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Hot to bot: Pygmalion's lust, the Maharal's fear, and the cyborg future of art

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Abstract

This paper explores the deeply interwound histories of art and robots from their roots in the Greek myth of the sculptor-king Pygmalion to the work of contemporary artists, such as Norman White. By analyzing the myths of Pygmalion, the Golem, Frankenstein's monster, and other notable automata of legend, a framework emerges for understanding how various cultures have expressed desires and fears about technology and the future and defined values with respect to human. This context offers insight into the role of artists in creating metaphors and working models of a posthuman, cyborgian future.

Keywords

art
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Frankenstein
Golem

The idea that non-living matter could be used to invoke, influence, and emulate living beings is probably as old as human life itself. Over thousands of years this concept has become deeply ingrained in the human imagination as a locus of desires and fears about the future; and about the role of art and technology in forming it. In reviewing some of this history, I shall focus on, for lack of a better term, the moral of the story; in other words, what prevailing attitudes towards robots and other surrogate beings at a certain place and time tell us about the values of that culture. This background sets the stage for a similar consideration of robots with regard to contemporary morals, mythologies, and values, as they relate to the production of robots and artificial life forms by artists. Norman White has written that, "For me, Art comes alive only when it provides a framework for asking questions." The intersecting histories of art and automata offer a fertile context for people like White to frame interesting questions and make art come alive - and come alive in a sense that arguably extends beyond the merely metaphorical. Moreover, I believe that the sorts of questions that artists ask about surrogate beings offer particularly valuable insights into contemporary perceptions of the human condition vis-a-vis the cyborgian condition of our artificial siblings, and the increasingly hybrid conditions of what social critics from Katherine Hayles to Marilyn Manson have termed the posthuman.

Although the field of robotics generally is perceived as belonging to the discipline of engineering it is in the realm of art that many seeds of technology are first born. In legend and in practice, artists have played a major role both in bringing matter to life and in bringing that living matter into culture, where, one might say, it takes on a life of its own. As artist Eduardo

Kac has written, "One of the most problematic issues of robotics in art is the very definition of what a robot is." He continued,

> If artists working with or interested in robotics cannot ignore mythological, literary, or industrial definitions of robots ..., it is also true that these definitions do not directly apply to any given robotic artwork. Each artist explores robotics in particular ways, developing strategies that often hybridize robots with other media, systems, context, and life forms. As artists continue to push the very limits of art... they introduce robotics as a new medium at the same time that they challenge our understanding of robots - questioning therefore our premises in conceiving, building, and employing these electronic creatures. The fascination robots exert on the population at large has unexplored social, political, and emotional implications. These implications must be coupled... with the new aesthetic dimension of modeling behavior and developing unprecedented interactive communicative scenarios in physical or telematic spaces.[1]

Kac rightly notes that the concept of the robot or automaton was not the invention of engineering, but rather emerged thousands of years ago in mythology. The word "robot" gained its contemporary meaning only in the 20th century after Czech dramatist Karel Capek used the term to refer to mechanical automata forced to do mundane, repetitive work in his 1921 play *R.U.R. (Rossum's Universal Robots)*. Mythology and the arts surely will continue to play an important role in creating the future of robots and other autonomous systems, if by no other process than simply imagining possibilities, including non-functional applications, that would not occur to non-artists. I have in mind here what artist Rafael Lozano-Hemmer has referred to as "perverting technological correctness."[2] This mode of operations turns technology in on itself in a critical manner that interrogates accepted norms and values with respect to the conventional, functional uses of technology. As I shall explain later with reference to the work of Norman White and others, in this way artists offer what art historian Jack Burnham termed a "psychic dress-rehearsal for the future."[3]

From Cave Paintings to Automata: Cro Magnon Man Meets *My Fair Lady*

Before jumping ahead, I'd like to establish a more historical perspective. Taking a giant step back into prehistory, the artist-shaman created images that would not only "indicate, imitate, simulate, *but literally replace*..." the animal that was painted or carved in its likeness.[4] Although the purpose of cave-paintings is not certain, many archaeologists believe that such images were used ritually as surrogates upon which spells might be cast to ensure or celebrate a successful hunt. Thus, as art historian Jack Burnham has observed, embodied in the roots of human culture is a "yearning to break down the psychic and physical barriers between art and living reality - not only to make an art form that is believably real, but to go beyond and to furnish images capable of intelligent intercourse with their creators."[5]

1. Eduardo Kac, "Foundation and Development of Robotic Art," Art Journal, 56:3 (Fall 1997): 60.
2. Rafael Lozano-Hemmer, "Perverting Technological Correctness," Leonardo 29:1 (1996): 5. Lozano-Hemmer cites art critic Lorne Falk as the source of the term "technological correctness."
3. Jack Burham, *Beyond Modern Sculpture*: The Effects of Science and Technology on Art Today (New York: Braziller) 1968; 376.
4. Ibid: 312. My emphasis.
5. Ibid.

