just working with or depending upon design professionals. Often, it is the citizens who lead the way. The UN Millennium Project offered the following policy statement in relation to the urban poor: "More people than ever before are doing more and more for themselves and others, pushing central and local governments to take progressive action …. Our policy conclusion … is to place the urban poor at the very centre of … policy formation."[2] This policy conclusion is significant for all societies because it reinforces the public's freedom to realize public works projects and the obligation of public policies and civic administrators to promote this capability.

A similar sentiment was issued by Sulfikar Amir[3] in his call for a more humanitarian policy of design. Amir outlined a set of human-centered national design policies that focus on people's needs, and incorporate participatory design methods. Urban designers and planners have been practicing participatory design for quite some time.[4] Carroll,[5] citing Herbert Simon, suggests that participa-

1 Vinit Mukhija, *Squatters as Developers?: Slum Redevelopment in Mumbai* (Aldershot, Hampshire, England: Ashgate, 2003).

2 UN Millennium Project, "A Home in the City: Task Force on Improving the Lives of Slum Dwellers" (Washington, DC: United Nations Development Program, 2005), xiv.

3 Sulfikar Amir, "Rethinking Design Policy," *Design Issues* 20:4 (2004).

4 Henry Sanoff, *Community Participation Methods in Design and Planning* (New York: John Wiley & Sons, Inc., 2000).

5 John M. Carroll, "Dimensions of Participation in Simon's Design," *Design Issues* 22:2 (2006).

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tory design makes users *ipso facto* designers. In a 1971 conference,[6] design professionals already were engaged in considering how user participation in design would reorient the design professions and approaches to design. Presciently, the group discussed the potential sway in the balance of power in design, from the professional designers to the users themselves. Several decades later, while user participation is firmly entrenched in the design practice of some professions, it takes only the merest reading of the debates surrounding the design of public works to know that the public is not always, in the viewpoint of local governments and the language of policy instruments, authorized to design, nor believed to be capable of designing.

In Australia, as in many wealthy, pluralistic, democratic societies; decision-makers often believe that public engagement in the design of public works may impede progress or result in the dreaded "design by committee" projects. This tension most recently played out in the State of New South Wales (NSW) when former Planning Minister Craig Knowles stated that the design of the Kurnell desalination plant is "beyond public debate."[7] Public policies can effectively remove public engagement in the name of expediency. A case in point is Part 3 of the NSW Infrastructure Implementation Corporation Bill 2005, authorizing the Premier to establish "project authorization orders" for major infrastructure development "on such terms and conditions as the Premier determines, and as are specified or referred to in the order." Thus, what the urban poor in developing countries and citizens in developed countries share is the problem of enacting a policy of design that reflects the values of the people.

However, asking public policy organs to require citizens' participation in design without understanding the parameters and conditions that can be transformed into a capability to design is cynical, and makes the potentially naïve assumption that the public can *do* design. People have the right to user participation in design only if there are effective policies to make people truly capable of design. So what is needed is not user participation in design as a counterforce to the power of designers, as thought by the 1971 conference of designers, but instead a design culture of pluralism with effective means for achieving it.

This article outlines a framework for the policy of design based on the theory of social justice known as the "capabilities approach." The author believes that the capabilities approach offers one avenue to situate design practice as part of an endeavor of social justice and not "after all, a tool for domination."[8] For the purposes of this article, a policy of design must assert a *just* socially-mediated process of devising a system, component, or process that achieves a set of goals established as a result of a shared understanding of the design work within a context defined by both the natural environment and human interests. At issue is the contention that design in the public arena shapes human development and well-being, thus

6 *Design Participation: Proceedings of the Design Research Society's Conference,* Nigel Cross, ed. (London: Academy Editions, 1972).

7 Wendy Frew, "Desalination Plant 'Too Important to Debate,'" *Sydney Morning Herald,* July 12, 2005.

8 Gui Bonsiepe, "Design and Democracy," *Design Issues* 22:2 (2006): 31.

making the policy of design an issue directly taken up by the capabilities approach. I suggest that the capabilities approach offers a theory for conceiving a policy of design that is suited to grapple with the planning and design of public works in a way that facilitates the conditions of possibility for designing by the public.

The Capabilities Approach

The capabilities approach is a normative theory of social justice developed primarily by the economist Amartya Sen[9] and legal ethics philosopher Martha Nussbaum.[10] Capabilities theorists claim that increasing the capacity of people to live the type of life that they value should be the primary concern of public policy organs. Their approach toward human development shifts the measurement of progress from output toward the measurement of people's capabilities to achieve outcomes. Such measurements include literacy, mortality, and women's employment participation outside the home, all reported in the UN Human Development Report. They stand in stark contrast to indicators such as GDP and GNP, which shield economic output from the reality of conditions that prevent people from leading valuable lives. The intuition is that an illiterate or innumerate person is unlikely to have the capability to produce economic outcomes. As a normative theory of social justice, the capabilities approach emphasizes a person's capability to achieve certain actions (functioning) that the person deems valuable for living.[11]

Capabilities theorists promote the idea that working to account for and advance human capability strengthens governance, not just at the level of macroeconomic measures but also in terms of civic engagement and citizenship. Jean Drèze and Amartya Sen write: "The object of public action can be seen to be the enhancement of the capability of people to undertake valuable and valued doings and beings." [12] In acknowledged support of this concept, both the United Nations Millennium Development Project and the World Bank recognize capability development in relation to community-led public works projects as the key to achieving poverty reduction.[13]

The World Bank forecasts ten percent of project cost goals toward capability development in large infrastructure projects because capability development sustains the human functioning achievements these projects generate.

Two key themes arise from the conceptual foundations of the capabilities approach. The first is Sen's economic theoretical justification for the approach.[14] Sen critiques aspects of utilitarianism as the foundation theory to account for economic development and assess human development. The principle aspects of his critique are that utilitarian approaches do not pay adequate attention to distributional inequality, neglect constraints on freedoms to pursue economic output such as the limitations on women's economic participation outside the home, and presume that manifest preferences are not

9 Amartya Kumar Sen, *Development as Freedom* (Oxford: Oxford University Press, 1999).

10 Martha Craven Nussbaum, "Human Capabilities, Female Human Beings" in *Women, Culture, and Development : A Study of Human Capabilities,* Martha C. Nussbaum and Jonathan Glover, eds. (Oxford: Clarendon Press, 1995).

11 Amartya Kumar Sen, "Capability and Well-Being" in *The Quality of Life,* Martha C. Nussbaum and Amartya Kumar Sen, eds., (Oxford: Clarendon Press, 1993).

12 Jean Drèze and Amartya Sen, *Hunger and Public Action* (Oxford: Clarendon Press, 1989), 12.

13 UN Millennium Project, "Investing in Development: A Practical Plan to Achieve the Millennium Development Goals. Overview" (Washington, DC: United Nations Development Program, 2005).

14 Amartya Kumar Sen, *Development as Freedom.*

subject to mental conditioning, that is, the problem of adaptive preferences. Sen further argues that the informational basis of the utility calculus of well-being, namely income, is inadequate. The utility calculus reduces well-being to the sum of resources (income) by excluding information about one's substantive capacity for economic output. The excluded information includes: intrinsic characteristics such as age, health, and disability; extrinsic conditions at the socio-economic and institutional levels; and, the available resources for the conversion of the capability set into a functioning. The limited informational basis for the utility calculus thus ignores, and at best is indifferent to, the notion of well-being as being more than the sum of income. According to the theory that evaluation guides policy in indirect ways, (i.e., focusing on collecting information, but not the information itself, changes institutional practices[15]), not having to collect such information for the utility calculus subalterns these capabilities to income. The capabilities approach is intended to reverse the teleology of economic development from an assessment exercise based on economic utility to the valuation of the human inputs.

The second key theme is the problem of differential inequalities that erect impediments to human flourishing. The basic critique here is that poverty, assessed in terms of income, is only one of a variety of factors that prevent people from leading valuable lives. Factors such as lack of environmental resources, political constraints, and medical conditions should not be discounted in their impact on limiting the capability of people to produce economic outputs. To illustrate this critique, take the problem of public transit. Without public transit suited to people in wheelchairs, for example, a disabled person is unlikely to be able to maintain stable employment. Even without transit amelioration, this impediment most likely would not exist for a person without any mobility impairment. While there are many more dimensions to the capabilities approach, its main contribution is to place humans at the center of economic development rather than economic growth itself. The capabilities approach asks what requisite "capability set" humans need to achieve self-defined goals of well-being.

In the context of design, the capability set denotes the requisite conditions for ("doing") design. The question is: "If I wanted to engage in design, what set of capabilities would I need?" The question is not "How capable of design am I?" but rather if one is capable of doing design at all. What resources are available for people to transform the capability set for design into the functioning of designing, and is the person appropriately positioned to do it?

