Electronic Art and Animation Catalog

Computer Graphics Annual Conference Series, 2001
A Publication of ACM SIGGRAPH

SIGGRAPH 2001
INSPIRE INTERACTION AND DIGITAL IMAGES

Electronic Art and Animation Catalog

Art Gallery: N-Space

Dena Eber
Bowling Green State University

Computer Animation Festival

Sande Scoredos
Sony Pictures Imageworks Inc.

Computer Graphics Annual Conference Series, 2001
A Publication of ACM SIGGRAPH

SIGGRAPH 2001 Electronic Art and Animation Catalog

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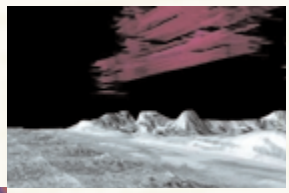

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"Yet I exist in the hope that these memoirs . . may find their way to the minds of humanity in Some Dimension, and may stir up a race of rebels who shall refuse to be confined to limited Dimensionality."
- from "Flatland." Edwin Abbott, 1884

N-Space, the SIGGRAPH 2001 Art Gallery, takes viewers to a place where ideas and expression are rich, and artistic freedom is unconstrained by dimension. All the work in the exhibition is in some way created with or connected to digital technology, but the thread of the show is content.

The more than 90 works in the exhibition encourage the SIGGRAPH 2001 audience to become a part of the art; to explore, question, and challenge their own interpretations and critiques. To do this, the N-Space exhibition has a treasure map of valuable ideas to search for in the gallery, as well as a gallery facilitator who holds a number of daily sessions to help engage viewers. The salon-style exhibition entices visitors to seek golden ideas embedded in the nooks and crannies of its turn-of-the-century decor.

The gallery showcases an even distribution of interactive installations, digital paintings, digital images, sculptures, performances, panels, animation, artist talks, Web sites, and interactive desktop programs.

Visitors interact with the performers and the installations: from wondering robots and stock market puppets to stirring-yet-beautiful pieces about women in foreign societies and those in the "have-not" worlds. Through the technology, participants experience a taste of life from distant dimensions.

The Web works further expand the interactivity of the installations to include a larger community, so users can experience a world different from their own. To do this, they traverse layers of exquisite form and complex ideas that exist in distant sites and far away spaces.

Although not physically interactive, the animations, videos, and 2D works captivate viewers through the aesthetic wonders of digital paint, mixed media, 3D models, digital photography, animation, and digital video. The works impel participants to question the distinction of media categories and the so-called "truth" embedded in them.

N-Space, the Studio, the Creative Applications Lab, SIGGRAPH TV, and Emerging Technologies

N-Space extends its boundaries into other programs to show aspects of the artists and their work in alternative, more suitable contexts. While some artists talk about preparing documents for print and demonstrate output techniques in the studio, others describe their processes during hands-on sessions in the Creative Applications Lab (CAL). SIGGRAPH TV provides highlights of the gallery, opening up the exhibition experience to viewers in other locations. Many of the innovations showcased in Emerging Technologies might be considered art in and of themselves, with their content-rich applications displayed in the adjacent art gallery. This symbiotic relationship often blurs the distinction between technology and art, further encouraging the viewer to simply experience the work.

Art Discussions, Panels, Art and Culture Papers, and Art Talks

The art gallery branches out to the Panels program to open the dialogue of gaming and art in Game Stories: Simulation, Narrative, Addiction. N-Space has two art discussions within the gallery: Erasing Boundaries: Intermedia Art in the Digital Age and The Pixel/The Line: Approaches to Interactive Text along with presentation of the art and culture papers. The essays, published in part here, will appear in full length in *Leonardo* and *Digital Creativity*.

It is this expression and representation that N-Space exhibits: art works that are not only technically proficient and novel, but that also go beyond the medium and into the realm of ideas, a place where the medium acts as a conduit for the message.

Art in the Information Age: Technology and Conceptual Art

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Introduction

By the mid-1960s, Marshall McLuhan prophesied that electronic media were creating an increasingly interconnected global village. Such pronouncements popularized the idea that the era of machine-age technology was drawing to a close, ushering in a new era of information technology. Sensing this shift, art historian and curator K.G. Pontus Hulten organized a simultaneously nostalgic and futuristic exhibition on art and mechanical technology at the Museum of Modern Art in New York in 1968. The Machine: As Seen at the End of the Mechanical Age included work ranging from Leonardo Da Vinci's 16th-century drawings of flying machines to contemporary artist-engineer collaborations that won a competition organized by Experiments in Art and Technology, Inc. (EAT).[1]

EAT had emerged out of enthusiasm generated by nine evenings: theater and engineering, a festival of technologically enhanced performances that artist Robert Rauschenberg and engineer Billy Klüver organized in New York in October 1966.[2] EAT also lent its expertise to engineering the multimedia extravaganza designed for the Pepsi Pavilion at the Osaka Worlds Fair in 1970.[3] Simultaneously, the American Pavilion at Osaka included an exhibition of collaborative projects between artists and industry, which were produced under the aegis of curator Maurice Tuchman's Art and Technology Program (A&T) at the Los Angeles County Museum of Art between 1967 and 1971.[4]

Ambitious as they were, few of the celebrated artist-engineer collaborations of this period focused on artistic use of the information technologies of computers and telecommuni-cations.[5] Taking an important step in that direction, Cybernetic Serendipity, at the Institute of Contemporary Art in London in 1968, was thematically centered on the relationship between computers and creativity. This show, however, remained focused on the materiality of technological apparatus and their products, such as robotic devices and computer graphics.[6]

Art critic Jack Burnham pushed exploration of the relationship between art and information technology to an unprecedented level. In 1970, he curated the exhibition Software, Information Technology: Its New Meaning for Art at the Jewish Museum in New York. This show was the first major US art and technology exhibition that attempted to utilize a computer in a museum context. Software's technological ambitions were matched by Burnham's conceptually sophisticated vision, for the show drew parallels between the ephemeral programs and protocols of computer software and the increasingly "dematerialized" forms of experimental art, which were interpreted, metaphorically, as functioning like information processing systems. Software included works of art by conceptual artists including Les Levine, Hans Haacke, and Joseph Kosuth, which were exhibited beside displays of technology including a hypertext system designed by Ted Nelson and a computer-controlled model of interactive architecture by Nicholas Negroponte and the Architecture Machine Group at MIT.[7]

Regardless of these points of intersection, and the fact that conceptual art emerged during a moment of intensive artistic experimentation with technology, few scholars have explored the relationship between technology and conceptual art. Indeed, art historical literature traditionally has drawn rigid categorical distinctions between conceptual art and art and technology. My talk seeks to reexamine the relationship between art and technology in the 1960s, and to challenge the disciplinary boundaries that obscure significant parallels between conceptual art and art and technology. The first part examines Burnham's curatorial premises for the Software exhibition and discusses the technological aspects of contributions to the show by Levine, Haacke, and Kosuth. The second part proposes several possibilities for why conceptual art and art and technology may have become fixed as distinct, if not antithetical, categories. This discussion focuses on British art historian Charles Harrison's discomfort with art and technology in his writings on conceptual art.[8] The conclusion suggests that the correspondences shared by these two artistic tendencies offer grounds for rethinking the relationship between them as part of larger social transformations from the machine age of industrial society to the information age of post-industrial society. Before proceeding, some working definitions will help clarify the terminology of conceptual art and art and technology in order to open up a discussion of their relatedness beyond the narrow confines of extant discourses.

Resisting the arch formalism that had become institutionalized by the 1960s, conceptual art has sought to analyze the ideas underlying the creation and reception of art, rather than to elaborate another stylistic convention in the historical succession of Modernist avant-garde movements. Investigations by conceptual artists into the networks of signification and structures of knowledge that enable art to have meaning have frequently utilized text as a strategic device to examine the interstice between visual and verbal languages as semiotic systems. In this regard, conceptual art is a meta-critical and self-reflexive art process. It is engaged in theorizing the possibilities of signification in art's multiple contexts (including its history and criticism, exhibitions, and markets.) In interrogating the relationship between ideas and art, conceptual art de-emphasizes the value traditionally accorded to the materiality of art objects. It focuses, rather, on examining the preconditions for how meaning emerges in art, seen as a semiotic system.[9] Frequently, art and technology has focused its inquiry on the materials and/or concepts of technology and science, which it recognizes artists historically have incorporated in their work. Its investigations include:

1. Aesthetic examination of the visual forms of science and technology.
2. Application of science and technology in order to create visual forms.
3. The use of scientific concepts and technological media both to question their proscribed applications and to create new aesthetic models.