Perhaps the earliest and most famous story that chronicles this yearning is that of Pygmalion, a loathsome artist King, whose nearly comic tragedy was recounted by Ovid (43 BC - 18 AD) in the *Metamorphoses*:

> Pymalion loathing their lascivious life,
> Abhorr'd all womankind, but most a wife:
> So single chose to live, and shunn'd to wed,
> Well pleas'd to want a consort of his bed.
> Yet fearing idleness, the nurse of ill,
> In sculpture exercis'd his happy skill;
> And carv'd in iv'ry such a maid, so fair,
> As Nature could not with his art compare,
> Were she to work; but in her own defense
> Must take her pattern here, and copy hence.
> Pleas'd with his idol, he commends, admires,
> Adores; and last, the thing ador'd desires.

Pygmalion treated his ivory creation as he might a living maiden. He bought her all manner of expensive gifts, kissed and fondled her, set her upon a bed, and declared her his wife. Though he imagined her flesh pliable and warming to his touch, this fantasy was continually crushed by the unforgiving stiffness of her artificiality. Aphrodite, the Greek goddess of love, answered Pygmalion's prayers and brought his sculpture to life and blessed their union. Her name was Galatea, and she bore a son named Paphos. In this classic story of an artist's vitalization of matter, it is divine intervention that animates the human creation, though it is significant that this human creation exceeded the beauty of nature itself, and was capable of inspiring love in an otherwise heartless, misogynistic man. If there is a Classical moral here, perhaps it is that the superior artist deserves special attention from the gods, and will be rewarded by them for extraordinary accomplishments.

Perhaps it is not surprising that the myth of Pygmalion has captivated the imaginations of artists and art-lovers for centuries, as is obvious by the persistent repetition of this theme and its variations in works by diverse artists from Raphael to Rodin. One might say that the myth has taken on a life of its own and Galatea becomes what one might now refer to as an autonomous agent. Indeed, in Rafael's *Galatea* (1513), which is deeply indebted to Botticelli's *Birth of Venus* (1480), her male progenitor, Pygmalion, is completely absent from the narrative and Galatea, depicted as a triumphant sea nymph, now appears as the result of a divine conception devoid of human artistry. Nor may one forget the legend's more recent and popular reincarnations: George Bernard Shaw's play *Pygmalion* and its many spin-offs, from the musical *My Fair Lady* to the Hollywood films *Pretty Woman, Educating Rita,* and *Trading Places*.

There is something very unsettling about the Pygmalion myth and many of its offshoots. They strike me as defying the logical balance that typically attends Greek mythology and most of all the transgression known as

hubris; that is, the human conceit that a mere mortal could undertake a task that is the proper domain of the gods. Pygmalion does just that: he attempts to create divine beauty, which he then hopes to bring to life by force of will. But instead of being struck down - if not for hubris then for his pathetic infatuation with a statue of his own making - he is rewarded by the gods, who vitalize Galatea by giving her life.[6]

In the case of Shaw's play and its variations, there is a more intellectual, post-Darwinian sub-text, a nature versus nurture question: Can one transform a commoner into a lady? Is what makes someone a lady intrinsic to her genetic disposition or is it something that can be taught and cultivated? While Ovid's tale recounts a transfer between base matter and life, mediated by divinity, to serve the lustful desires of an artist-king, Shaw's variation highlights a transfer between common and genteel, mediated by education. For Professor Henry Higgins, the ambitions of a cockney flower-girl for upward mobility may amount to nothing more than an amusing occasion for a wager to prove his pedagogical skills. Eliza Doolittle, however, is willing to pay her own way (on a sliding scale) to become a lady. Although she had fallen in love with Higgins, once she becomes a lady she asserts her independence from her teacher, whose self-absorption and inhuman coldness (composite characteristics of both Pygmalion and Galatea) she now recognizes and is repulsed by. Unlike the ivory that Pygmalion carved to his specifications, Eliza Doolittle has a will of her own and is an active agent in her rebirth as a lady and in her choice of a partner; for she chooses not to wed Higgins and marries another man.