The Capabilities Approach and the Policy of Design

As a basis for design policy, the capabilities approach foregrounds what people need to achieve self-defined goals in the theorization of what counts as a just policy. The dilemma of justice in the policy of design is a component of the tension that is always present in

15 Caron Chess, "Evaluating Environmental Public Participation: Methodological Questions," *Journal of Environmental Planning and Management* 43:6 (2000).

design in the public arena—the tension "in seeing public participation as involving citizens on the one hand, and government on the other."[16] The social and political exclusion of the public in the design of public works is becoming a real concern, and thus important to design policy. Consequences of the lack of capability to design extend beyond the lack of public engagement in design into matters of public health and social capital:

1. Design is becoming a matter of public health. Urban designers and planners, architects, public health professionals, real-estate developers, and local governments are beginning to recognize the health costs of certain urban design solutions. Inappropriate urban design is linked to obesity, mental health, and chronic illnesses such as asthma and heart disease.[17] But communities often treat "outside experts" with disdain and suspicion. In response to expert advice that cul-de-sacs are poor suburban design, the *Sydney Morning Herald* interviewed residents in cul-de-sacs who say they would never live anywhere but in a cul-de-sac because they are quiet, safe, and neighborly. "It's a good way for the kids to grow up," say Patrick "Snowy" Sheehan and Lucy Zappavigna.[18] These residents' lifestyle preference for the cul-de-sac design is in stark contrast to evidence of their negative health implications reached by urban designers and public health professionals. The low-density and disconnected sidewalks prevalent in cul-de-sac neighborhoods have been shown to be correlated with more driving and less walking.[19] In turn, less walking is symptomatic of a sedentary lifestyle, which ultimately contributes to obesity.[20] An ability to address the set of complex issues in urban design, architecture, public health, and lifestyle choices by the public must be part of their capability set for design if they are to be engaged in the design of new suburbs.
2. The design of the civic environment is linked to the establishment of identity as part of the matrix of the visual field that says you belong and have a stake in its formation. This does not mean that design is a form of social engineering. Instead, design is a source of social transformation. As Kwame Anthony Appiah writes, "If we are authors of ourselves, it is state and society that provide us with tools and the contexts of our authorship. We may shape selves, but others shape our shaping."[21] Thus, the lack of capability to design could lead to a loss of a civic identity.

However, these social development and justice aspects of design often are overlooked in frameworks for design policy that link design development to socio-economic gains. One of the most widely cited models is Gui Bonsiepe's theoretical model of industrial design development[22] H. Alpay Er's[23] extension of Bonsiepe's model

16 Judith E. Innes and David E. Booher, "Reframing Public Participation: Strategies for the 21st Century," *Planning Theory & Practice* 5:4 (2004): 421.

17 Howard Frumkin, "Urban Sprawl and Public Health," *Public Health Reports* 117 (2002).

18 Sherrill Nixon, "Once There Were Walkers," *Sydney Morning Herald,* August 12, 2006.

19 Lawrence D. Frank and Gary Pivo, "Impacts of Mixed Use and Density on Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit, and Walking," *Transportation Research Record* 1466 ("Issues in Land Use and Transportation Planning, Models, and Applications," 1995).

20 U.S. Department of Health and Human Services, "Physical Activity and Health: A Report of the Surgeon General" (Centers for Disease Control and Prevention, 1996).

21 Kwame Anthony Appiah, *The Ethics of Identity* (Princeton, NJ: Princeton University Press, 2005), 156.

22 Gui Bonsiepe, "Developing Countries: Awareness of Design and the Peripheral Condition" in *History of Industrial Design: 1919–1990: The Dominion of Design,* C. Provano, ed. (Milan: Electa, 1990).

23 H. Alpay Er, "Development Patterns of Industrial Design in the Third World: A Conceptual Model for Newly Industrialized Countries," *Journal of Design History* 10:3 (1997).

suggests interventions such as government-financed postgraduate schools of design and government agencies supporting particular design enterprises to stimulate industrial design growth. There are two significant problems with this framework. First, we have good reason to worry about marshalling newly industrialized countries toward "big" industrial design and expecting those socio-economic gains to produce real gains *equitably*. The critiques against utilitarianism in economic development lodged by Sen apply in this case. Stimulating industrialization of design may not necessarily lead to the creation of communities which are capable of transforming ideas into designed works that advance their interests and well-being.

Second, if what is measured and promoted is the economic growth of design-related industries, there is then a serious misrecognition of the potential of communities outside of formal industries as sites of design and innovation. Policy justifications supporting industries based on aggregate utility and economic rationalization of industries create an expert discourse about the relevance of design to industry—not to people. The Industry Sector Productivity Indexes published by the Productivity Commission in Australia, is one example of a measurement that governments track and cite to assess the health of industries. These measurements are based on the aggregate, market sector productivity in terms of *output* of goods and services. Yet, there are relatively few measures on the availability of technical means for the public to become engaged in design-related industries and activities. Measures such as personal computer ownership and broadband access compiled in the Household Use of Information Technology by the Australian Bureau of Statistics are the kind of capability indicators needed by the capabilities approach.

The presumption in Alpay Er's formulation that design success in industry is valuable to nations misses the point that for many of the world's poor, design, inter alia, is a means to goals that provide for quality of life. Access to design and means of production is at stake in the policy of design. Reflecting on a project for capacity building of women in Mumbai to design better settlement, the Society for the Promotion of Area Resource Centres (SPARC), an Indian NGO, wrote: "The most powerful advocacy tool for land security and housing for the poor is when the poor themselves take on housing projects which demonstrate how to develop solutions. This is the role that the federation plays—supporting local communities [that] negotiate for land and build and design houses themselves."[24] While promoting formal, design-related industries is vital, a capabilities approach to design policy should focus attention on capacity-building of this "informal design sector."

Thus, the capabilities approach directly handles what most models linking industrial design development and socio-economic advance lack; overcoming the problem of the reliance on economic efficiency and aggregate utility as measures of design progress, without first considering what it takes to do design. A capabilities

24 Society for Promotion of Area Resource Centres (SPARC), *Sparc Annual Report* (Bombay, India: 2005), 20.

approach to design policy asks what is needed for the public to be engaged in ("do") design. The ambit of the capabilities approach is the space of poverty, inequality, and the design of social institutions. By asking what is needed to be equal—instead of just asking what level of equality is desirable—the capabilities approach showcases the level of real freedoms people actually have to achieve the valued functions that constitute their self-defined well-being.

In her book *Women and Human Development,* Martha Nussbaum proposes a provisional list of "Central Human Functional Capabilities" [25] in order to theorize what basic level of normative justice is desirable under the capabilities approach. Nussbaum offers the list in order to formulate the basic intuitions as to the core human capabilities that allow a person to "function in a fully human way." Her list of central capabilities echoes some of the goals in Maslow's hierarchy of needs. For example, the capability for "Life and Bodily Health" are similar to the goal of satisfying physiological needs.[26] However, the capability to live in harmony with nature and to participate effectively in political choices is not taken up in Maslow's hierarchy. Of particular relevance to design is the tenth capability for "Control over one's environment" both political (such as participation in civic administration) and material (such as being able to hold property). Given the centrality of design to bodily health and identity for the reasons argued above, I would add "Control over the design and production of civic building" to Nussbaum's list as sitting astride political and material control.

I offer the following capability set for design as the foundation for ethical principles in design policy. The list is based on research in design cognition, theory and methods in architecture and engineering, supplemented by the author's discussions with designers and "non-designers." In the list, we must be careful not to confuse *capability to design* with *capability as a designer.* Nigel Cross distinguishes between everyone's innate capability to design and an expert designer's fluency as a seemingly "natural intelligence" [27] for design. However, in the language of the capabilities theorists, Cross's "capability to design" conjecture is more akin to what Sen calls "functionings"—the things that people actually do. In the spirit of Nussbaum's list, the list I offer is both a proposal that should be tested over time and a set of necessary conditions for designing.

Capability to Design and Public Policy

At issue for design policy then is to develop citizens' capability to design. It is about the creation of the conditions of possibility for citizens to transform the capability set needed to do design into the functioning of being engaged in ("doing") design. Here, it is important to note that the capabilities approach does not propose to compel people toward specific functionings. For example, we might ask citizens, "Would you like to take part in the design of a public

25 Martha Craven Nussbaum, *Women and Human Development: The Capabilities Approach* (Cambridge: Cambridge University Press, 2000), 78–80.