In this third case, art and technology, like conceptual art, is also a meta-critical process. It challenges the systems of knowledge (and the technologically mediated modes of knowing) that structure scientific methods and conventional aesthetic values. Further, it examines the social and aesthetic implications of technological media that define, package, and distribute information.

Art as Software: Burnham, Levine, Haacke, Kosuth

The title for the software exhibition was suggested to Burnham by artist Les Levine. Burnham himself had interacted directly with software as a fellow at the Center for Advanced Visual Studies at MIT during the 1968-69 academic year. Burnham reported on that experience in a public lecture at the Guggenheim Museum in 1969, later published as "The Aesthetics of Intelligent Systems." He expressed his interest in how "a dialogue evolves between the participants – the computer program and the human subject - so that both move beyond their original state."[10] He further theorized this bi-directional exchange as a model for the "eventual two-way communication" that he anticipated emerging in art.[11] Karl Katz, director of the Jewish Museum, heard the talk and invited Burnham to curate an exhibition.

Following the ideas outlined in "The Aesthetics of Intelligent Systems" and related articles, including "Systems Esthetics" (1968) and "Real Time Systems" (1969), Burnham designed software to function as a testing ground for public interaction with "information systems and their devices."[12] Many of the displays were indeed interactive and based on two-way communication between the viewer and the exhibit. Software was predicated, moreover, on the ideas of "software" and "information technology" as metaphors for art. Burnham conceived of "software" as parallel to the aesthetic principles, concepts, or programs that underlie the formal embodiment of the actual art objects, which in turn parallel "hardware." In this regard, he interpreted contemporary experimental art practices, including conceptual art, as predominantly concerned with the software aspect of aesthetic production.[13]

In his 1970 article "Alices Head," Burnham suggested that, like the "grin without the cat" in Lewis Carroll's *Alice in Wonderland*, onceptual art was all but devoid of the conventional materiality associated with art objects. He subsequently explained software in similar terms, as "an attempt to produce aesthetic sensations without the intervening object."[14] Burnham theorized this artistic shift as paralleling larger social transformations based on cybernetics and systems theory. Here, the interactive feedback of information amongst systems, and their components in global fields, eradicated any "separation between the mind of the perceiver and the environment."[15]

In the late 1960s, Levine began using interactive, electronic feedback to interrogate the boundaries between the viewer and the environment. He was represented in software by three pieces, including Systems Burn-Off X Residual Software (1969).[16] The original installation at the Phyllis Kind Gallery in Chicago was comprised of 1,000 copies of each of 31 photographs taken by Levine at the March 1969 opening of the highly publicized Earth Works exhibition in Ithaca, New York. Numerous New York critics and the media had been bused upstate for the event. Most of the 31,000 photographs, which documented the media event were "randomly distributed on the floor and covered with jello; some were stuck to the wall with chewing gum; the rest were for sale."[17]

In the software exhibition catalog, Levine wrote a statement outlining his concept of software and its relationship to art. His definition of software was highly metaphorical and diverged from how the term is used in computer science. It emphasized his belief that the proliferation of mass media was changing knowledge into a second-hand mental experience of simulations and representations (software) as opposed to first-hand, direct, corporeal experiences of actual objects, places, and events (hardware).

All activities that have no connection with object or material mass are the result of software. Images themselves are hardware. Information about these images is software. The experience of seeing something first hand is no longer of value in a software-controlled society, as anything seen through the media carries just as much energy as first-hand experience. In the same way, most of the art that is produced today ends up as information about art.[18]

Levine conceived of the 31,000 individual photos as the residual effects or "burn-off" of the information system he created – as the material manifestation of software. In other words, Systems Burn-Off was an artwork that produced information (software) about the information produced and disseminated by the media (software) about art (hardware). It offered a critique of the systematic process through which art objects (hardware) become transformed by the media into information about art objects (software). Whereas Levine stated that most art "ends up as information about art," Systems Burn-Off was art as information about information about art, adding a level of complexity and reflexivity onto that cycle of transformations in media culture.[19]

Systems Burn-Off can be related to Levine's interactive video installations, such as Iris (1968) and Contact: A Cybernetic Sculpture (1969). In these works, video cameras captured various images of the viewer(s), which were fed back, often with time delays or other distortions, onto a bank of monitors. As Levine noted, "Iris ... turns the viewer into information... Contact is a system that synthesizes man with his technology... the people are the software."[20] While these works demanded the direct, corporeal experience of the participant, it was the experience of seeing oneself as information – as transformed into software – that was of primary concern to the artist. In this regard, Levine has provocatively noted that "simulation is more real than reality. Reality is an over-rated hierarchy."[21] For many artists working at the intersection of conceptual art and art and technology, the particular visual manifestation of the artwork as an object was secondary to the expression of an idea that becomes reality by simulating it.

Like Levine, other conceptual artists, such as Hans Haacke, utilized technology and mass media in the production of artworks. Haacke is perhaps best known for his politically charged critiques of power relations among art institutions, industry, the military, and politics. However, his work in the early 1960s evolved from kinetic sculpture. As such, he was included in a number of key *nouvelle tendence* exhibitions[22] and considered himself a "sort of junior partner" of the German-based Zero group.[23] It is perhaps for this reason that the Howard Wise Gallery, the premier commercial venue for presentation of art and technology, gave Haacke solo exhibitions in 1966, 1968, and 1969. At the same time, his early works were predicated on the dynamism of natural systems, an idea that was integral to diverse strains of process and conceptual art, as well as to art and technology.

Haacke, who had been a close friend of Burnham since 1962, contributed two pieces to software: Visitors Profile and News. These works were part of the artist's Real Time Systems series, which was inspired in part by conversations with Burnham, who introduced Haacke to the idea of open biological systems developed by Ludwig Von Bertalanffy, and to Norbert Wiener's theories of cybernetics.[24] Burnhams article, "Real Time Systems," differentiated between "ideal time" and "real time" with respect to art.[25] In ideal time, the aesthetic contemplation of beauty occurs in theoretical isolation from the temporal contingencies of value, while in real time, value accrues on the basis of an immediate, interactive, and necessarily contingent exchange of information.

News (1969) incorporated several teletype machines that delivered a perpetual flow of information about local, national, and international events, which was printed out on continuous rolls of paper in real time. The computerized version of Visitors Profile was more technologically sophisticated than the manual installation at the information exhibition in 1970. The computer was programmed to instantaneously cross-tabulate demographic information about the museum audience (age, sex, education, and so on) with its opinions on a variety of provocative subjects, ranging from "Should the use of marijuana be legalized, lightly or severely punished?" to "Assuming you were Indochinese, would you sympathize with the present Saigon regime?"[26] Whereas the statistical data from the other versions of Visitors Profile were tabulated on a daily basis, the software version was designed to perform these calculations in real time. As Haacke noted in his artists statement:

> The processing speed of the computer makes it possible that at any given time the statistical evaluation of all answers is up to date and available. The constantly changing data is projected onto a large screen, so that it is accessible to a great number of people. Based on their own information a statistical profile of the exhibitions visitors emerges.[27]

Like Levine, Haacke did not use technology as an end in itself, but rather put it in the service of the ideas which were central to his artistic practice. As in earlier technologically enhanced works by Haacke, such as Photo-Electric Viewer-Programmed Coordinate System (1966-68), technology was employed as a means to enable art to become a responsive, real-time system that, according to the artist, "merges with the environment in a relationship that is better understood as a system of interdependent processes."[28] Similarly, in the software version of Visitors Profile, a computer was meant to enable the work to receive, process, and distribute information instantaneously. The piece could interact with participants in real time by responsively gathering and evaluating information about the systematic relationship of art and society. In this regard, Haacke's work shares affinities with the conceptual goals of real-time systems actualized in the work of many artists associated with art and technology: Nicolas Schöffer's CYSP series of cybernetic sculptures of the mid-1950s, James Seawright's interactive robotic sculptures of the mid-1960s, and Myron Krueger's "artificial reality" environments of the early 1970s, to name just a few examples.