The other great legend of automata is that of the golem, which is said to have been brought to life in 1582 by the Maharal Rabbi Judah Loew of Prague. There are many versions of the legend, but the motivation for bringing the golem to life was to protect the Jews against violent anti-semitism. The golem was fashioned out of clay by the rabbi, who, with the help of his two assistants carried out a cabbalistic ritual that brought the entity to life by breathing a form of God's name into it. In some versions, the golem was killing too many non-Jews and had to be deactivated; in others, it grew drunk with its mounting power and became a threat to the residents of the ghetto itself. The rabbi again performed a ritual, the eyes of the golem closed, the soul departed from its body and it returned to a lump of clay, which to this day lies in the uppermost part of the synagogue of Prague. In the story of the golem, human meddling into the artificial creation of life benefited some by protecting them for a while but it had calamitous consequences for others and ultimately became a threat for all. The legend of the golem, like that of Pygmalion, has also spawned distinguished progeny, the most famous of which is Mary Shelly's *Frankenstein, or The Modern Prometheus* (1818). But before discussing that strand, I'd like to fill in some of the history of automata that led up to the Victorian period.

6. In one version of the tale, Aphrodite is angered by Pygmalion's hubristic creation of divine beauty and orders her son Eros to shoot an arrow and make the sculptor fall in love with his creation as punishment. Later, either upon visiting the studio and seeing that the sculpture is a perfect copy of herself, or after Pygmalion's endless prayers to her, the goddess's vanity gets the best of her and she relents and brings the sculpture to life.

Yea, Though I Walk Through the Uncanny Valley, I Shall Fear No Evil (Or Shall I?): From Jack the Smiter to Frankenstein's Monster

Myth and legend have walked hand in hand with real mechanical ingenuity in the history of robots. In the mid-13th century, legend has it that automata created by Bishop Albertus Magnus that served dinner to guests at a banquet were destroyed by Saint Thomas Acquinas. In the 14th century, clockwork mechanisms actually had advanced to the point at which the human role of the "keeper of the clock" was replaced by the "Jack," an anthropomorphized mechanical apparatus that rang the bell at regular intervals. Jacks evolved into multiple automata coordinated in narrative scenes of medieval and biblical life. For example, the Southwold Jack, aka, Jack the Smiter (1480), which resides in St. Edmund's strikes the hours on a bell with his axe. Apparently the world's largest cuckoo clock is a tourist attraction at the Alpine-Alpa Restaurant in Wilmot, Ohio. Measuring nearly twenty-four by twenty-four feet, animated figures come to life when this contemporary timekeeper strikes the hour.

According to legend, around 1640 Descartes constructed an android, *ma fille Francine,* that could do somersaults on a tightrope. The excellence of his artistry proved to be its undoing: a terrified captain threw the machine overboard out at sea. This may be the first account of what has come to be known as the "uncanny valley," an important concept in robotics, which deserves a minor diversion. This term, coined around 1978 by Japanese roboticist Masahiro Mori, refers to Mori's theory that if one were to plot emotional response against similarity to human appearance and movement, the curve is not a sure, steady upward trend. Instead, there is a peak shortly before one reaches a completely human "look" . . . but then a deep chasm plunges below neutrality into a strongly negative response before rebounding to a second peak where resemblance to humanity is complete.

This chasm - or uncanny valley - represents the point at which a person observing the creature or object in question sees something that is nearly human, but just enough off-kilter to seem eerie or disquieting. The first peak, moreover, is where that same individual would see something that is human enough to arouse some empathy, yet the fact that it is not human is obvious enough to avoid the sense of wrongness. Apparently, *Ma Fille Francine* inhabited the uncanny valley.