26 Abraham H. Maslow, "A Theory of Human Motivation," *Psychological Review* 50:4 (1943).

27 Nigel Cross, "Natural Intelligence in Design," *Design Studies* 20:1 (1999).

Table 1

Capability	Description
INFORMATION	Have transparent access to all technical, financial, community, and political information relevant to a design work. Be in contact with communities and experts who have faced similar design problems as sources of ideas and solutions.
KNOWLEDGE	Have sufficient numeric, mathematical, and scientific training to engage in a conceptual and technical understanding of the design work. Knowledge of technical design methodologies. Have knowledge of making and interpreting relevant technical standards and codes.
ABSTRACTION	Develop aptitude for analysis and contextualization of design work at multiple levels of abstraction, from low-level functional, behavioral, and structural aspects to higher-order aspects such as systems integration, lifecycle maintenance and operations, and disposal.
EVALUATION	Be able to engage in a critical evaluation of the implications of the design work on matters such as the welfare of the community, the health of the environment, and economic viability. The welfare of the community includes individual concerns such as cognitive and physical ergonomics and universal design.
PARTICIPATION	Be part of, and collaborate with, others in the design process; from early project definition stages, through to conceptual design, concept testing, prototype development, prototype testing, prototype review, full-scale implementation, and final project delivery and validation. The formation of a shared understanding of all aspects of design work is paramount.
AUTHORITY	Have the power and right to enact a design work rather than token "paper studies." Have the authority to commission reports and information. Have the authority to select and set criteria and requirements for design work.

square if you had the opportunity to do so?" This question can indicate whether a person would choose to do the design of the public square (the functioning) if the person had the capability (phrased as opportunity) to do so. While design policy should not seek to make every citizen *do* design, it is the rightful purview of public policy to develop their capability to design.

The capability set that I proposed in the previous section and the concept of differential inequalities in the capabilities approach make us think about framing public policy toward design capability in terms of what is required for citizens to design. Framing the policy of design by understanding and theorizing citizens' capability to design as a matter of justice necessitates the consideration of factors that precede capability, factors that indicate capability, and what the public manages to achieve. The space between an innate capability to design and functional performance in design has to be addressed when accounting for capability to design, in as much as this space is relevant for the aims of public policy.

Asymmetries in capability to *do* design may arise from differences between people and socio-political barriers. Sen noted these differences in human development. He categorized human differences as relating to personal characteristics such as age, gender, and physical abilities; external characteristics such as economic wealth, environmental resources, and accessible cultural institutions, and, most important, their ability to convert resources into valued functionings.[28] There will be people who, through background experiences, engaged in activities which increased their "innate" capability for design, such as knitting, sewing, gardening, drawing, or building model cars. Others, less advantaged, may not have been afforded these same opportunities, which could have increased their aptitude for the capability set for design. The capability to achieve a functioning is attenuated by real differences between people. On the other hand, the achievement is regulated by external factors; the expression of the designed work which the public manages to achieve as a result of their capability is ineffectual if the policy mechanisms inhibit their capability to design.

To develop the capability to design, design policy therefore must recognize the "pre-conditions" scaffolding capability, the operational conditions "transforming" capability, and what the public manages to achieve as a result of the capability set. First, let us begin with pre-conditions. The pre-conditions set up the basic framework for capability to design independent of any specific design project or design work. The pre-conditions for the capability to design are a function of both "internal factors," such as creativity and the ability to handle different levels of abstraction simultaneously, and "external factors," such as public participation and planning laws, which amplify or attenuate the expression of these internal factors. Public activities and institutions that increase interest and understanding of design and cultural attitudes toward design are part of the pre-conditions/external factors for capability to design, while background experiences that increase a person's ability for abstract thinking are part of the pre-conditions/internal factors.

Internal factors related to capability to design constitute the subject of research in design cognition. Explanatory frameworks for mental processing in design seek to identify mental operations evident in expert designers but not novice designers,[29] patterns of reasoning,[30] and how design knowledge might be mentally represented.[31] Design studies researchers have sought to uncover the ultimate and proximate factors which influence successful ways of designing. The institutionalizing of design in universities and the production of accreditation criteria for academic programs in design that codify what constitutes competence in design is recognition of the required capabilities for design inculcated through formal education.

External factors regulate the possibility of expression of the internal factors. The first category of external factors includes the policy instruments for civic administration and governance such as local planning codes and other laws concerning the legislative and executive powers (e.g., oversight over public finance) of the public. There are known differences in external factors arising from legal statutes related to design policy. For example, Part 3 of the NSW Infrastructure Implementation Corporation Bill 2005 authorizes the Premier to establish "project authorization orders" on "such terms

28 Amartya Kumar Sen, *Inequality Reexamined* (Oxford: Oxford University Press, 1995).

29 Saeema Ahmed, Ken M. Wallace, and Lucienne T. M. Blessing, "Understanding the Differences between How Novice and Experienced Designers Approach Design Tasks," *Research in Engineering Design* 14:1 (2003).

30 Donald A. Schön, "Designing: Rules, Types and Words," *Design Studies* 9:3 (1988).

31 John S. Gero, "Design Prototypes: A Knowledge Representation Schema for Design," *AI Magazine* 11:4 (1990).

and conditions as the Premier determines." The Environmental Planning and Assessment Act 1979 Section 75A specifies the types of projects that fall under the Premier's authority. Conversely, in San Francisco, no such authority vests solely in the government, and San Francisco residents retain legislative and executive capability. This authority has been exercised by the citizens of San Francisco in relation to the reconstruction of the Central Freeway off-ramp. Citizens in San Francisco voted three times over three consecutive years on voter-initiatives related to the urban design, planning, and operation of the Central Freeway Replacement.

The second category of external factors encompasses investments toward public activities and institutions that increase interest and understanding of design and cultural attitudes toward design. These include design resource centers, museums of design, media attention to design, public awards for design, and public events about design. Design resource centers for the urban poor such as the Byculla Area Resource Centre in Mumbai, India[32] provide people-to-people horizontal learning through which the community documents, consolidates, and accesses strategies for slum redevelopment. Museums of design and applied sciences such as the Design Museum in London, Ann Arbor's (Michigan) Hands-On Museum, and The Exploratorium in San Francisco take designed works out of their market and industrial context, and put them into an environment in which the processes and technologies for designing the work can be understood. Research has shown that these museums can transfer the *knowledge* capability for design when the interactive exhibits are structured so that the learner knows "what is expected from them in relation to what they need to do (procedures) and in relation to the facts or concepts they are expected to learn (concept understanding)."[33] The long-running television show *The New Inventors* broadcast by the Australian Broadcasting Corporation educates the public about design and invention, and encourages do-it-yourself designers. A design policy which invests in institutions, technologies, and practices that enable everyday creativity and engagement in design is of strategic value in terms of social capital and broad capability to design. Investments in these institutions, coupled with public policy recognizing the capability set, should be evaluated based on their contribution to design education outside of formal schooling, literacy about design through the media, and access to practical information about designing through community-based learning resources.

The operational conditions transform capabilities into functionings, and are likely to be related to a specific design project. These conditions are:

1. *Actions toward capability development* such as type(s) of public participation; action(s) to include those otherwise unlikely to participate; and education on matters specific to a project. Public participation may range from consultative

32 Sundar Burra, "A Journey Towards Citizenship: The Byculla Area Resource Centre, Mumbai" (Mumbai, India: 2000).

33 Agostinho Botelho and Ana M. Morais, "Students-Exhibits Interaction at a Science Center," *Journal of Research in Science Teaching* 43:10 (2006): 1014.

and informational to functional and interactive,[34] though each may have different impacts on design capability.

2. *Support of capability development* such as percent of project funds allocated to capability development; measurements of intensity and duration of such efforts (i.e., whether integrated throughout the life cycle of the design process); and continuous improvement toward collaborative planning.

Thus, we have two problems for design policy: one is to inculcate the capability to design, and the second is to direct the capability towards tangible outcomes. A third problem is one of measurement. Assessments of the capability producing investments described above are likely to include the type of econometric measurements that will have substantive resonance to public policymakers. While it is not obvious what we should measure, it is likely that we will be measuring the sorts of investments in pre-conditions and operational conditions mentioned above, and what the public manages to achieve. Instead of solely focusing on measuring output, such as public sector efficiency or rates of participation, we need to measure the potential for output. For example, a measurement of national science and engineering capability is the number of students majoring in science and engineering at institutions of higher learning. Likewise, investments in the knowledge of and practical engagement with design could be partially assessed in terms of public expenditures toward institutions which provide access to the understanding of the technical means of design and general design literacy. Measures such as the number of visitations to hands-on museums of design, the number of design resource centers, the number of social networks for community-based redevelopment projects, and the value of prizes awarded for community-based redevelopment projects may indicate the public's capability to design. It should be noted that agreement on empirical measurements of capabilities remains one of the most elusive and challenging aspects of the capabilities approach.[35]

The measurement of capability to design calls our attention towards factors that precede the functioning of designing and the likely effectiveness of public engagement in design. What is needed is a consensus on aspects that can be usefully quantified as indicators of capability to design, but not design capability itself.

Conclusion

Realizing that our aspirations for a pluralistic form of design that is efficient and effective is far from straightforward and, at times, is perceived as a social cost rather than a social benefit, we nonetheless should work towards conceiving the outcome of a just policy of design. The rapid growth of urbanization underscores the need for an urban identity woven into the urban fabric. The question that we must deal with is the way design is practiced so that the identities of

34 Jules N. Pretty, "Participatory Learning for Sustainable Agriculture," *World Development* 23:8 (1995).

35 Enrica Chiappero Martinetti, "A Multidimensional Assessment of Well-Being Based on Sen's Functioning Approach," *Rivista Internazionale di Scienze Sociali* 2 (2000).

citizens inhabit it. The absence of a normative framework for citizen engagement in designing, not just participating in designing, is an abandonment of the possibility of expression of identity of everyday urban spaces and practices.