Like Levine and Haacke, Joseph Kosuth has utilized mass media as a component in his work. However, unlike those artists, Kosuth has not made explicit use of technology such as video, computers, or telecommunications. Nonetheless, the technological metaphor of information processing offers an insightful model for interpreting his work. His contribution to software, the Seventh Investigation (Art as Idea as Idea) Proposition One (1970), included the same printed text in various international contexts: a billboard in English and Chinese in the Chinatown neighborhood of lower Manhattan, an advertisement in The Daily World, and a banner in Turin.[29] The text was comprised of a set of six propositions:

1. To voluntarily assume a mental set.
2. To voluntarily shift from one aspect of the situation to another.
3. To simultaneously keep in mind various aspects.
4. To grasp the essential of a given whole; to break up a given whole into parts and to isolate them voluntarily.
5. To generalize; to abstract common properties; to plan ahead ideationally; to assume an attitude toward the "mere possible" and to think or perform symbolically.
6. To detach our ego from the outer world.[30]

Kosuth's statement in the software catalog emphasized his intention that the work not be able to be reduced to a mental image but that it exist as information free of any iconography: "The art consists of my action of placing this activity (investigation) in an art context, (i.e. art as idea as idea)."[31]

This stance would preclude the presence of technological apparatus in Kosuth's work, unless it could be employed in such a way that it did not become iconic, as anti-formalist critics might argue was the case in the work of Levine and Haacke.[32] Applying Burnham's software metaphor, the artwork was not the billboard or the other structural elements (hardware), but rather was manifested in Kosuth's philosophical questions (software), simultaneously contextualized within the framework of visual art and decontextualized in various public media. In this way, his work investigated the relationship between art and non-art ideas, the vehicles by which they are expressed, and the semiotic networks that enable them to have meaning.[33]

Because Kosuth neither utilized technological media in his art nor commented directly on the relationship between technology and art, it is difficult to ascertain the technological quality of his work. Nonetheless, in the context of software, Kosuth's Seventh Investigation lends itself to an interpretation based on Burnham's notion of art as an information-processing system. As mentioned above, Burnham had already drawn a parallel between how computer software controls the hardware that runs it and how information directs the activity of the human mind.[34] In this regard, Kosuth's propositions operate like instructions in the mind of the viewer.[35] But whereas computer software has an instrumental relationship with respect to coordinating the operation of hardware, the artist's propositions function as meta-analyses of the phenomenological and linguistic components of meaning. In other words, they demand that the viewer examine the process of processing information, while in the process of doing so.

Though Kosuth did not draw on computer models of information processing, his investigations follow a logic that shares affinities with that model, while at the same time demanding a self-reflexivity that goes beyond it. In posing propositions that required viewers to investigate the cognitive functioning of their own minds with respect to the processing of information and the creation of meaning, Kosuth's Seventh Investigation sought to interrogate how and why what he called the "language game" of art functioned in a larger cultural framework. This critical attitude reflects the Information Age in general and the shift from an industrial to post-industrial economic base. Here, meaning and value are not embedded in objects, institutions, or individuals so much as they are abstracted in the production, manipulation, and distribution of signs and information.

Resistance to Parallels Between Conceptual Art and Art and Technology

In *Art into Ideas*, Robert C. Morgan credited Burnham's "Systems Esthetics" as having clarified the "feeling that art had traversed from the object to the idea, from a material definition of art to that of a system of thought." Morgan then described onceptual art as "a significant and innovative method or type (not a style) of artistic practice on the eve of the Informational Age," and noted a "parallel socio-economic phenomenon ... the penumbra between industry and post-industry."[36]

Burnham had already drawn a similar parallel in Systems Esthetics, which referred to the shift in industry from control of production to control of information that John Kenneth Galbraith described in *The New Industrial State*. However, in "Systems Esthetics," he also drew explicit parallels between conceptual art and developments in systems theory and computer information processing. For Burnham, these scientific and technological advances were inseparable from the sweeping economic and social changes that Galbraith and others were identifying and forecasting.

Morgan's alliance with Burnham ceases precisely at the point of drawing an explicit parallel between conceptual art and technology. Indeed, no art historian since Burnham has made that connection so emphatically, and nearly all have sought to dismiss it.

However, it is unclear how the relationship that Morgan recognizes among conceptual art, the Information Age, and post-industrial society can be explained without recourse to the specific technologies that emerged at the same time. If those relationships are going to be drawn (and it seems valuable to do so), then it will be necessary to address, as Burnham did, the scientific and technological advances that contributed to broader cultural and social changes.

Nonetheless, it is understandable why conceptual art and art and technology have been identified as distinct categories of artistic practice. By the early 1970s, public interest in art and technology was waning dramatically, while interest in conceptual art was on the rise. Art and technology, which had offered a useful path of aesthetic experimentation throughout the 1950s and 1960s, no longer appeared to be a viable direction for many artists in the 1970s.[37] Public skepticism toward the military-industrial complex after May 1968 and amidst the Vietnam War, the Cold War, and mounting ecological concerns, all contributed to problematizing the artistic use of technology, and the production of aesthetic objects in general, within the context of commodity capitalism.[38] Conceptual art, on the other hand, with its assault on the modernist object, became increasingly central to a variety of artistic and critical discourses, ranging from post-minimalism to performance and from installation to earthworks.[39]

The disjunction between the critical and public reception of conceptual art and art and technology in the early 1970s contributed to exacerbating distinctions between these two artistic tendencies, rather than to identifying continuities between them. For it stands to reason that artists, critics, dealers, curators, and collectors invested in internationally prestigious conceptual art would want to distance themselves from any association with art and technology, which, for the reasons explained above, appeared peripheral to contemporary artistic concerns, if not simply passé.

It would be a mistake, however, to underestimate the commonalities among conceptual artists and artists such as Schöffer, Takis, and Tinguely, who, like other mid-century artists associated with art and technology, were concerned with process, real-time interaction, and dynamic systems. Nonetheless, the charges that art and technology was dominated by the materiality and spectacle of mechanical apparatus (which were anathema to the conceptual project) were not unfounded. At the same time, artists who merged a vested interest in technological ideas with a primarily conceptual approach to art-making did not easily fit the category of art and technology. For example, Roy Ascott, the British artist most closely associated with cybernetic art in England, was not

included in cybernetic serendipity because his use of cybernetics followed a primarily conceptual approach.[40] Conversely, though his 1964 essay "The Construction of Change" was quoted on the dedication page of Lucy Lippard's seminal *Six Years: The Dematerialization of the Art Object from 1966-1972*, Ascott's anticipation of, and contribution to, the formation of conceptual art in Britain has not received proper recognition, perhaps (and ironically) because his work was too closely allied with art and technology. In this regard, Ascott's use of the Thesaurus in 1963 drew an explicit parallel between the taxonomic qualities of verbal and visual languages, a concept that would be taken up in Kosuth's Second Investigation, Proposition 1 (1968) and Mel Ramsden's Elements of an Incomplete Map (1968).[41] In these ways, the inheritances of art and technology and conceptual art were somewhat opposed, complicating the fluidity between the two categories, and creating absences where useful associations could have been made. Ascott's example, however, powerfully demonstrates the significant intersections between conceptual art and art and technology, exploding the conventional autonomy of these art historical categories.

Sol Lewitt's influential essay, "Paragraphs on Conceptual Art" (1967), further exemplifies these complications and contradictions. In the second paragraph, he described conceptual art as a quasi-mechanical process: "In conceptual art the idea of concept is the most important aspect of the work ... [t]he idea becomes a machine that makes the art." Several paragraphs later, however, he warned that, "New materials are one of the great afflictions of contemporary art ... The danger is, I think, in making the physicality of the materials so important that it becomes the idea of the work (another kind of expressionism).[42] Whatever once was relevant about unifying art and technology, it was increasingly perceived by many artists, critics, and historians as weighted down by (in Lewitt's words) the "physicality of the materials," which dominated the "idea of the work." Indeed, in the introduction to *Conceptual Art*, Ursula Meyer appropriated a technological metaphor and wrote: "Conceptual Art is diametrically opposed to hardware art."[43]

Burnham himself acknowledged the "chic superficiality that surrounded so many of the kinetic performances and light events" and further noted that "there was ... more than a little of the uptown discotheque in Haacke's gallery, Howard Wise."[44] However, this sentiment was held perhaps more strongly in those conceptual art circles, and especially art and language, where the battle against the formalism of modernist objects (and their complicity as commodities in reinforcing capitalist ideology) was being waged most fervently. From this anti-formalist perspective, the bells and whistles of art and technology appeared to be gaudy, expressionistic, and commercial excesses that were extraneous and antithetical to the aesthetic investigation of signifying systems that defined the agenda of conceptual art.

One of the most able proponents of this position is art critic Charles Harrison. His work in this context demands a close and careful analysis because of its centrality to the discourses of conceptual art. He has written that, "the rapprochement of art and technology ... tended to suffer from a trivial equation of modernity with scientific and mechanical development. It tended also to be co-opted by the very representational technologies it set out to exploit."[45] He further stated that during this time of experiments in art and yechnology and cybernetic serendipity, "it seemed to some as if fascination with design and technology might be significantly injected into artistic modernism. The boot was on the other foot, however."[46] Nonetheless, Harrison was obliged to acknowledge the interest in technology shared by art and language founding members David Bainbridge and Harold Hurrell. Harrison claimed, however, that the "legacies of Pop-Art-and-technology were never part of the Art & Language agenda"[47] and never "furnished much better than chronic distractions from the more interesting and intractable problems of modern art."[48]

While pop art and art and technology overlapped in some ways, they also represented two very different legacies. By collapsing them together, Harrison effectively reduced the unique qualities and goals of each to their least common denominator. With respect to the more theoretically sophisticated aspects of art and technology (its concern with process and systems; the relationship between technological and aesthetic structures of knowledge; and an interactive, two-way exchange of information) these concepts can be seen as closely related to aspects of conceptual art.