Descartes is important in the history of robotics not only for the first anecdotal account, albeit mythical, of the uncanny valley, but perhaps more importantly for his theory that the functioning of all animals below humans could, in theory, be mechanically reproduced, as could all human qualities save language and reason, paving the way for other mechanistic accounts and embodiments of behavior. Building on Descartes, in the *Principia* (1687) Newton explained the cosmos itself in terms of mechanical, clockwork laws, with the proviso that God was the divine clockmaker. And La Mettrie in *L'Homme Machine* (1755) put forward a mechanistic explanation of human physiology, including speech and reason. Such theories were

made concrete by inventor Jacques Vaucanson, who brought mechanized automata to new heights of realism with his famous life-size *Flutist*, *Drummer,* and *Duck*, a tremendous sensation when first exhibited in 1738. The *Flutist* made music in a manner that emulates the way a human plays a wind-instrument, by blowing air through the flute, and regulating its flow by coordinated movements that open or close the instruments valves.

In these cases, the artificial, mechanical reproduction of natural functions was conceived of as embodied in forms that mimicked the visual forms of the entities they emulated. By contrast, Pascal's invention in 1642 of the arithmetical calculating machine known as the Pascaline has been described as "the first non-anthropomorphic automata ... while it performed the human act of abstract problem solving, it did so without looking human."[7] The moral of these stories changes between the 17th and 18th century from a belief in a partially mechanical explanation of nature which relies on God to explain the rest, to the belief in a fully mechanical explanation of nature independent of God. Stafford claims that the artificiality of automata, which inevitably failed to live up to to expectations, and Vaucanson's *Duck*, in particular, whose digestive system was a hoax, "proved an embarrassment to the Age of Reason." At the same time, she also maintains that, "Vaucanson's dynamic figures belonged to the Enlightenment ethos of unlimited progress. Smoothly performing machines ... seemed to hold out the promise that organisms could become infinitely perfectible by blending muscle with metal."[8]

New electroactive polymers (EAPs) appear to be on the verge of challenging the principle of the uncanny valley by creating automata that may reach the far side of Mori's chasm. Perhaps still fueled by an ethos of unlimited progress, such technologies blend metal with muscle-like materials, wrapped under a flesh-like surface, thus emulating the formal appearance of actual human facial expressions more closely than any previous robots, like Kismet, a so-called "cute-critter" whose obviously non-human appearance locates it decidedly on the left slope of Mori's theory. By contrast, David Hanson's *K-Bot* has 24 servomotors that emulate the major muscles in the human face, activating EAPs that represent human emotional responses far more realistically than prior robots. Digital cameras in its eyes can watch people watching and software will soon enable the to head mimic viewers, enhancing the realism and pushing the robot further in to the uncanny valley. *K-Bot* is modeled after Kristen Nelson, Hanson's lab assistant and fiancée. One is tempted to wonder if this a new Pygmalion myth in the making... In this regard, Ingres's *Raphael and the Fornarina* (1814) offers interesting and foreboding variant on the tale. In this painting, the artist has fallen in love, not with the flesh and blood woman whose portrait he has painted, but with his painting of her. Let's hope Hanson and Nelson fare better!

Drawing on prior mechanistic models of life and automata, the 19th century imagined the human creation of artificial forms of life in similarly mechanistic terms, though informed by more recent scientific discoveries. Diverging from Mary Shelley's novel *Frankenstein*, in the classic 1931 film

7. Burnham, *Beyond Modern Sculpture*: 198.

8. Barbara Maria Stafford, *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education* (Cambridge, MA: MIT Press) 1994: 194-5. According to Stafford, the makeshift metabolism of Vaucanson's *Duck* (c. 1733-4) was intended to prove "Hecquet's ... hydraulic model of the digestive system." Fifty years later, after the maker's death, it was revealed to be a hoax because "seeds actually only entered the breathing tube and not the stomach."

version starring Boris Karloff, the artificial life form is a patchwork of dead human organs and an abnormal, criminal brain, animated with high-voltage electricity by a mad-scientist inebriated with his own godlike power. Early 19th century ideas about electricity consisted of its primeval and occult quality as a quasi-divine source of life and attraction. Historian Richard Asendorf notes that the sudden discharge of the Kleist jar provided the metaphor of electrical epiphany with its corresponding religious connotations, which Balzac later associated with intentional, momentary psychic ecstasy - akin to more secular ideas of inspiration and genius in modernist aesthetics. However, electricity had not yet become a force tamed by science for human ends, and possessed all the tantalizing danger of something simultaneously powerful and unknown. Despite these occult undercurrents, it is significant that Frankenstein's monster was created by scientific methods without recourse to divine intervention. Also noteworthy is that Frankenstein's associate and fiancée remarked that the good doctor had changed as a result of his "insane ambition to create life." And while Pygmalion's Galatea bore a son who founded a city, Frankenstein's monster killed a small girl, taking away her life and that of her progeny.