A capability approach to design shifts the dialogue in the policy of design by asking "What could citizens design?" given *constitutive and instrumental conditions*, rather than "What was designed?" given the *procedural conditions*. The capability approach to design policy circumvents the dilemma of "bean counting" the number of public review forums, amount of money spent notifying the community, and the number of participants in a project as indicators of public engagement. In view of the capabilities approach, the choice is not between the situation in which "citizens and other players work and talk in formal and informal ways to influence action in the public arena before it is virtually a foregone conclusion,"[36] and the delegation of authority to design to experts. Rather, the capability to design connects the discourse about public engagement in design to the question of who can impose order upon the designed world. If the answer to that question is the citizens who inhabit that designed world, then our attention logically turns to their capability to write and inscribe the designed world and developing their capability to express a designed world that resonates their states of mind, desires, and affects.

Michel Foucault, when asked if architecture could resolve social problems, responded: "I think that it can and does produce positive effects when the liberating intentions of the architect coincide with the real practice of people in their exercise of their freedom."[37] This article echoes Foucault in seeking a normative theory on the capabilities of citizens to design.

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36 Innes and Booher, "Reframing Public Participation: Strategies for the 21st Century," 429.

37 Michel Foucault, "Space, Knowledge, and Power" in *The Foucault Reader,* Paul Rabinow, ed. (London: Penguin Books, 1991), 246.

New Pragmatism and the Vocabulary and Metaphors of Scholarly Design Research

Gavin Melles

The pragmatism of Dewey, James, and Pierce is familiar vocabulary to the philosophical, educational, social, and political landscape of North America. In its treatment of truth, action, values, and the theory-practice divide, it is particularly relevant to a range of fields including design. This pragmatist legacy is developed in Donald Schön's work, and Rittel's and Weber's metaphor of the wicked problems of planning and design—to suggest a distinctive disciplinary vocabulary of design research and practice. Existing treatments of the relations between pragmatism and design disciplines such as urban and environmental planning, architecture, and interaction design highlight this expanded version. However, such treatments have not addressed how the neo-pragmatist account developed by Richard Rorty might enlarge design research. Combining particular readings of Dewey, James, and others with Wittgenstein, Foucault, and Derrida; Rorty offers an account which reinforces conventional pragmatist theses, but then looks beyond them in an environment where science and the humanities have equal claims to truth, meaning, and representation. Reviewing existing treatments of these themes, including those in this journal, I trace connections between pragmatism and Horst's and Rittel's formulation of wicked problems and Schön's reflective practitioner. I examine the current use of Deweyan and new pragmatism in design fields, and suggest how Rorty's claims about redescription and vocabularies have some unexplored consequences for design research and scholarship. I close with some thoughts on how the expanded pragmatist approach might support the kind of epistemological and methodological perspective to benefit design scholarship.

Pragmatism: Revisiting Terms of Reference

The pragmatism of the early twentieth century offered a distinctive perspective on knowledge, meaning, and truth. In particular, William James[1] and John Dewey's[2] work, through the late-nineteenth and early and middle years of the twentieth century, was prolific and continues to generate discussion in education, politics, and other fields.[3] Pragmatism holds to an instrumental account of ideas as plans of action that borrow their meanings from their practical real-world consequences. This contrasts with current philosophical positions, such as those of analytic philosophy, which propose abstract

1 William James, *The Varieties of Religious Experience, A Study in Human Nature* (New York: Collier, 1936); *Pragmatism: A New Name for Some Old Ways of Thinking: Popular Lectures on Philosophy* (London and New York: Longmans, 1907); and *The Will to Believe and Other Essays in Popular Philosophy* (New York: Dover, 1956).

2 Dewey's ability to show the relevance of pragmatism to multiple fields and social concerns is evident in John Dewey, *Reconstruction in Philosophy* (Boston: Beacon Press, 1958); *Experience and Nature* (New York: Dover, 2nd ed.,1958); *Art as Experience* (New York: Capricorn Books, 1959); *Moral Principles in Education* (New York: Philosophical Library, 1959); and *Democracy and Education: An Introduction to the Philosophy of Education* (New York: Free Press, 1966).

3 Some recent treatments showing the breadth of these concerns for knowledge, ethics, and politics include James Campbell, *Understanding John Dewey: Nature and Cooperative Intelligence* (Chicago: Open Court, 1995); Steven Fesmire, *John Dewey and Moral Imagination: Pragmatism in Ethics* (Bloomington: Indiana University Press, 2003); Matthew Festenstein, *Pragmatism and Political Theory* (Cambridge, UK: Polity Press, 1997); and Russell B. Goodman, *American Philosophy and the Romantic Tradition* (Cambridge, UK and New York: Cambridge University Press, 1990).

accounts of knowledge and ideas as correspondence with truth and objective reality. This truth-as-correspondence-to reality position was roundly critiqued by analytic and post-analytic philosophy in the wake of the later Wittgenstein's work. Pragmatism also proposed that individual action and experience in the world was the most realistic basis for decision-making. This action-oriented environment was where an interdependent version of theory-practice knowledge developed. Pragmatism's demise as a flourishing perspective on the forms and practices of science, education, and other fields came with a shift to a rationalist and logical empiricist mood in North America following WWII.

In addition to the general postmodern challenges to existing philosophical positions, the recent renaissance of pragmatism and its broad appeal has been motivated by a shift to the current historicist mood of philosophy and allied areas. As a result, "Truth is now conceived more historically and, as a consequence, pragmatism is more generally acknowledged as a position, rather than as a consequence of particular arguments and theses or as a methodological limit." [4] In addition to this historicism, the current range of pragmatist positions that are grounded in intellectual readings of the early twentieth century and postmodern critique have other common features. Prado [5] identifies four key tenets of current manifestations of pragmatism: a pluralistic empiricism, a temporalistic view of reality, a contextualist conception of reality and values, and a secular democratic individualism. Pluralistic empiricism accepts alternative explanations of phenomena on the grounds of the inherent indeterminacy of theory relationships to data. A temporalistic view of reality enshrines the need to consider the historical situatedness of current philosophical, educational, and other views. The need to comprehend reality and address values from the perspective of concrete situational contexts is a concomitant of the two previous assumptions, while the fourth, democratic principle locates choice and reality within a political legacy that addresses both individual and community needs.

In a period where design fields were only beginning to distinguish themselves, pragmatism had little to say directly to design. However, Dewey's views on the success of techno-scientific methods of inquiry and art and aesthetics as forms of communication have direct relevance to the field of design. For Dewey, art and aesthetics were modes of public communication and experience that could help transcend ideological and moral boundaries. This Deweyan view of the role of art in social and political debate, and transformation, continues to have adherents and critics.[6] In *Art & Aesthetics*, Dewey deplored the separation of industrial arts from fine arts on the basis of a dichotomy between objects for use (industrial arts) and those for speculation and theorizing (fine arts). Dewey saw the separation of fine arts from experience and circumstances of production in

4 "Truth is now conceived more historically and, as a consequence, pragmatism is more generally acknowledged as a position rather than as a consequence of particular arguments and theses or as a methodological limit," Charles G. Prado, *The Limits of Pragmatism* (Atlantic Highlands, NJ: Humanities Press International, 1987), 1.

5 Ibid.

6 John Dewey, *Art as Experience*; Robert E. Innis, "Meaning, Art, and Politics: Dimensions of a Philosophical Engagement," *The Journal of Speculative Philosophy* 19:1 (2005): 55–62; Mark Mattern, "John Dewey, Art and Public Life," *The Journal of Politics* 61:1 (1999): 54–75; and John H. White, "Pragmatism and Art: Tools for Change," *Studies in Art Education* 39:3 (1998): 215–229.

galleries as artificial. He also suggested that it was unproductive to a public understanding of the function and value of art in a democratic society.

This practical account of aesthetics and creativity has potential lessons for design fields. Following James's and Deweys' emphasis on the aesthetic nature of all thinking, Coyne,[7] for example, sees pragmatism as an approach to creativity that avoids the excesses of artistic romanticism and cognitive rationalism in design. Pragmatism also can control the flight of interpretation from practical realities. Interpretation is, for Coyne, the central concern for creativity within pragmatism; and involves focusing on the indeterminate, but active, engagement with the meanings of objects for both designers and users.