Indeed, many of the concerns of art and technology were manifest in Hurrell's Cybernetic Artwork that Nobody Broke, (1969),[49] Bainbridge's electronic installation for Lecher System (1969-70),[50] and Terry Atkinson and Michael Baldwin's key to 22 Predicates: The French Army (1967).[51] Because all these works by art and language members were infused with irony, their technological components must be interpreted as parodies of scientific structures of knowledge and their uncritical application in art. But by challenging the systems of knowledge (and the technologically mediated modes of knowing) that structure scientific methods and conventional aesthetic values, these works have much in common with the objectives of art and technology. Indeed, the critical questioning of the social implications of technology characterizes a wide variety of artistic inquiries in the domain of art and technology since the 1950s. Key monuments include Gustav Metzger's theory of auto-destructive art (1959), Tinguely's Homage to New York, (1960), Nam June Paik and Shuya Abe's Robot K-456 (1964), and Oyvind Fahlstrom's Kisses Sweeter than Wine (1966). The work of Stelarc and Survival Research Laboratories beginning in the mid-1970s continued this tradition of artists' use of technology in a critical manner.

Harrison equated technology with the machine aesthetic of American modernism. In the tradition of Marcel Duchamp's dismissal of "retinal art," he interpreted the kinetic gadgets and other spectacles commonly associated with art and technology as capitulating to the modernist "beholder discourse." Since modernism represented the entrenched seat of authority and power in the art world that art and language strategically set out to deconstruct, technological references posed a potential contradiction to the collectives project. Harrison was unable to acknowledge the ways in which artists' use of technology has been critical not only of technology itself, but also of modernist aesthetics. This resistance to technology obscured his ability to see the use of technology by art and language members in positive terms, interpreting them simply as a rejection of modernism. For example, he described Hurrell's Cybernetic Artwork and Bainbridge's Lecher System as "flailing about – products of the search for practical and intellectual tools which had not already been compromised and rendered euphemistic in Modernist use."[52]

Oddly enough, Harrison's discussion of Index (1972),[53] an art and language group collaboration, explicitly referred to the fields of artificial intelligence and what has come to be known as neurophilosophy, with strong overtones of cybernetics and systems theory. In fact, his description of the systematic approaches of conceptual art sounds remarkably similar to the ideas that Burnham theorized in the late 1960s to discuss the systematic relationship between technology and conceptual art, later exemplified in software. Index, moreover, can be thought of as a kind of manual hypertext system that allows for interactive association and linking of ideas. Ironically, the first public display of a hypertext system took place in Burnham's software exhibition!

It is hard to imagine that Harrison, a consummate, culturally informed intellectual, the former editor of *Studio International,* and a contributor to Artforum, was not familiar with Burnham's *Beyond Modern Sculpture*, his prominent writings in *Arts* and *Artforum*, or the highly publicized software exhibition. Clearly, Burnham and Harrison disagreed on some fundamental issues regarding conceptual art, especially with respect to its relationship to technology. Harrison was dismissive of technology in his account of art and language, which focused on differentiating it from conceptual art, and on identifying the philosophical and political foundations of its challenges to the aesthetic discourses of modernism.[54] But by limiting his foil to pre-war notions of materiality and production, and the aesthetic issues of modernist formalism, Harrison's history of art and language and conceptual art is unnecessarily narrow in its implications and fails to address the relationship of late 20th-century experimental art to the Information Age of post-industrial society. In addition to the relevant philosophical, political, and aesthetic issues, a more comprehensive account of post-World War II art must also take into consideration the specific scientific and technological theories and developments that contributed to larger social formations that impacted all aspects of material culture. For indeed, an awareness of such developments is not only present in the art and language works discussed above, but also seeped into Harrison's interpretation of the collective's work, as the example of his description of "Index" shows.

Conclusion

The continuities between art and technology and conceptual art are more readily apparent from an historical distance of three decades, removed from the aesthetic-political debates of that time. Advances in electronics, computing, and telecommunications, and especially the advent of the Internet, have provided tools that enable artists to interrogate the conventional materiality of art objects in ways that were not available 30 years ago. This perspective also brings into relief the ways in which critical discourse has been unable to reconcile how the work of an artist could be allied simultaneously with both art and technology and conceptual art. Haacke, for example, exhibited at the Howard Wise Gallery, and his work features prominently in key monographs on kinetic art and art and technology.[55] Nonetheless, his work has been canonized primarily within the context of conceptual art.[56] Other artists, like Ascott, remained simultaneously visible and invisible to each camp throughout the 1960s and 1970s.[57] The critical reception and historicization of Haacke and Ascott say less about their work than they do about the institutional mechanisms that have created and reinforced categorical distinctions between art and technology and conceptual art at the expense of identifying continuities between them.

By respecting the differences between these artistic tendencies, while at the same time understanding some of the common theoretical threads that they have shared, a more comprehensive account of art in the 1960s and in the post-World War II period can be formulated. Such a history will acknowledge how cybernetics, information theory, and systems theory were foundational intellectual models that, in combination with the advent of digital computing and telecommunications, played a significant role in shaping culture. As Burnham wrote in 1970, "information-processing technology influences our notions about creativity, perception, and the limits of art … It … is probably not the province of computers and other telecommunication devices to produce works of art as we know it; but they will, in fact be instrumental in redefining the entire area of esthetic awareness."[58]

By re-examining the relationship between technology and conceptual art, this essay has attempted to develop a better understanding of how computers and telecommunications entered into aesthetic discourses (explicitly and implicitly) in the late 1960s and early 1970s. The impact of these intellectual, technological, and social shifts on art and on culture in general are just beginning to be theorized, as their manifestation becomes increasingly pervasive, and as scholarship can, for the first time, reflect on the critical moments of those transformations from an historical perspective.