A Victorian moral of the story, written at a moment during which more critical attitudes towards technology began to emerge amidst the increasingly toxic effects of industrialization, might suggest that science should be wary of the hubris inherent in the artificial creation of life by humans. We may be able to make it, but can we control it? Or might it end up controlling us instead? Such questions regarding what Langdon Winner referred to in the mid-1970s as "autonomous technology" are emblematic of common human fears about becoming the robots (in the sense of slave or indentured servent) to our own creations. The motivation behind Frankenstein's automata experiments are different than the golem; however, in many ways, the morals of the two tales are similar. To lose oneself in such endeavors causes one to lose touch with one's partner, family, and community, indeed, to lose touch with life itself. As a result, the outcome imperils the natural cycle of human regeneration. Although the Maharal who created the golem had the ability to put the genie back in the bottle, so to speak, the ideological and economic forces in the post-industrial west are more likely to support a self-reinforcing cycle of "relying on technological means to solve problems caused by previous technological means."[9]

9. Paul Goodman, *New Reformations: Notes of a Neolithic Conservative* (New York: Random House, 1970): 192-3.

Are We There Yet? Art and Technology in the 20th Century: From Vitalism to Vitality

Joining this long lineage of myth, art, science, and engineering, 20th century artists have dreamt and sought to imbue form with life. In *Beyond Modern Sculpture,* Burnham described how the vitalist philosophy of Henri Bergson and the concepts of biomorphology advanced by D'Arcy Thompson became an important influence on the vitalist, biomorphic sculpture of artists such as Jean Arp, Constantin Brancusi, Henry Moore, and Barbara Hepworth, who attempted to instill the essence of life in artistic form. Vitalism, especially the theosophical variety, maintained a spiritual belief in the intercon-

nectedness of nature and humanity, and the related ability of the artist to distill the essence of life in abstract form such that it could be intuited and experienced by the viewer.

In the wake of WWI, a war in which machines unleashed previously levels of butchery previously unknown, the idea of a creating a visual language of organic forms appealed to artists as a way to embrace and abstractly embody regenerative energy in art that could transcend national boundaries and supercede technological mechanism. Such art sought to revitalize culture and help it get back in touch with the purity of life through the humanizing qualities of organic form.

Given Moore's prominence in British art, variants of these ideas, particularly as they were reformulated by art historian and critic Herbert Read, were adopted after WWII by Victor Pasmore, who taught a course at University of Newcastle in the mid-1950's entitled "Growth and Form" clearly indebted to Thompson's seminal book, *On Growth and Form* (1917). Also at Newcastle, Pasmore's colleague Richard Hamilton was experimenting with the confluence of organic and technological forms in such works as *Homage à Chrysler Corp.* (1957) and *$he* (1958-61). Integrating an iconic, 1950s shapely, female figure with the modern design of automobiles, refrigerators, and other mass-produced consumer appliances, these images draw on the heritage of Dada, and Marcel Duchamp in particular, to suggest a proto-cyborgian confluence of human and machine.[10] As an aside, Pasmore's star pupil at Newcastle during this time was Roy Ascott, who, during his short tenure as President of the Ontario College of Art in 1971-2, created the Photoelectric Arts division, where White taught from 1978 until 2003.

Although Burnham's diagnosis of vitalist sculpture pronounced it dead on arrival - a misguided effort that was flawed at its theoretical foundations - his prognosis for the future was more optimistic.

> In retrospect, we may look upon the long tradition of figure sculpture and the brief interlude of formalism as an extended psychic dress rehearsal for the intelligent automata... As the Cybernetic art of this generation grows more intelligent and sensitive, the Greek obsession with "living" sculpture will take on an undreamed reality.[11]

The publication of *Beyond Modern Sculpture* coincided with a tremendous burst of enthusiasm for and dedication of resources to the idea of joining art and technology, galvanized in part by the happening, *nine evenings: theater and engineering* in 1966. This collaborative event, spearheaded by engineer Billy Klüver and bankrolled in large part by collaborator Robert Rauschenberg, joined avant-garde artists, dancers, and musicians associated with the Judson Church in New York with engineers at Bell Labs, where Klüver worked. Klüver and E.A.T. offer a useful detour on the path to our theme of cyborg art and the work of Norman White. So yes, we're almost there...