Hickman notes that Dewey's "productive pragmatism" amounted to showing how the techno-scientific disciplines and those of arts, law, and others shared general problem-solving strategies. "Both types of enterprise, when successful, are bound to criteria by means of which the elements and facts of their selected problem areas are subjected to critical appraisal, to honesty with respect to materials, to evaluations within a peer group or community of inquiry, and to relevance with respect to cultural-historical contexts."[8] This critical but productive engagement with technology is a decidedly late-modern vision, consistent with the liberal democracies within which pragmatism (and design) has flourished. As Hickman[9] also observes, the instrumentalism and techno-scientific focus of Dewey's "productive pragmatism" was anathema to a generation of critical theorists who condemned technology as the source of human ills. Although misunderstood as a view of science and technology as general panacea, especially by early critical theory, Dewey hoped to show rather that scientific and technological pragmatism "could be applied toward the resolution of pressing social ills."[10]

Notwithstanding the substantial intellectual legacy of Dewey, James, and their interpreters, current conversations about the significance of pragmatism for design can flounder on the multiple meanings of the term, which vary between a philosophically informed version, and a version that "is still widely (but inadequately) equated with a kind of theory-free common-sense pragmatism in the everyday sense of the word."[11] For example, Fisher identifies a current simplification of the pragmatist legacy as a market- oriented practicalism: "The so called pragmatists of our time are generally concerned only with the immediate consequences of their actions: will a building meet market expectations right away or bring in a short-term profit? A true pragmatist would argue that the meaning and value of an action depends upon its consequences over time and that by attending only to immediate effects, we may in fact completely misjudge what we do."[12] To avoid confusion and acknowledge a certain intellectual legacy, a number of scholars have distinguished critical pragmatism from its vulgar or popular

7 Richard Coyne, "Creativity as Commonplace," *Design Studies* 18:2 (1997): 135–141.

8 Larry Hickman, *Philosophical Tools for Technological Culture: Putting Pragmatism to Work* (Bloomington: Indiana University Press, 2001), 67.

9 Ibid., 81.

10 Ibid., 66.

11 Richard J. Ormerod, "Philosophy for Professionals: Towards Critical Pragmatism," *Journal of the Operational Research Society* 58 (2007): 1109. Already in the 1950s, an intellectually vacuous conception of pragmatism is mentioned as prevailing in architectural education by Oskar Stonorov, "Education for Housing Design: A Dim View," *Journal of Architectural Education* 10:1 (1955): 33–36.

12 Thomas Fisher, *In the Scheme of Things: Alternative Thinking on the Practice of Architecture* (Minneapolis: University of Minnesota Press, 2000), 130.

version.[13] The version of critical pragmatism of relevance here, which I will call "new pragmatism," accepts the importance of the ideological contexts and consequences of social, educational, and other decisions, while resisting the foundational and rationalistic critiques of scholars like Habermas.[14]

The educational researcher and theorist, Cleo Cherryholmes, was the first to provide the relevant contrast between vulgar and critical pragmatism that is relevant for the concerns of this paper.[15] Cherryholmes has sustained a critical pragmatist critique of education and educational research to suggest, for example, that many versions of state-sponsored and institutionalized curriculum have negative consequences for learning and good pedagogical practice in general. Through a careful pragmatist (consequential) reading of objective and competency-oriented curricula, for example, Cherryholmes shows how the consequences for teacher professionalism and student learning are significantly curtailed. It is a similar critical and consequential reading of research and knowledge and practice proposals that design education should bring to its enterprise. The relevant neo-pragmatist version here incorporates traditional pragmatic concerns with an attempt to address postmodern concerns regarding discourses and ideology; an approach consistent with Richard Rorty's conversations with Foucault, Derrida, Habermas, and others.

Pragmatism and the Metaphoric Turn of Schön and Rittel and Weber

While pragmatism has found its way into various design disciplines, it is the appropriation of pragmatism in urban planning, architecture, and information technology where it appears to have had the most

13 A philosophically (and practically) vacuous concept of pragmatism is not helped by studies that use pragmatism as a designation for practical, de-contextualized problem-solving. For example, Dan Davies, "Pragmatism, Pedagogy and Philosophy: A Model of Thought and Action in Action in Primary Technology and Science Teacher Education," *International Journal of Technology and Design Education* 13:3 (2003): 207–221.

14 Thus, Ulrich combines Schön's work on reflective practice, Habermasian critical theory, and pragmatist thought; but resists postmodern pluralism, preferring critical systemics. He argues strongly for a "predefined" ideological position for critical pragmatism in the field of planning, and is critical of the less political stance of John Forester. Werner Ulrich, *Critical Heuristics of Social Planning: A New Approach to Practical Philosophy* (Bern, Switzerland: Haupt. reprint ed. And Chichester, UK, and New York: Wiley, 1994); Werner Ulrich, "Reflective Practice in the Civil Society: The Contribution of Critically Systemic Thinking," *Reflective Practice* 1:2 (2000): 247–268; and Werner Ulrich, "The Quest for Competence in Systemic Research and Practice," *Systems Research and Behavioral Science* 18:1 (2001): 3–28.

15 Cleo H. Cherryholmes, *Power and Criticism: Poststructural Investigations in Education* (New York: Teachers College Press, 1988). Tom Barone notes that "Cherryholmes contrasts vulgar pragmatism with critical pragmatism, the kind of neopragmatism favored by writers such as Richard Rorty and Hilary Putnam," Tom E. Barone, "On the Demise of Subjectivity in Educational Inquiry," *Curriculum Inquiry* 22:1 (1992): 25–38. While Cherryholmes has revisited the negative connotations of the term "vulgar," the distinction remains a useful one. For some of the flavor of this contrast and its function in discerning where research discourses are, see also Cleo H. Cherryholmes, "Construct Validity and the Discourses of Research," *American Journal of Education* 96:3 (1988): 421–457; and Cleo H. Cherryholmes, "Notes on Pragmatism and Scientific Realism," *Educational Researcher* 21:6 (1992): 13–17. For an analysis, see Jean Anyon, "The Retreat of Marxism and Socialist Feminism: Postmodern and Poststructural Theories in Education," *Curriculum Inquiry* 24:2 (1994): 115–133.

impact. In these fields, pragmatism is collocated with the oft-cited work of Donald Schön, and Rittel's and Weber's wicked problem formulation. Although Schön's writing, including the *Reflective Practitioner*, is widely cited in a range of fields, Schön's pragmatism is less well known.[16] Building on Deweys' pragmatism, Schön emphasized that reflective practice in design was the characteristic property of professional practice by which expertise emerged over time. As Waks[17] also points out, among the major achievements of Schön was to recognize the power of metaphor: "He discovered that generative metaphors permitted us to 'construct meaning in our perpetually changing circumstances, providing continuity between our older experiences and our new situations by pointing at similarities or family resemblances between them.'" [18]

This vision of the productive power of metaphor echoes Wittgenstein. As Waks observes, "Schön's theory of inquiry as design can be seen as an attempt to update Dewey's theory of inquiry by substituting within it ideas from the later philosophy of Wittgenstein in place of those of Pierce." [19]

Productive metaphors are central to the development of design theory and models. Coyne and Snodgrass[20] have suggested that models of the design process may in fact be viewed as relatively useful or useless metaphors. They claim, for example, that design science as metaphor / model represents designing in ways that are disabling to advancing the field. In general, they note that "metaphors provide the means by which problems are defined and resolved, but if we are uncritical of the metaphors that prompt our actions, we may miss opportunities for useful action." [21] Rittel's and Weber's wicked-problem metaphor has proved to be a more

16 Schön's commitment to Dewey is evident in Donald A Schön, "The Theory of Inquiry: Dewey's Legacy to Education," *Curriculum Inquiry* 22:2 (1992): 119–139. For a fuller account of his thinking, see Camilla Stivers and Mary R. Schmidt, "You Know More Than You Can Say: In Memory of Donald A. Schön (1930-1997)," *Public Administration Review* 60:3 (2000): 265–274.

17 Leonard J. Waks, "Donald Schön's Philosophy of Design and Design Education," *International Journal of Technology and Design Education* 11:1 (2001): 37–51.

18 Ibid., 38.

19 Ibid., 50. Significantly, Schön places Wittgenstein; along with Dewey, Piaget, and Vygotsky; in his pantheon of exemplary educators. Waks links this latter claim to Donald A. Schön, "The Theory of Inquiry: Dewey's Legacy to Education," *Curriculum Inquiry* 22:2 (1992): 119–139.

20 Richard Coyne and Adrian Snodgrass, "Models, Metaphors and the Hermeneutics of Designing," *Design Issues* 9:1 (1992): 57–64.

21 Richard Coyne and Adrian Snodgrass, "Problem Setting within Prevalent Metaphors of Design," *Design Issues* 11:2 (1995): 31–61.

productive metaphor, in this sense, for design. The wicked-problem metaphor has been taken up as an appropriate formulation of problem-solving in many fields of practice, including design.[22] Coyne[23] recently has suggested that, in fact, the original intent of the "wicked" qualifier as a form of aberrant and unusual problem-solving now can be revised: all design problems are fundamentally wicked, but they also are in other fields. This current reevaluation of the cash value of "wicked" does not, however, displace the value of the metaphor as a convenient semantic packaging of the nature of design.