Notes

1. Because of the extraordinary response to the MOMA competition, the numerous other proposals resulted in a spin-off exhibition, Some More Beginnings, that EAT organized at the Brooklyn Art Museum concurrently with The Machine. See K.G. Pontus Hulten, The Machine: As Seen at the End of the Mechanical Age. New York: Museum of Modern Art, 1968. See also, Experiments in Art and Technology, Some More Beginnings, New York: Experiments in Art and Technology, 1968.
2. nine evenings was the culmination of collaborations between artists and dancers, like Rauschenberg, who were associated with the Judson Dance Theater, and engineers, like Klüver, from Bell Laboratories. If any single event could be identified as the spark that ignited American interest in the idea of joining art and technology in the 1960s, this was it.
3. See Klüver, B., Martin, J., and Rose, B., eds., *Pavilion*. New York: Dutton, 1972.
4. See Tuchman, M., "A Report on the Art and technology Program of the Los Angeles County Museum of Art," 1967-1971.
5. Many of the artists who offered proposals to A&T wanted to use computers, but corporate sponsors were resistant to donate the use of their computers, except for Information International, Inc., which collaborated with Jackson MacLow, helping the artist to create computer-generated poems. See Tuchman, "A Report: 19," 201-23. With regard to telecommunications projects, on July, 1971, EAT organized Utopia Q&A, an international telex project that involved participants in New York, Tokyo, Ahmedabad, and Stockholm exchanging information about changes they anticipated in culture and society in 10 years. EAT archives: 67:1, Getty Research Institute, Los Angeles.
6. Reichardt, J., ed., *Cybernetic Serendipity: The Computer and the Arts*. London: Studio International, 1968.
7. See Judith Benjamin Burnham, ed., Software, Information Technology: Its New Meaning for Art. New York: The Jewish Museum, 1971. The exhibition featured a stellar cast of experimental artists, including Robert Barry, Douglas Huebler, Agnes Denes, Sonia Sheridan, Alan Kaprow, Vito Acconci, David Antin, John Giorno, John Baldessari, John Goodyear, Ted Victoria, and Donald Burgy.
8. Like Burnham, Harrison was extremely close to the pulse of conceptual art, and his writings, like those of his American counterpart, warrant respect and response. Harrison first met the four founders of art and language in 1969, the same year he wrote a catalog essay ("Against Precedents") for the London showing of the landmark conceptual art exhibition When Attitudes Became Form. He became an active member of Art & Language in 1971, merging his professional training as an art historian with art practice. Formally trained as an artist, Burnham made his first light sculpture in 1954 and his first programmed kinetic sculpture in 1959. He received his MFA in sculpture from Yale in 1961 and later merged his insights as an artist working with technology with his self-taught vocation as an art critic and historian. A close friend of Hans Haacke since 1962, he was also associated with the group of Conceptual artists represented by New York dealer Seth Sieglaub.
9. As art historian Kristine Stiles has noted, many Conceptual Artists, especially Mel Bochner and Art & Language, recognized the contradiction of the so-called "dematerialization" of the art object theorized by Lucy Lippard and John Chandler in their influential article, "The Dematerialization of Art" Art International (February 1968) and reinscribed in Lippards Six Years: The Dematerialization of the Art Object, 1966-1972 (1973). Stiles points out that "dematerialization of art" can best be seen as a "strategy for repositioning art in relation to politics - not a shift from material per se, but a shift from an artworks value as an object of commercial exchange to its value as aesthetic and political interchange." See Kristine Stiles, "Language and Concepts" in Kristine Stiles and Peter Selz, eds., Theories and Documents of Contemporary Art: A Sourcebook of Artists Writings, (Berkeley: University of California Press, 1996): 804-816; and Mel Bochner, "Book Review," Artforum 11:10 (June, 1973), reprinted in Stiles and Selz, Theories and Documents: 828-32.
10. Burnham, J., "The Aesthetics of Intelligent Systems" in Edward Fry, Intro., *On the Future of Art,* (New York: Viking, 1970): 119.
11. Ibid.
12. Burnham, J., "Notes on Art and Information Processing," *Software: 10*
13. See my "The House That Jack Built: Jack Burnhams Concept of Software as a Metaphor for Art," Leonardo Electronic Almanac 6:10 (Nov 1998) online publication: mitpress.mit.edu/e-journals/LEA/ARTICLES/jack.html
14. Burnham, J., Personal correspondence with the author, April 23, 1998.
15. Burnham, J., "Alices Head," *Artforum 1970, reprinted in Jack Burnham*, Great Western Salt Works, (New York: George Braziller): 47.
16. The other two works were A.I.R. (1968-70) and Wire Tap (1969-70). A.I.R. (Artist In Residence) was conceived as a live, real-time video link to Levines studio, so that the museum audience could observe the minute-to-minute activities of the artist, which were displayed on a ring of television sets encompassing the viewer. Due to financial limitations, the actual implementation used pre-recorded videotapes of the artist in his studio. Wire Tap was comprised of live telephone conversations between the artist and whoever happened to call him at the moment, played over an array of 12 12-inch x 12-inch speakers.
17. Burnham, *Software: 60.*
18. Levine, L., artists statement, *Software: 61.*
19. This cycle of transformations does not stop here. The reproduction of imagery from Systems Burn-Off in the software catalog added another level to the cycle, creating information about art as information about information about art. And my discussion of it represents information about information about art as information about information about art.
20. Levine quoted in Gene Youngblood, *Expanded Cinema*. (New York: E.P. Dutton and Co., Inc, 1970): 340.
21. Ibid.
22. Burnham, J., Haacke, H. "Wind and Water Sculpture," *Tri-Quarterly, 3*

Evanston: Northwestern University Press, 1967.

23. Haacke, H., Interview with the author, January 2, 1999.
24. Ibid. Bertalanffy's ideas were compiled in *General Systems Theory: Foundations, Development, Application*, New York: George Braziller, 1968. See also, Wiener's *Cybernetics: or, Control and Communication in the Animal and the Machine*, Cambridge: MIT Press, 1948. Many artists were introduced to these concepts by Burnham's *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century,* New York: George Braziller, 1968, which included references to Bertalanffy's proto-cybernetic biological theories of the 1930s; the cybernetic theories of Wiener, Stafford Beer, Ross Ashby, and Gordon Pask; and Claude Shannon's related principles of information theory. For more on Burnham's influence on artists, see Simon Penny, "Systems Aesthetics + Cyborg Art: The Legacy of Jack Burnham," *Sculpture Magazine, 18* (1), January-Febuary 1999. Published online at www.sculpture.org/documents/scmag99/burnham/sm-burnh.htm
25. Burnham, J., "Real Time Systems," *Artforum* (Sept 1969): 49-55, reprinted in *Great Western Salt Works*: 27-38.
26. The questionnaire was almost identical to the version Haacke proposed for his solo exhibition at the Guggenheim Museum in 1971, which the museum cancelled. See Brian Wallis, ed., *Hans Haacke: Unfinished Business*, Cambridge: MIT Press, 1986: 82-7; and also in this volume, Rosalyn Deutsche, "Property Values: Hans Haacke, Real Estate, and the Museum": 20-38.
27. Haacke, H., artists statement in *Software: 34.*
28. Haacke, H., artists statement in "Hans Haacke," exhibition catalog, New York: Howard Wise Gallery, 1968, quoted in Jack Burnham, *Systems Esthetics*, *35.*
29. Kosuth recalls that much of the material for the software installation (loose-leaf folders filled with propositions, information, and documentation) was "borrowed" by an audience member for an extended period, though ultimately it was returned to the museum. Joseph Kosuth, interview with the author, April 5, 1999.
30. See Kosuth, J., "Seventh Investigation (Art as Idea as Idea) Proposition One" illustrated in *Software, 69*.
31. Kosuth, J., artists statement, *Software, 68*.

32. The photographic reproduction of the billboard has come to signify the Seventh Investigation, reducing it, at least on a superficial level, to a recognizable icon for those who have not studied the work in sufficient depth or who continue to insist on seeing art in iconic terms. At the same time, like most conceptual artists, Kosuth needs "hardware" to convey the concepts of his "software," hence the critique of a so-called "dematerialized" art.
33. For more on Kosuth's theorization of conceptual art, see Joseph Kosuth, *Art After Philosophy and After: Collected Writings, 1966-90,* Gabriele Guercio, ed. Cambridge: MIT Press, 1991.
34. Burnham, "The Aesthetics of Intelligent Systems."
35. A further parallel may be drawn between the event scores of artists like George Brecht and Yoko Ono, and Kosuth's propositions, which can be interpreted as functioning like event scores for the mind.
36. Morgan, R. C., *Art into Ideas*, New York: Cambridge University Press, 1996: 2-3.
37. The journal *Leonardo*, founded by artist/scientist Frank Malina in 1967, and excellent books like Jonathan Benthall's *Science and Technology in Art Today* (1972) and especially Douglas Davis's *Art and the Future* (1973), helped to keep interdisciplinary discourses among art, science, and technology alive. However, much of that research either became autonomous (like video art) merged with other movements, or retreated from the center stage of the contemporary art world to be undertaken in eclectic university departments at MIT, Carnegie-Mellon, the Art Institute of Chicago, the University of Illinois at Chicago, and The Ohio State University. Howard Wise closed his gallery in 1971 in order to create the Electronic Arts Intermix, a not-for-profit organization serving video artists, which is still in operation in New York.
38. For more on the ideological context for art and technology in the 1960s, see Edward A. Shanken, "Gemini Rising, Moon in Apollo: Attitudes Towards Art and Technology in the US, 1966-1971" in ISEA97 *(Proceedings of International Society for Electronic Art),* Chicago: ISEA97, 1998; reprinted online in Leonardo Electronic Almanac 6:12 (January, 1999): mitpress.mit.edu/e-journals/LEA/ARTICLES/gemini.html
39. Public interest in conceptual art had steadily increased since the mid-1960s, when artists, curators, and critics began the process of historicizing a broad range of international artistic tendencies under the rubric of "conceptual art." Nineteen sixty-nine was a watershed year, marked by an extraordinary number of international exhibitions. Its increasing reputation led to the publication in 1972 of Ursula Meyers' *Conceptual Art*, a compilation of statements, essays, artworks, and interviews by conceptual artists; and in 1973, Gregory Battcock's *Idea Art: A Critical Anthology*.
40. Jasia Reichardt, interview with the author, July 30, 1998, London.
41. Moreover, since Ascott's diagram entitled "Thesaurus" was largely textual, he expressly put in writing his intention to use text in and as art.
42. Sol Lewitt, "Paragraphs on Conceptual Art," Stiles and Selz, Theories and Documents: 825.
43. Ursula Meyer, *Conceptual Art*, New York: Dutton, 1972, xvi.
44. Jack Burnham, "Steps in the Formulation of Real-Time Political Art" in Kaspar Koenig, ed., *Hans Haacke: Framing and Being Framed, 7 Works* 1970-75, (Halifax: The Press of the Nova Scotia College of Art and Design, 1975): 128-9.
45. Charles Harrison, "A Kind of Context," in *Essays on Art & Language* (London: Basil Blackwell, 1991): 17.
46. Ibid: 260, fn 25.
47. Ibid: 261, fn 30
48. Harrison, C., "The Late Sixties in London and Elsewhere" Hillary Gresty, ed., 1965-1972, When Attitudes Became Form, (Cambridge: Kettles Yard Gallery, 1984): 10-11.
49. This spurious computer program for interactively generating color refused to allow the user to interact beyond the rigid banality of binary input. If the user entered a number other than 0 or 1, the program proffered the message: "YOU HAVE NOTHING, OBEY INSTRUCTIONS!" If the user entered a non-number, The Cybernetic Art Work That Nobody Broke responded that there was an "ERROR AT STEP 3.2." Ibid: 58.
50. This work juxtaposed a "sculptural morphology and an electromagnetic morphology." The perceptual experience of interacting with the sculptural aspect of the system was intended to result in knowledge about the electromagnetic aspect of the system, which, in turn, would create knowledge about the sculptural aspects. See, Terry Atkinson, David Bainbridge, Michael Baldwin, and Harold Hurrell, "Lecher System" Studio International 180:924 (July/Aug 1970), reprinted in Ursula Meyer, *Conceptual Art*: 22-25.
51. In this work, Terry Atkinson and Michael Baldwin offered a key to abbreviations for the French Army (FAA), the Collection of Men and Machines (CMM), and the Group of Regiments (GR), then described the inter-relationships among them: The FA is regarded as the same CMM as the GR, and the GR is the same CMM as (for example) a new order FA (for example, morphologically a member of another class of objects): by transitivity, the FA is the same CMM as the New Shape/Order one. This ironic passage reduces to absurdity the systematic relationships among individuals, groups, and institutions characteristic of cybernetics and the military. See, Harrison, *Essays on Art & Language*: 52 Ibid: 56.
53. Index had a variety of manifestions, including a component of Index 4, which consisted of a computer printout. Several instances of the work can be likened to hypertext, an electronic text system in which a non-linear narrative is navigated by participants through a process of making associational links. Ibid: 72.
54. Some of the distinctions Harrison has made between art and language and "the normal work of ... Conceptual Art," such as the idea that "it was the supposed end product of the [Conceptual] artists activity that claimed primary attention," contradict the stated goals of so-called "normal ... Conceptual art[ists]" like Robert Barry and Douglas Huebler, whom Burnham discussed in "Alices Head." See, Harrison, Essays: 51
55. See for example, Popper, F., *Origins and Development of Kinetic Art.* Trans. Stephen Bann. Greenwich, CT: New York Graphic Society, 1969; Jack Burnham, *Beyond Modern Sculpture*; Douglas Davis, *Art and the Future: A History/Prophecy of the Collaboration between Science, Technology and Art.* New York: Praeger, 1973.
56. See, for example, the prominence of Haacke in many issues of *October Magazine*. See also, Wheeler, *Art Since Mid-Century*; Meyer, *Conceptual Art*; and Morgan, *Art into Ideas*.
57. When computer-telecommunications became accessible to civilians, Ascott was one of the first artists to use them for aesthetic purposes and developed a distinguished reputation as a pioneering theorist and practicioner of telematic art, which achieves a state of technologically mediated dematerialization that Ascott has referred to in Derridean terms as "pure electronic difference." See Roy Ascott, "Is There Love in the Telematic Embrace" *Art Journal* 49:3 (Fall, 1990): 241-7. While deeply ensconced in theoretical concerns regarding process, systems, and linguistic structures of communication, Ascott's work is in the process of being canonized in the domain of media art, the apparent successor to art and technology.
58. Burnham, "Notes on Art and Information Processing" *Software: 11* (16).