Nine evenings spawned the non-profit organization Experiments in Art

10. Hamilton also organized two early and highly influential exhibitions on the relationship between art and technology: *Man, Machine and Motion* (Hatton Gallery, Newcastle upon Tyne, 1955) and *This is Tomorrow* (Whitechapel Art Gallery, London, 1956). See, Richard Hamilton. *Collected Words: 1953-1982.* London: Thames and Hudson, 1983.

11. Burnham, *Beyond Modern Sculpture*: 376.

and Technology (E.A.T.), which was instrumental in facilitating artist-engineer collaborations and promoting what became, for lack of a better word, the art and technology movement in the late 1960s. Between 1966-1971, there was a rash of exhibitions dedicated to this theme, including *Cybernetic Serendipity* (1968, Jasia Reichardt, ICA London; Corcoran, Washington, DC, Exploratorium, San Francisco), *The Magic Theater: Art Technology Spectacular* (1968, William Rockhill Nelson Gallery, Kansas City), *Software, Information Technology: Its New Meaning for Art* (1970, Jack Burnham, Jewish Museum, New York), and the US Pavilion at the 1970 Osaka World's Fair, which featured works produced by the *Art and Technology Program* at the Los Angeles County Museum of Art (1966-1971, Maurice Tuchman.)

Of particular note was *The Machine: As Seen at the End of the Mechanical Age*, organized by Klüver's friend and fellow Swede, the distinguished curator Pontus Hultén at the Museum of Modern Art (MOMA) in New York.[12] This large-scale, transhistorical survey of art and technology included work by some 100 artists and designers representing the historical intersections of art and technology, from Leonardo DaVinci's drawings of visionary flying machines (c. 1485-90) to a commissioned competition amongst contemporary artist-engineer collaborations, publicized and overseen by E.A.T.[13] Hultén envisioned including approximately ten such contemporary collaborative works. The unexpectedly enthusiastic response to E.A.T.'s call for proposals in the *New York Times* and *Scientific American* resulted in approximately two hundred submissions from nine countries,[14] indicating that the interest in joining art and technology was more than a fashionable idea fabricated by curators and art institutions, because individual artists and engineers were extremely interested to participate in such collaborative endeavors.[15] One of those artists was Norman White.

A five-member jury was selected on the basis of their technical knowledge, rather than their interest in or expertise on contemporary art. These employees of IBM, Celanese Plastics, Columbia University, Bell Labs, and the National Science Foundation judged the submissions on the following criteria: "First, how inventive and imaginative is the use of technology? Second, to what extent have the engineer and the artist collaborated successfully?"[16] A first prize of $3000 and two second-prizes of $1000 were awarded to the winning engineers, NOT to the artists. Hultén, in consultation with the jury, selected nine works, which were exhibited as part of *The Machine*. However, due to the overwhelming number and quality of the submissions, E.A.T. organized an independent exhibition entitled *Some More Beginnings*. This exhibition of 139 works that resulted from the call for proposals was shown at the Brooklyn Museum of Art from November 24 - January 6, concurrently with *The Machine*.

Finally: Norman White & the Cyborg Future of Art

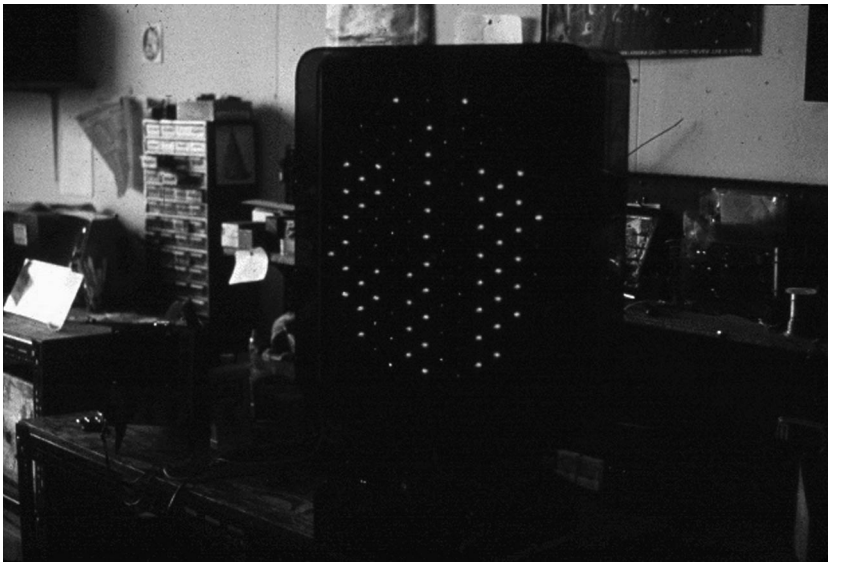
White's work for *Some More Beginnings* combined Thomas Alva Edison's dictum, "To invent you need a good imagination and a pile of junk" with the concept of cellular automata, associated with mathematician John Von Neumann (though it wasn't until later that White made that connection.)