Rittel's and Weber's oft-cited formulation of the wicked nature of planning and policy problems,[24] which they distinguish from those of science and engineering paradigms, is very much a part of the pragmatist manifesto. It offers a vision of problem-formulation and iterative solution-making that attends to circumstances, and where solutions are judged by standards of usefulness and aesthetics. As Buchanan suggests, the wicked- problem formulation claims that "there is a fundamental indeterminacy in all but the most trivial design problems."[25] As a result, the designer does not so much solve a problem, but "must discover or invent a particular subject out of the problems and issues of specific circumstances."[26]

Given its origins in considerations about planning practices, it is not surprising that Rittel's and Weber's heuristic has been developed in the fields of urban and environmental planning and design.[27] Bryan Norton, for example, has foregrounded the need for (pragmatic) wicked-problem perspectives in environmental planning to address issues such as sustainability.[28] He contrasts the limitations of conventional linear modeling and decision-making in environ-

22 For example, see David Watson, "Managing in Higher Education: The 'Wicked Issues,'" *Higher Education Quarterly* 54:1 (2000): 5–21. Marshall W. Kreuter, Christopher De Rosa, Elizabeth H. Howze, and Grant T. Baldwin, "Understanding Wicked Problems: A Key to Advancing Environmental Health Promotion," *Health Education Behaviour* 31:4 (2004): 441–454; Donald Chisholm, "Problem Solving and Institutional Design," *Journal of Public Administration Research Theory* 5:4 (1995): 451–492; and Gerald Emison, "The Complex Challenges of Ethical Choices by Engineers in Public Service," *Science and Engineering Ethics* 12:2 (2006): 233–244. Emison deals with "reflective pragmatism" as an approach which employs Dewey's five-stage process of inquiry to engage the ethical complexity inherent in the practice of engineering in the public service.

23 Richard Coyne, "Wicked Problems Revisited," *Design Studies* 26:1 (2005): 5–17.

24 In Horst W. Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973): 155–169. Herbert Simon uses the term "ill-structured" to attempt to capture these ambiguities and contingencies in design decision-making. Herbert A. Simon, "The Structure of Ill- Structured Problems," *Artificial Intelligence* 4:3–4 (1973): 181–201.

25 Richard Buchanan, "Wicked Problems in Design Thinking," *Design Issues* 8:2 (1992): 15–16.

26 Ibid., 16.

27 I deal with specific texts and scholars below. For some further versions, see Donald Ludwig, Marc Mangel, and Brent Haddad, "Ecology, Conservation and Public Policy," *Annual Review of Ecology and Systematics* 32:1 (2001): 481–517. *Environmental Pragmatism,* Andrew Light and Eric Katz, eds. (London and New York: Routledge, 1996).

28 Bryan G. Norton, *Searching for Sustainability: Interdisciplinary Essays in the Philosophy of Conservation Biology* (New York: Cambridge University Press, 2002); *Sustainability: A Philosophy of Adaptive Ecosystem Management* (Chicago: University of Chicago Press, 2005); and Bryan G. Norton and Douglas Noonan, "Ecology and Valuation: Big Changes Needed," *Ecological Economics* 63:4 (2007): 664–675.

mental planning to a wicked- problem formulation; observing that, in environmental policy and planning, "there is no single, accepted formulation of the problem; and answers are often in more-or-less terms in which planners and managers at best can find reasonable, but shifting balances among competing interests and values … the correct formulation of the problem cannot be known until a solution is accepted."[29] This vision of the essentially pragmatic nature of urban planning and design, combined with critical perspectives, also has been championed by John Forester and, more recently, Charles Hoch.[30] Thus, Forester argues that wherever urban planners work, "They will soon have to do the complex work of *anticipating*—and responding reflexively to—the pressures of *political power* and the challenges of working with, even reconciling *value differences*.… I try to explore planning practice by taking seriously but not uncritically planners own accounts of the challenges, accounts, and lessons—the friction—of their own practice." Hoch[31] meanwhile suggests that a pragmatist outlook on evaluating planning decisions should displace rationalist approaches as more appropriate to the wicked problems of planning.[32] He concludes that: "The pragmatic approach reviews the plausibility of plan alternatives; the similarity binding plan and product, the breadth and depth of the consensus the plan informs and the responsibility the plan inspires among those able to follow it. These prudent pragmatic judgments provide theoretical coherence for the practical common sense that wise planners acquire on the job. Instead of promoting an exaggerated distance between the judgments of experts and practitioners, it invites a critical engagement."[33]

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29 Bryan G. Norton, "Building Demand Models to Improve Environmental Policy Process" in *Model-based Reasoning in Scientific Discovery,* L. Magnani, N. J. Nersessian, and P. Thagard, eds. (New York: Kluwer Academic/Plenum Publishers, 1999), 194.

30 John Forester, *Critical Theory, Public Policy, and Planning Practice: Toward a Critical Pragmatism* (Albany: State University of New York Press, 1993), 98. Also see John Forester, "Creating Public Value in Planning and Urban Design: The Three Abiding Problems of Negotiation, Participation and Deliberation," *Urban Design International* 3:1 (1998): 5–12 and "Reflections on the Future Understanding of Planning Practice," *International Planning Studies* 4:2 (1999):175–189. Hoch's work is wide-ranging, but in Charles J. Hoch, "Evaluating Plans Pragmatically," *Planning Theory* 1:1 (2002), 66, he contrasts rationalist and pragmatic approaches to planning evaluation: "When we evaluate plans, our judgments do differ as we select alternatives, compare consequences, conduct critiques, or assess competence. But these ideas flow less from the logic of rational method and more from fitting purposes to context, helping blind persons learn to speak to one another. A pragmatic viewpoint encourages us to refine our practical reasoning critically and contextually, but without the confinement of rational precision, fit, principle, and expertise." In Charles J. Hoch, "Pragmatic Communicative Action Theory," *Journal of Planning Education and Research* 26:3 (2007): 272–283, Hoch concludes with the practical focus of a pragmatic account of planning theory thus: "Adopting a pragmatic orientation shifts debate about political and moral differences for planning from doctrinal disputes about knowledge claims to a focus on empirical and interpretive claims about the effect of particular urban changes and planning activity." (280).

31 Charles J. Hoch, "What Can Rorty Teach an Old Pragmatist Doing Public Administration or Planning?" *Administration Society* 38:3 (2006): 389–398.

32 Charles J. Hoch, "Evaluating Plans Pragmatically," *Planning Theory* 1:1 (2002): 53–75.

33 Ibid., 70.

In his recent book, *In the Scheme of Things*,[34] Thomas Fisher connects a consideration of architecture and pragmatism to the need to revitalize the discipline. Fisher sees the pragmatist architectural legacy in North American environment and architecture, including Frank Lloyd Wright's work and others.[35] In a sustained treatment, Betsky and De Long,[36] for example, develop a particular account of the pragmatist architectural vision of James Gamble Rogers—visible in Yale and elsewhere. They see Roger's vision as "an architectural practice that connected the rational strains inherent in both Neo-Gothicism and Classicism with the picturesque tendencies also present in both, while rejecting both hierarchies and symmetries and systems of preplanned order and mystical ideas about the inherent rightness of organic form." [37] The late-modern and current dominance of formalism and the postmodern in architectural theory displaced these pragmatic material concerns. However, having recently moved beyond a period in which the postmodern has dominated intellectual conversation, architecture and the built environment also have begun to reconsider the merits of pragmatism in an environment of global competition.[38] Thus, Michael Speaks[39] argues that the architectural fetish with postmodernism in the '80s and '90s has been superseded by a confrontation with professional realities, which must now address practical problem-solving and innovation through a pragmatist approach that values the recent theoretical past, but must supersede it. He concludes that, to survive, architectural thinking "must focus on time, interactivity, and innovation, and give up its obsession with space, genius and the Utopian search for the new." [40]

34 Thomas Fisher, *In the Scheme of Things: Alternative Thinking on the Practice of Architecture* (Minneapolis: University of Minnesota Press, 2000). And see his "Letter to the Editor" on contemporary confusion and the need for engagement with neo-pragmatism in *The New York Times* (December 1, 2000): "Pragmatism is not against theory, nor is it an 'imperialist gambit' by American thinkers. Pragmatism urges us to look to the consequences of what we do; which the discipline of architecture, infused with an idealistic focus on intentions; frequently resists. And it has deep roots in modern European thought; which architects, unfamiliar with the work of the 'neo-pragmatist' philosopher Richard Rorty, might easily miss. The architectural community would greatly benefit from a more serious engagement with the ideas of pragmatism, which can illuminate some of the blind spots in architecture today."

35 For some thoughts on the pragmatist outlook of Frank Lloyd Wright and his contemporaries, see Peter Kucker, "Framework: Construction and Space in the Architecture of Frank Lloyd Wright and Rudolf Schindler," *The Journal of Architecture* 7:2 (2002): 171–183.

36 Aaron Betsky and David G. De Long, *James Gamble Rogers and the Architecture of Pragmatism* (New York and Cambridge, MA: Architectural History Foundation; MIT Press, 1994).

37 Ibid., 65.

38 I focus on architecture and architectural education, although note that Susan Savage tries to put Dewey and Schön in conversation with urban design education and new forms of knowledge production in universities. Susan Savage, "Urban Design Education: Learning for Life in Practice," *Urban Design International* 10 (2005): 3–10.