Dialogue with a Monologue: Voice Chips and the Products of Abstract Speech

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This paper argues that voice chips and speech recognition chips can be used as a unique analytic tool for understanding the complex techno-social interactions that define, imagine, and produce new products. Using these chips as an in situ instrument allows a focus on products in their actual context of use, capturing the multiple interpretations of new technologies, and a method to analyze their failures and successes in human machine interaction. It is the use of voice that is direct evidence of the interactive, particularized and social aspects of products that are traditionally underrepresented in the attempts to understand technological innovation, design, and deployment.

The first part of the paper examines the use of integrated circuits that produce speech in consumer products, commonly called voice chips. The goal is to document what these products actually say and to try to understand what the voices of these products represent, specifically, what they say about techno-social relations. The paper describes how voice chip technology differs from other talking hardware of the recording and communications industries, and places it in a unique social and functional position: and provides insights into the possibilities of ubiquitous computational devices more generally. This section includes a survey of the voice chip patent literature; samples the products currently on the market; and investigates how the voices of these products can be interpreted as speech and interaction, drawing largely upon Suchman's examination of human-machine interaction. I conclude this section by using the chips voice to question their performance of abstract speech, and preprogrammable interaction, and therefore what actually happens in the realworld context when we attribute speech and agency to technological products.

The second part of this paper introduces a preliminary examination of the opposite techno-social phenomena: what we say to our things (rather than what they say to us). Using speech recognition chip sets, which enable relatively widespread and cheap speech recognition to be embedded in devices as a secondary function (e.g. cell phones), we can hear and examine what we say to our devices. Taken seriously as speech acts we can recognize the social position our address conveys. In other words: now that we can speak to our things, what do we say? And, furthermore, what do we mean? Because there are not many of speech recognition engines deployed in distributed products currently, the method we have used to survey a range of applications is by hosting a competition in which entrants proposed speech recognition interfaces to existing product. Just under three hundred designs were submitted and are available on the Web site www.cat.nyu/neologue. These proposed applications are analyzed in terms of the technological desires, expectations, and hopes they embody: particularly popular is the desire for social and individual envisioning and regulation; and there clearly stated within these proposed product interfaces explicit desired social transformations. This initial analysis is presented in order to set up some the preliminary ideas and interpretation, so that as the speech recognition chips become more widely distributed we can tune in to this particular historical moment and hear what it is we expect, want and bring to our human machine interaction. Listening to our daily interactions with products can work to contest and complicate the dominant methods used to describe technological trends and patterns of product innovation: demographically driven and massified market research and the capture of consumptive behaviors at point of purchase.

The database of voice chip and speech recognition products, patents, and sound files is available at www.cat.nyu/neologue, including instructions on how to contribute to material, from products to further analysis.

Voice: a social technology

Voice is the icon of person. It is the icon of the political agent. "To be given a voice" is how we understand the fundamental unit of democracy, voting or being represented. It is the recognition of each person and also the device for interpolating a subject into society.[1] In short it is the fundamental device of sociality and therefore interaction. Used in contrast to techniques and technologies, the voice is a responsive and ephemeral social device. The predetermined functions of products, manufacturing systems, word-processing software and other work-related technologies symbolize the stable, predictable, and material aspects of society, while the voice is reserved as the device that is claimed to define human-ness, expressing emotion, negotiating, conversing, and ultimately, having agency. In fact, the preconditions for individuation and socialization rely if not directly on the voice, then at least symbolically. Individual agency and free will are both preempted by the voice and operationalized through the voice. All notions of the social are somehow tangled with the voice.

Further, a voice is always understood from a social position.[2] Thus, if talking is the act of sociality then the product must talk from its social position. Or conversely perhaps the products words are understood from its place in the social world. Giving a voice, gives a political presence – to be counted, understood, or at least listened to. Because voice is situated and local (the same words can mean different things in different contexts), voice chip products articulate the tension between the product as a mass market phenomena and its actual incarnation into an individuals daily activity and meaning making.

Hearing Voices

Given this theoretical context we ask: What does technology have to say for itself? When hardware has a voice, what does it say?

Talking hardware has existed since before the time of Thomas Edison, who is generally credited with a having invented the phonograph around 1877, when Alexander Graham Bell's telephone learnt to talk. The proliferation of talking hardware since has bought the recording industry, the broadcast industry, and the multimedia industry. Our exposure to voices (and other com-

municative sounds) that emanate from inanimate objects has become a significant part of our daily interactions: from radios to talking elevators, answering machine messages, and prerecorded music, television, automated phone menus, automatic teller machines, alarms and alerts, each of which, we will show, speaks in a language or dialect that makes little distinction between music, sound effects, and articulated words.