12. The show later traveled to the Institute for the Arts, Temporary Exhibition Building at Rice University, Houston, Texas, March 26-May18, 1969, and opened at the San Francisco Museum of Modern Art, June 27, 1969.
13. See Experiments in Art and Technology, *Some More Beginnings*. New York: Experiments in Art and Technology, Inc., 1968.
14. K.G. Pontus Hultén, *The Machine as Seen at the End of the Machine Age,* (New York: Museum of Modern Art, 1968): 199.
15. The range and number of artists and manufacturing companies that participated in the Art and Technology Program at the Los Angeles County Museum of Art also reinforces this assertion.
16. E.A.T., "Instructions to the Jury for the Competition," Getty Archives.

The piece, "First Tighten Up on the Drums" was made from several hundred donated digital circuits and dozens of small neon bulbs, and was named after a 1968 pop song by Archie Bell and the Drells.

Cellular automata are discrete dynamical systems or closed universes, whose behavior is completely specified in terms of a local relation. Space is organized as a uniform grid and each cell contains a few bits of data; e.g., it may be either on or off. Time advances in discrete steps and the laws of this microcosmic universe are fixed so that each cell computes its new state by cross-referencing those laws with the state of its neighbors.[17] From this simple logical system, complex and unpredictable behaviors may emerge. White intended for "First Tighten Up on the Drums" to create an autonomous system that would "generate shimmering light patterns similar to those seen at the bottoms of swimming pools." The effect turned out to be more like "clouds swirling past an airplane porthole, or rain dripping down a window-pane."

Although the desired imagery was not achieved, White succeeded in



Norman White: "First Tighten Up on the Drums" (1969)

producing both the invisible behavior and the visible effect of a complex dynamic system. Whereas Vaucancon's "Duck" took a top-down approach that used phony organs to produce a convincing external appearance, White took a bottom-up approach that employed a simple internal logic structure to generate emergent patterns that emulated the behavior of natural phenomena. This bottom up methodology, as it has been applied to robotics, particularly in the work of Rodney Brooks at MIT, is a radical departure from the top-down approach of what is known as "good old fashioned AI." In the late 1980s, a new field of research known as artificial life emerged, predicated in part on the principles that White applied in 1968.

This combination of practicality, complexity, and whimsy continues to

17. http://www.brunel.ac.uk/depts/AI/alife/al-ca.htm) Accessed February 3, 2004.

characterize White's work, as does his emphasis on behavior rather than formal appearance. His robots are rarely anthropomorphic and, as such, never approach the uncanny valley, though they do attempt to produce empathy in human audiences by exhibiting life-like behaviors, including lust (e.g. *Them Fuckin' Robots* with Laura Kikauka, 1988) and vulnerability and manipulativeness (e.g. *Helpless Robot* 1987-96). "First Tighten Up on the Drums" was an early foray into making visible the invisible patterns and processes that underlie the behavior of living things.

Of the artistic ethos that informs his work, White has written that, "Artistic inquiries often come down to a search for pattern, both pattern which can be seen and recorded directly through graphics, and pattern which can not..." "Is it possible," he asks, "that all the seemingly random phenomena of the universe really derived from surprisingly few constant, basic principles interacting in a complex and out-of-phase way?" Such questions led White to create works like "First Tighten Up on the Drums," which he describes as having, "an unpredictable 'life of its own,' a set of internal rules and cycles which gave it a characteristic behavior somehow accessible to onlookers."[18]

White's work with cellular automata was prescient with respect to other artistic, and indeed, scientific, research on robots and artificial intelligence but also fits within other early experiments conducted by artists involving robots, such as the work of Nicholas Schöffer, James Seawright, Nam June Paik, Edward Ihnatowicz, and others. Artists of subsequent generations, including Ken Rinaldo, the team of Christa Sommerer and Laurent Mignonneau, and White's former student, David Rokeby, extend this research in various directions. In particular, Rokeby's *nChant* (2004), included in the *Machine Life* exhibition, expands on the concept of cellular automata by creating a community of artificially intelligent robots that respond to the words of the audience, which trigger linguistic associations that initiate a dialog between the bots.