39 Michael Speaks, "Theory Was Interesting … but Now We Have Work," *Architectural Research Quarterly* 6 (2003): 209–212.

40 Ibid., 212.

This respecificaton of architectural education and practice must, it seems, tread a path between both critical and vulgar tendencies. Kathryn Moore,[41] for example, suggests that pragmatic skepticism towards the prevailing romantic metaphor of visual thinking in design could produce a more educationally useful version. The current version, she suggests, "mystifies design discourse, is responsible for the invidious distinction made between theory and practice and lies at the heart of the dangerous argument that it is, to all intents and purposes, impossible to even teach design." [42] This is so because such primitive form of thinking that escapes language and is, therefore, fundamentally idealized and abstract. Guy and Moore,[43] meanwhile, view the pluralist imagination exercised in architectural concepting as encouraged by pragmatism and as an advantage to resisting prevailing notions of technical and scientific certainty in the field of sustainable architecture in particular. Similar to Ockman and others,[44] the authors want to see how a pragmatist approach to designing with technical and social constraints in mind might be combined with an eye to critical theory into a "critical pluralism" that echoes concerns mentioned about critical pragmatism.

Information technology design also has attempted to engage with new pragmatism. As a response to the limitations of rationality in design, Richard Coyne[45] has been a leading voice in addressing the potential of pragmatism to inform design, and claiming that the characterization of design problems as "wicked," following the Rittel and Weber formulation, is essentially a pragmatic proposal: "Rittel and Webber … argued persuasively, and in terms understandable to the systematizers, that the design process, and any other profes-

41 Kathryn Moore, "Overlooking the Visual," *The Journal of Architecture* 8:1 (2003): 25–40.

42 Ibid., 26.

43 Simon Guy and Steven A. Moore, "Sustainable Architecture and the Pluralist Imagination," *Journal of Architectural Education* 60:4 (2007): 15–23.

44 *The Pragmatist Imagination: Thinking about "Things in the Making,"* Joan Ockman, ed. (New York: Princeton Architectural Press, 2000).

45 Richard Coyne, "Wicked Problems Revisited," *Design Studies* 26:1 (2005): 5–17. Coyne is not alone though in seeing the need for critical and social dimensions to information technology design. See, for example, Geraldine Fitzpatrick, *The Locales Framework: Understanding and Designing for Wicked Problems* (Dordrecht and London: Kluwer Academic Publishers, 2003).

sional task, is only very poorly explained in terms of goal setting, constraints, rules, and state-space search…. Problem-setting is a contingent, fraught, and sometimes consensual process for which there is no authoritative set of rules, criteria, or methods." [46] Citing Dewey and Rorty, Coyne shows that pragmatism highlights the fact that all scientific and professional judgments are imbued with aesthetic considerations: the theory-practice distinction vanishes when considering the actual practices of designers.

Following Coyne's lead on the design of technology and information systems, Wakkary[47] chooses complexity to designate the typically messy contingent factors and problem formulations typical of interaction design and HCI. Wakkary argues for designing as "a dynamic process that is improvisational and responsive to the changing design situation." [48] Wakkary also compares the improvisational, but situated, response of reflective design practice to Schön's description of "frame experiments" by the designer.[49] Referring to the Schön the pragmatist, Keulartz et al.[50] extend the frame experiment metaphor to include double vision[51] as part of designer competency to resolve tensions in problem solutions. According to Wakkary, Coyne[52] and Gedenryd,[53] root the reflective practitioner model in pragmatism of Dewey, Heidegger, and Rorty, particularly where the designers interpret the effects of their designs on the situation at hand.

Beyond Wicked Problems: Rorty's Distinctive Contribution: Vocabularies, Redescription, and Design

Rorty is no stranger to the power of metaphor. In his landmark book *Philosophy and the Mirror of Nature*, Rorty challenged the familiar ocular metaphor of the mirror of philosophical and empiricist discourse as an accurate reflection of the world.[54] Rorty replaces

46 Coyne, "Wicked Problems Revisited," *Design Studies*: 6.

47 Ron Wakkary, "Framing Complexity, Design and Experience: A Reflective Analysis" in *Digital Creativity* 16:2 (2005): 65–78.

48 Ibid., 67.

49 Donald A. Schön, *The Reflective Practitioner: How Professionals Think in Action* (New York: Basic Books, 1983), 150. Schön describes frame experiments as the iterative modeling and revision of solutions to design problems through a range of strategies, including sketching, scenarios, etc. The reflective engagement with the design situation itself constitutes the nature of the response, a familiar design experience.

50 Jozef Keulartz, Michiel Korthals, Maartje Schermer, and Tsjalling Swierstra, "Pragmatism in Progress: A Reply to Radder, Colapietro and Pitt," *Techné: Research in Philosophy and Technology* 7:3 (2004). Available at: http://scholar.lib.vt.edu/ejournals/SPT/v7n3/reply.html (last accessed February 2, 2008). Schön is interested in the creative and constructive resolution of policy controversies. They require what Schön calls "frame restructuring"—a necessary condition for frame restructuring. The recasting and reconnecting of things and relations in the perceptual and social fields is frame reflection.

51 Double Vision is "the ability to act from a frame while cultivating awareness of alternative frames," Donald A. Schön and Martin Rein, *Frame Reflection: Toward the Resolution of Intractable Policy Controversies* (New York: Basic Books, 1994), 207.

52 Richard Coyne, *Designing Information Technology in the Postmodern Age: From Method to Metaphor* (Cambridge, MA: Leonardo Books, MIT Press, 1995).

53 Henrik Gedenryd, *How Designers Work* (Lund: Lund University, 1998).

54 Richard Rorty, *Philosophy and the Mirror of Nature* (Princeton: Princeton University Press, 1979).

the ocular metaphor with a discursive one in which philosophy is replaced by an enlarged conversation among texts of science and the humanities to help transcend current dead and misleading metaphors. Such metaphoric transition from old to new also has been signaled by Schön.[55]

Rorty's new pragmatism[56] takes up the instrumental account of knowledge and ideas in pragmatism, but rejects the Deweyan view of the privileged status of science methods in engaging inductively and deductively with the world. In his later work, Rorty[57] emphasizes the power of vocabularies to achieve public and private aims: "Keenly aware of the contingency of human belief and the precarious status of our liberal institutions, Rorty insists that we keep our pursuit of private desires and public expectations separate—publicly focus on developing practical alternatives for resolving differences through compromise and consensus; privately imagine possibilities for self-development that generate and celebrate new differences."[58] Rorty's anti-foundational, pragmatist program looks to the practical benefits and consequences of an enlarged reading list and conversation. Rorty, like Dewey, recognizes that the validity of poetry or policy does not flow from the command of more inclusive propositions about human nature or matter, but the consequences they evoke. Thus, "We need to pay attention to consequences—the quality of the edification that poetry delivers or the quality that family planning policy offers a particular clientele. In such cases, we cannot escape the contingency of human judgment in specific cultural contexts."[59]

Hiley and Guignon suggest that one interpretation for vocabulary, as Rorty's uses it, is Kuhn's notion of "agreed-upon disciplinary matrix" which underpins normal discourse and practice in

55 Terry Barnes, "Metaphors and Conversations in Economic Geography: Richard Rorty and the Gravity Model," *Geografiska Annaler: Series B, Human Geography* 73:2 (1991): 111–120.

56 I'm using Charles Hoch.

57 Here, I'm thinking of the work that followed his explicit pragmatist manifesto: Richard Rorty, *Consequences of Pragmatism: Essays, 1972–1980* (Minneapolis: University of Minnesota Press, 1982); and particularly Richard Rorty, *Contingency, Irony, and Solidarity* (Cambridge, MA and New York: Cambridge University Press, 1989); and *Objectivity, Relativism, and Truth* (Cambridge, MA and New York: Cambridge University Press, 1991), where the instrumental value of redescription and vocabularies are on a level playing field, where science and the humanities have an equal chance and stake in dealing with truth (but not "Truth").

58 Hoch, "What Can Rorty Teach an Old Pragmatist Doing Public Administration or Planning?" *Administration Society* 38:3 (2006): 395.

59 Ibid., 396.

the sciences.[60] Malachowski[61] also makes the Kuhnian connection, but points to the similarities between vocabulary in Rorty's writing and the "language game" in Wittgenstein. Prado rightly, to my mind, makes a terminological distinction between "discourses" and "dialects" which is relevant to the overall pursuit of design as discipline and sub-disciplinary conversations. Prado suggests that when Rorty talks of vocabularies, discourses, and metaphor sets (synonymously), the scope of the terms are as broad as Foucault's discourse or Kuhn's disciplinary matrix. Exemplifying dialects as the working jargon of physicists or that of graphic artists, Prado describes dialects as "specialized implementations of metaphor-sets." [62] Discourses are "ways of speaking and thinking that shape and condition what we do and say, not just specialized pursuits but in an overall way. For example, consider the differences between the thought and conversation of a sixteenth-century theistic serf and a twentieth-century atheistic technician."