There are, however, interesting distinctions to make between the voice chips, the concern of this paper, and noisy hardware more generally. Voice chips refers colloquially to: Texas Instrument TSP50C04/06 and TSP50C13/14/19 synthesizers; Motorola MC34018 or any other "speech synthesis chip implemented in C-MOS to reproduce various kinds of voices, and includes a digital/analog (D/A) converter, an ADPCM synthesizer, an ADPCM ROM that can be configured by the manufacturer to produce sound patterns simulating certain words, music or other effects.[3]

The voice chip differs from other technologies of automated sound production in that it technically offers autonomous voices, as opposed to broadcast voices, that is, voices which are not necessarily associated with a performer or any other pre-established identity. These chips present local talk in independent products that need not make a claim to belong to an identity, or to the faithful reproduction of someone elses voice. In fact their sound quality has effectively precludes this. However, the I in "I'm sorry, I could not process your request" or the "I will transfer you now" voice of the automated operator claims agency by using the first person pronoun.[4] Presumably, the machine is referring to itself when saying I, because it is not identifiably anyone else. [5]

Attributing agency to technologies is a theoretical strategy that has been used by others to better understand the social role of technologies.[6] It is a strategy that dislodges the immediate polarization of techniques and society, a strategy that refuses reduction to a situation that is merely social or only technological. Latour bases his Actor Network Theory, a theory that regards things as well as people as actors in any socio-technological assemblage, on the ability of humans and non-humans to swap properties. He claims that every activity implies a generalized principal of symmetry or, at least, offers an ambiguous mythology that disputes the unique position of humans. Callon and Law have also explored non-humans as agents, but their strategy starts with an indisputable agent (a white male scientist) and strips away his enabling network of humans and non-humans to demonstrate that his agency, his ability to act as a white male scientist, is distributed throughout his network of people, places, and instruments.[7] Even a more traditional theory like technological determinism rests on the assumption that technology has an agency apart from the people who design, implement or operate it, and hence can determine social outcomes. Voice chip products take these ideas literally and actually attribute, with little academic debate or contest, the defining human quality of speech to technology. Voice chips have humbly preempted the theory.[8]

The voices of chips differ from those of loudspeakers, TV/radio, and other broadcasting technologies in the social spaces they inhabit. Although radio and TV have become so portable that their voices can emanate from any vehicle, serving counter or room, voice chip voices, by virtue of their peripheral relationship to the product, inhabit even more radically diverse social spaces. The identity of the voice that emanates from TV and radio reminds us that it is coming from elsewhere "for CBS News," "It is 8 oclock GMT; this is London." And although Channel 9 is not a physical place, its resources and speech are organized around creating its identity, as an identifiable place on the dial. The voice chip that tells you "your keys are in the ignition" is not creating a Channel 9 identity, however. Its identity is "up for grabs," not quite settled, it speaks from a position of a product in the social space of daily use.

Similarly, recording media and hardware refer to what they record. We know we are listening to someone when we listen to an Abba CD. And although it is the tape-recorder in the car that produces the sound, we claim to be listening to the Violin Concerto itself. The tape recorder as a product does not itself have a voice, it never pretends to sing, speak, or synthesize violin sounds itself. The recording industry and associated technologies, born at a very different historical moment from voice chips, came out of the performance tradition.[9] Its claim to represent someone, from the earliest promotions using opera singers, to contemporary mega stars, has focused the technologies around "fidelity" issues. Additionally, telephones, telephonic systems, and the telecommunications industry, motivated by communication imperative, prioritize real-time voices passing to real-time ears, over fidelity. Simply stated, it is an industry that puts technologies between people, things to communicate through, "overcoming the tyranny of distance."[10] Invisible distance and seamless technology, reflect the recording industrys ambition to "overcome the tyranny of time," enabling people to duplicate the performance regardless of when or where it was originally performed. Voice chips and their inferior sound quality, do not refer beyond themselves. Their position in a product becomes their position as a product.

The Distribution of Voice Chips

Voice chips provide the opportunity to add "voice functionality" to the whole consumer based electronics industry. They are the integrated circuits that can record, play, and store sounds, and more importantly voice. They are the patented chips that play "Jingle Bells" in the Hallmark greeting card.[11] They are the voice in the car that reminds you "Your lights are on." [12] They are the technology that makes dolls that say "Meet me at the Mall,"[13] and give products ranging from picture frames to pens.[14] The well

sung virtues of integrated circuits (chips) is that they are cheap, tiny, and require little power. Smaller than a baby's fingernail, they have the force of a global industry of behind them and an entire economic sector invested in expanding their application. Technically, they can be incorporated into any product without significant changes in their housing, their circuit design, power supply, or price. Wherever there is a flashing light, there could instead, or as well, be a voice chip.

Although most computers can record and play voice, the voice chip is different in that it is dedicated solely to that function. The same integrated circuit technology of calculators and computers allows this tiny package to be placed ad hoc, in consumer devices. Their development exploited the silicon chip manufacturing processes and its dedication to miniaturization. With sound storage capacities ranging from seconds of on board memory to minutes and hours of recording time when configured with memory chips, they were conceived to enable voices in existing hardware, to be incorporated into products. They are the saccharin additive of consumer electronics.[15] They were first mass marketed in 1978 by Texas Instruments though they had existed in several forms before that. It was not until seven years later, in 1985, that the Special Interest Group in Computer-Human Interface (SIGCHI) of the American Computing Machine (ACM) professional society, mobilized an entire community to break off into their own conference from other more general computing conferences. This historic moment, which crystallized a discussion in design communities on the Human-Computer Interface as a site of scientific investigation, differs from earlier formulations of this interface, such as Engleberts human augmentation thesis or Turings standing-in-for ideal, but dominates still. This site, the liminal zone where people and machine purportedly interact is where the voice chips were intended to reside. The voice chips arrived to mediate, even to negotiate, this boundary. Voice chips promised to make hardware "user friendly," a phrase that defines the technical imagination of the time, by turning the person into an interchangeable standardized "user" and attributing a personality (i.e. friendliness) to the device. In this context the problem for designing user-friendly devices begins with the assumption that the hardware has agency in the interaction. Writes Turkle:

> Marginal objects, objects with no clear place, play important roles. On the lines between categories, they draw attention to how we have drawn the lines. Sometimes in doing so they incite us to reaffirm the lines, sometimes to call them into question, stimulating different distinctions.[16]

Marginal Voices

Finally, before listening to the voices themselves, I want to emphasize the peripheral relationship of the voice chip to the product. It is the position of the voice chip, as marginal, not particularly intended to be the primary function the product that increases the present curiosity in it. The motor vehicle, for example is not purchased primarily for its talking capacity, and pens that speak are useful for writing. This marginality gives voice chips a mobility to become distributed throughout the product landscape and mark, like fluorescent dye, a social geography of product voices.

The chips are usually deployed, to borrow from the economic sense of the term, for their marginal effects, to give one product (e.g. an alarm system) some marginal benefit over a competing product. However, the chips are not evenly distributed throughout competitive markets, (e.g. consumer electronics) in the manner one would expect for the propagation of a low-cost technical innovation driven by market structure alone. Although consumer preferences are often claimed to have a causal determination on the appearance or disappearance of marginal benefits, it is difficult to see how the well-developed paths of product distribution have the capacity to communicate those preferences developed after the point of purchase. Lending the market ultimate causality (or agency) ignores the specific experience of conversing with products, the micro interactions that enact the market phenomenon, and occludes the attribution of agency to the voice chip products, in so much as these products speak for themselves. The voice chip products themselves have something to say, although their voices are usually ignored. In this paper we will not examine voice chip products in the interactions of daily use, as contrapuntal to market descriptions, however by recognizing the social assumptions which determine their physical design, we frame the imagined interactions and social worlds in which these products make sense.

Finding the Voices

The marginality of the product makes it difficult to systematically study. Neither of the two largest manufacturers of voice chips of various types (Motorola and Texas Instruments) keep information on what products incorporate this technology, partly because they can be configured in many different ways, not necessarily as voice chips, and partly because products that talk are not a marketing category of general interest. This paper traces voice chips in two ways: firstly via the patent literature, and secondly through a more ad hoc method of searching catalogues, electronics, toy and department stores to compile a survey of products that were available at the time of my year long study (June 1996 to June 1997).[17]

What is initially observable from the list of products and patents that contain voice chips is that there is no systematic relationship between the products that include voice chips and the uses or purposes of those products. Except for children's toys, no one market sector is more saturated with talkative products than another. These chips are distributed throughout diverse products. However, we can view the voices as representatives, as in a democratic republic where voices are counted. Just as in a republic each citizen has a vote but most chose not to exercise it, likewise, most products could incorporate voice chips but most do not, so we will count what we can.

What do voice chips say?

A review of the patents literature yielded a loose category scheme, or a typology, not by where the voice chips appeared, but by what they said. The patents themselves hold a peculiar relationship to the products: For only two of the products on the market did I find the corresponding patents, the CPR device[18] and the recordable pen.[19] Though patents do not directly reflect the marketed products, they do represent a rather strange world

of product generation, a humidicrib for viable and unfeasible proto-products. Patents track how products have been imagined and while they do not by any means demonstrate market success, they do reflect a conviction of their worth, being invested in and protected. Patents are a step in the process of becoming owned, therefore worth money, and thereby demonstrate how voice, a social technology, becomes property.