One of my favorite Norman White artworks is *Telephonic Arm Wrestling* (1986), created in collaboration with former student Doug Back. Perhaps the first work of art to join robotics with telecommunications, a field now known as telerobotics, the idea for the piece emerged from a bar-room conversation regarding the Arms Race. "Wouldn't it be great," Back suggested, "if it could be resolved by arm-wrestling?"[19] White later explained that, "the idea was to allow contestants in two different cities to arm-wrestle, using motorized force-transmitting systems interconnected by a telephone data link."[20] As such, the system would not follow the conventional active-passive relationship of telerobotics, but instead would allow information to flow bi-directionally between identical robotic arms controlled by active agents at each of two sites. After engineers at the University of Toronto estimated a cost of $75,000, the artists decided to try to build it themselves, which they succeeded in doing in two months for approximately $500 by "throwing together a bunch of junk" together with some home-made custom electronics (and some superb welding by Caroline Langill.) Edison would have been proud.

18. Quotations from Norman White's website, The Normill, www.normill.ca/ntwbi097.html Accessed February 3, 2004.

19. Paraphrased by Norman White, telephone interview with the author, May 23, 1999. Other quotes by White are from this interview unless otherwise noted.

20. Norman White, "Telephonic Arm Wrestling" project description published on the artist's website, http://www.bmts.com/~normill/artpage.html (cited May 23, 1999).

The first successful implementation of the work took place between the Canadian Cultural Centre in Paris and the Artculture Resource Centre in Toronto. While so much of the rhetoric surrounding artists' use of telecommunications in the 1980s focused on the idealistic if not utopian goals of collaboration, emergence, decentralization, and so on, *Telephonic Arm Wrestling* wryly established a low-tech system for resolving competitive, if not antagonistic relations. Due to time-delays (latencies) in the telephone link, the system undermined standard rules of engagement. It was impossible for the competitors to really have much of a fight. Under certain circumstances, both sides could win simultaneously, fundamentally undermining the bipolar competitive model of win-lose, and demanding a different sort of interactional goal between participants. In this case, there was no victor, only local perceptions, a telling commentary on the Arms Race and the apparent opposition of capitalism and communism. Moreover, because each participant "inhabited a separate Einsteinian time-space continuum," the work brought into relief the contingency of perception and the relativistic constraints of agency. At the same time, the system was remarkably sensitive. As White explained, "You could almost feel the pulse of the other person ... it was uncannily human-like - the sensation of sinews and muscle - not at all like feeling a machine." The work poetically revealed some of the unpredictable phenomena and perceptual warps of telecommunications and telerobotics, offered an ironic cultural response to Cold War politics, and raised important issues regarding agency in technologically mediated systems.

It is with respect to agency that the radical nature of *Telephonic Arm Wrestling* becomes apparent, for telerobotic systems nearly always follow what the engineering literature refers to as a "master-slave" relationship. An active human master at one location influences the behavior of a passive robot slave at another. By creating a symmetrical system of active agents (cyborgs joining human and machine), White and Back explore alternative modes of agency that question conventional values and reconsider the foundations of knowledge. In these ways, they offer expanded conceptions of what telerobots can be, and what sorts of relationships they can enable between humans, machines, and cyborgian hybrids.

Pygmalion had a master-slave relationship with the piece of ivory he carved into Galatea. But Eliza Doolittle, who had a mind and will of her own, demanded that Professor Higgins not just mold her into a lady but that he interact with her as an equal, which he was unable to do. In the 20th century, art - and particularly art incorporating emerging technologies - has made two-way interaction increasingly central and explicit. Like Eliza, viewers have become more interested in playing an active role as agents who determine salient features of an artwork. As the line between artist, artwork, and audience becomes increasingly blurry and as humans and machines become increasingly intermixed, the human condition and the machine condition will meld into a post-human condition of hybrid entities. It is at these interstices that visionaries like Norman White, and subsequent

generations of artists who have been inspired by his work, are already marking out the cyborg future of art.

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