The key mechanism Rorty uses to reinforce the merits of his own self-creative and public project is a synergistic redescription of particular readings of past thinkers. Rorty demonstrates the technique by drawing simultaneously on Freud, Derrida, Orwell, Nabokov, Wittgenstein, and others to do this.[64] His use of this rhetorical and literary technique itself instantiates the practice he observes in his intellectual peers and predecessors. Thus, Rorty wants to show how change or "progress" happens when a visionary poet, philosopher, musician, or writer redescribes aspects of the world in new ways with new metaphors, and gets others to talk this way. Available vocabularies are tools that have proved useful for some purposes and not others. His method has design parallels in that appropriating the past in text and form and transforming it into designed outcomes produces a distinctive (self-creative) interpretation of the physical world, which also remains open to public interpretation and use for social and ethical projects such as sustainable design or social critique.

One possible consequence of taking the new pragmatism's concern with language seriously is to accept that the vocabulary of design is not something that we should be too concerned to pin down.[65] On the one hand, as Whitfield and Smith[66] suggest, the significance of a consensual dialect of design is to help legitimize a professionalism some design disciplines seek. This entails combining a program for professional recognition with an agreed upon set of terms with legal, membership, and other consequences. However, at the level of concrete practice, terminological definitions have different values and processes of negotiation. For example, "A neo-pragmatic planning view suggests that the choice of linguistic form should be determined on the basis of the purpose(s) and goals of the planning process and not on the basis of what accords better with reality. Categories such as 'environmentalist' and terms such as

60 Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 3rd ed. (Chicago: University of Chicago Press, 1996).

61 Alan R Malachowski, *Richard Rorty* (Teddington: Acumen, 2001).

62 Prado, *The Limits of Pragmatism* (Atlantic Highlands, NJ: Humanities Press International, 1987), 147.

63 Ibid., 147.

64 It is particularly, though not exclusively, Davidson's theory of meaning and language in Donald Davidson, *Inquiries into Truth and Interpretation* (Oxford and New York: Clarendon Press, 1984) that Rorty brings in. Although, like other appropriations by Rorty, Davidson challenges some of the interpretations of his work.

65 This suggests that the concerns of some to pin down a language of design may be misplaced (e.g., Sharon Poggenpohl, Praima Chayutsahakij, and Chujit Jeamsinkul, "Language Definition and Its Role in Developing a Design Discourse," *Design Studies* 25:6 (2004): 579–605). For a more complex account of how sources are as a language of inspiration in design, see Claudia Eckert and Martin Stacey, "Sources of Inspiration: A Language of Design," *Design Studies* 21:5 (2000): 523–538. And for categorization systems underlying product semantics, see Uday A. Athavankar, "Categorization: Natural Language and Design," *Design issues* 5:2 (1989): 100–111.

66 Thomas W. A. Whitfield and Gillian Smith, "The Social Standing of the Design Professions: An Intercultural Comparison," *Journal of Intercultural Studies* 24:2 (2003): 115–135.

'ecological integrity' are therefore fluid, that is, they involve characteristics, properties, and descriptions that are open and evolving over time rather than being rigidly definable, fixed, and real. The choice of linguistic forms, categories, names, and labels should be in the service of our goals rather than being their master."[67] The question design might ask is whether a flexible pragmatism in the interpretation of disciplinary terms could be compatible with the formalization necessary for social and professional legitimatization.

In the specific context of academic design research, the notion of vocabulary or metaphor set discussed here as a project for design scholarship aims to take up the existing disciplinary considerations of neopragmatism in design, and suggest this as a vision or framework of design scholarship that novice scholars (students) should embrace. Conventional Deweyan and Jamesian pragmatism, supplemented by the now familiar perspectives on reflection in action of Donald Schön and Rittel's and Weber's characterization of wicked problems in design take us a long way along this path. Combined with Rorty's proposal that the projects of private self-creation and public significance may both be achieved through a broader reading of the textual artifacts of science, humanities, and culture in general is a project that connects with certain aspirations of the design field and its communities.

Responses to the possibilities of a neo-pragmatist approach to design research have been mixed. In the field of planning and public administration, Hoch argues that: "Rorty has little to say that public administrators or planners can put to practical use, but I think he does help us understand why we should replace metaphysical belief with social hope. This is enough for me."[68] Noting a general absence of consideration of the built environment in pragmatist writing, Ockman,[69] meanwhile, argues that the pragmatist tradition is unlikely to help with revitalized space, place, and scale, especially transnational, and post-national projects, "since pragmatists have been hard pressed to explain how a general predisposition to things public should translate into spatial and place-based projects."[70] More specifically, Ockman dislikes the linguistic turn in the neo-pragmatism of Rorty, which envisions "a philosophy of conversation among different, even incommensurable vocabularies with no other foundation than agreements reached through them."[71] She wants to reinstate Dewey's focus on the significance of experience, and follow the kind of pragmatist aesthetics Shusterman,[72] for example, offers.

These are, I suggest, limited readings of the potential of Rorty's approach to invigorate and inform scholarly design research. What new (critical) pragmatism offers is scope for the self-creative and public projects of individuals to be achieved through appropriations and transformation of the past in built and designed forms. Such an approach accepts the inherent wicked nature of design problems, and accepts the creative quality of the theory-practice inter-

67 Tazim B. Jamal, Stanley M. Stein, and Thomas L. Harper, "Beyond Labels: Pragmatic Planning in Multistakeholder Tourism-Environmental Conflicts," *Journal of Planning Education and Research* 22: 2 (2002), 171.

68 Ibid., 391.

69 *The Pragmatist Imagination: Thinking about "Things in the Making,"* Joan Ockman, ed. (New York: Princeton Architectural Press, 2000).

70 Ibid., 267.

71 Ibid., 11.

72 Jerold Abrams, "Pragmatism, Artificial Intelligence, and Posthuman Bioethics: Shusterman, Rorty, Foucault," *Human Studies* 27:3 (2004): 241–258, claims Shusterman's approach is the best and most internally diverse in the literature incorporating self-fashioning on linguistic and somatic levels, feminism, African-American culture, Asian studies, American pragmatism, and cosmopolitan democracy. The fundamental split between Rorty and Shusterman is their position on Dewey's notion of experience. While Shusterman wants to revitalize this in relation to aesthetics, Rorty essentially shifts the focus to language and vocabularies. Shusterman has coined the phrase "somasthetics" to refer to subdisciplines around the body and its experience. For Shusterman's work see, for example, Richard Shusterman, *Analytic Aesthetics* (Oxford: Basil Blackwell, 1989); *Pragmatist Aesthetics: Living Beauty, Rethinking Art* (Oxford, UK and Cambridge, MA: Basil Blackwell, 1992); *Performing Live: Aesthetic Alternatives for the Ends of Art* (Ithaca, NY: Cornell University Press, 2000); and *Surface and Depth: Dialectics of Criticism and Culture* (Ithaca, NY: Cornell University Press, 2002).

action that Schön proposes as distinctive for design in general. It also sees neither the humanities nor the sciences or design as having special purchase on truth, but equally pursuing truths whose merits must be judged by their consequences.

Recent proposals about the form that design theories should take and how such theories differ from both art and science often make no mention of new pragmatism.[73] This is due, among other things, to the fact that new pragmatism deliberately resists pigeonholing through the kinds of rhetorical and stylistic ploys evident in Rorty's writing. In doing this, Rorty himself follows a tradition already evident in the later Wittgenstein's aphoristic approach to philosophy, and Derrida's deliberate avoidance of entrapment through playful toying with language. This paper suggests that neopragmatism; with its concerns for traditional Deweyan and Jamesian concerns, but also with strategies of reappropriation and the development of distinctive vocabularies in an atmosphere of cultural and ideological pluralism, should underpin design scholarship. Such a project will encourage methodological pluralism in approaches to the inherently wicked and indeterminate nature of design projects.[74] As Rorty suggests, projects of private self-creation evident in the work of Proust, Nabokov, and others emerges with new vocabularies—distinctive uses of language and rhetorical form whose aesthetic power strikes us as distinctive and potentially incorporable within our own self-description. This creative and aesthetic angle on the function of vocabularies in design allows for the creative individual dimension of design practice to show through in designed outcomes and forms. At different moments, when social and ethical public projects form part of our current desire for solidarity and community, we may appropriate distinctive texts and objects—even those whose stylistic innovation and creativity remain conservative—into our own socially and ethically sensitive design projects.

73 Ken Friedman, "Theory Construction in Design Research: Criteria: Approaches, and Methods," *Design Studies* 24:6 (2003): 507–522.

74 Robert B. Johnson and Anthony J. Onwuegbuzie, "Mixed Methods Research: A Research Paradigm Whose Time Has Come," *Educational Researcher* 33:7 (2004): 14–26. For sustained treatments of the pragmatist rationale for mixed methods, see John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd ed. (Thousand Oaks, CA: Sage Publications, 2003); and Abbas Tashakkori and Charles Teddlie, *Mixed Methodology: Combining Qualitative and Quantitative Approaches* (Thousand Oaks, CA: Sage Publications, 1998).