There are as of March 2001 only 84 North American patents that include a voice chip. Of these 34 were issued in the year 1996-7, approximately 15 since, and the remainder in the previous five. In the context of the patent literature, the first thing to note is that this is a very small number, compared, that is, to the integrated circuit patent literature more generally. The question "why not more?" we will return to later. The federal trademark office offers a suggestive list of speech invoking names, including: who's voice; provoice; primovox; ume voice; first voice; topvoice; voice power; truvoice; voiceplus; voicejoy; activevoice; vocalizer; speechpad; audiosignature. These nomickers provide another introduction into how the voice is conceptualized in the realms of intellectual property. However the voice chips themselves seem to fall into the following categories: (a) Translators, which range from reporting and alerting to alarming and threatening and include interactive instructional voices; (b) Transformers, which transform the voice; (c) Voice as Music, that makes speech indistinguishable from music or that present voice as sound effect; (d) Locating Voices, speaking from here to there about being here; (e) Expressive Voices, expressing love, regret, anger, and affection (f) Didactic voices and Imitative voices, mainly as in the educational and whimsical children's toys; (g) Dialogue Products, which explicitly intend to be in dialogue with the user as opposed to delivering instructions to a passive listener.

The product and patents often exist in more than one of these categories; for instance, the Automatic Teller Machine will not only apologize (expressive) for being out of order but will also simply function to translate the words on the screen into speech. This said, the categories remain, for the most part, distinguishable and useful.

Translators

A large category, this is the voice that translates the language of buzzes and beeps into sentences whether English, French or Chinese. A translator is a chip that translates the universal flashing LED, the lingua franca of the peizo electric squeal, the date code, the bar-code, the telephone ringer adapter that translates that familiar ring, the tingling insistent trill of an incoming call, into "a well known phrase of music"[20] an approach that has since become popular in cell phones which this function finds a use in differentiating who's phone is ringing, or the unrelated patent that translates the caller identification signal into a vocal announcement. Within the translators there are distinct attitudes, for instance, the impassive reporting, almost a voice of nature. This is exemplified by the patent for the menstrual cycle meter. The voice reports the date and time of ovulation, in addition to stating the gender more likely to be conceived at a particular date or time during a woman's fertility cycle. Another example is the patent for the train defect and enunciating system, that "reports detected faults in English." These chips speak with a "voice of reality," reporting "fact" by the authority of the instrument that triggers them.

The other types of translator are more urgent than reporting. They raise alarm and expect response. They are less factual, more contestable perhaps. Take the "Writing device with alarm,"[21] an "invention which relates to a writing device which can emit a warning sound-or appropriate verbal encouragement — in order to awaken a person who has fallen asleep while working or studying"; or the baby rail device which exclaims "the infant is on the rail, please raise the rail,"…and then if there is no subsequent response from an attendant caregiver raises it automatically.[22] A product on the market that will politely tell you if there is water on the ground is pictured in figure 2.

These voice chips ask for and directs the involvement of their humans counterparts, they assume interactive humans. These chips articulate not only simple commands but series of instructions as well. The CPR device[23] (see figure. 3), guides the listener through the resuscitation process. And finally, these chips translate menus of choices into questions. The car temperature monitor that asks the driver "Would you like to change the temperature?" translates from the visual menu of choices but in the process also takes over the initiating role. What is lost or gained in the translation generates many questions: Does translating from squeals to a more articulate alarm make it any more alarming; how do spoken instructions transform written instructions? We will try to address these questions later.

There is an notable set of aberrant but related patents that exist in this category: The Alarm system for sensing and for vocally warning a person approaching a protected object[24]; The Alarm system for sensing and for vocally warning of an unauthorized approach towards a protected object or zone[25]; and the Alarm system for sensing and for vocally warning a person to step back from a protected object.[26] What seems almost a turn of a phrase to get three separate patents, has little technical consequence: the second patent has the extra functionality to detect authorized persons (or their official badge), and the third can, but need not, imply a different sensor perhaps, but each implies a different attitude. Although all patents are contestable, patent attorneys typically advise that you would not successfully win as separate patents an alarm system that warned at 15 feet from one that

alerted at two feet. The novel use being patented here depends on the wording, the phrasing of the instruction that determines the arrangement of the sensor and alarm/voice chip. On the strength of a differently worded warning the importance of the technically defined product description seems to have diminished. Perhaps ElectroAccoustic Novelties, the owners of the patents, have a linguist generating an alarm system for other phrases. These patents seem to be articulating the semantics of the technology. The intentionality of the system is its voice.

The transformers

The transformers are distinct from the patents that translate the voice. They translate in the other direction, not from the buzzes and squeals to spoken phrases but from the human voice to a less particular voice. For instance: to assist the hearing impaired, the chip that transforms the voices into the frequency range which still functions, usually into a higher frequency; or the "Electronic Music Device" effecting a "favorable musical tone." The voice tone color can be imparted with a musical effect, such as vibrato, or tone transformed.[27]

Into this category fall childrens products like "YakBak," popular in the 1997-99 seasons which plays back a childs voice with a variety of distortions, and the silicon-based megaphones that allow children to imitate technological effects, or sound like machines. These are voice mask for putting on the accent of techno dialect. The socializing voices broadcast on radio, and TV, the voices of authority heard over public address systems, and the techno personalities of androids and robots are practiced and performed in playing with these devices. This is also category of voice chips that is concentrated in products for the hearing impaired or otherwise disabled, and for children. These transforming devices act as if to integrate these marginalized social roles into a socio-technical mainstream.

Speech as Music

Many of the patents that are granted specifically collapse any difference between music and speech. This contrasts with the careful attention given to the meaning of the words used in the alarm system family of the Translators. An explicit example is the business card receptacle, which solves the problem of having business cards stapled onto letters making them more difficult to read, and provides an "improved receptacle that actively draws attention to the receptacle and creates an interest in the recipient by use of audio signals, such as sounds, voice messages, speech, sound effects, musical melodies, tones or the like, to read and retain the enclosed object."[28] Another example is the "Einstein" quiz game that alternately stated "Correct, you're a genius!!" or sounded bells and whistles, when the player answered the question correctly. This interchangeability of speech and music is common in the patent literature presumably because there is no particular difference technically. In this way patents are designed to stake claims – the wider the claim the better. The lack of specificity, and deliberate vagueness in genre of intellectual property law contradicts the carefulness of copyright law, the dominant institution for owning words.

Local talk from a distance

One would expect chips that afford miniaturization and inclusion in many low power products to be designed to address their local audience, in contrast to booming public address systems or broadcast technologies. However, several of these voice chip voices re-circulate on the already established (human) voice highways, imagined to transmit information as you or I would. The oil spill detector[29] that transmits via radio the GPS position of the accident, or the cell phone based automatic emergency vehicle location system which reports the latitude and longitude into an automatically dialed cell phone.[30] These are examples of a voice chip standing in for, and exploiting the networks established for humans, transmitting as pretend humans. This class of products, local agents speaking to remote sites, are curious because the information can easily be transmitted efficiently as signals of other types. Why not just transmit the digital signal instead of translating it first into speech? The voice networks are more public access, more inclusive, if we count these products as part of our public, too. The counter example, of voice chips acting as the local agent to perform centrally generated commands, is also common, as in the credit card actuated telecommunication access network that includes a voice chip to interact locally with the customer while the actual processing is done at the main switchboard. Although the voice is generated locally, the decisions on what it will say (i.e. the interactions) are not.

Expressives

The realm of expressiveness, often used to demarcate the boundaries between humanity and technology, is transgressed by the voice chips. There are, of course, expressive voice chips ranging from: a key ring that offers a choice of expletives, swear words and curses; the portable parent that plays stereotypical advice and parental orders; the array of Hallmark cards that wish you a very happy birthday, or say I love you. These expressives applications also remind us of the complexities of interpreting talking cards. The meaning of these products is of course, dependent on the details of the situation rather than the actual words being uttered: who sent the card, when; or what traffic situation preceeded the triggering of the key ring expletive.

These novelty devices lead into the most populous voice chip category: those intended for children. The local toy department store, Toys R Us, currently has seven aisles of talking and sound making products, approximately 45 different talking books alone, in addition to various educational toys, dolls and figures that speak in character. The voices are intended for the entire age range from the earliest squeaking rattles for babies to strategy games for children 14 years of age and up. For example the Talking Battle Ship in which you can hear the Navy Commander announce the action as well as "exciting battle sounds." The categorization of the multitude of toys extends far beyond expressive types; from the encouraging voices inserted in educational toys: "Awesome!," "No, try again," or "You're rolling now" in the Phonics learning system, the "Prestige Space Scholar," and "Einstein's Trivia" game; the same recordable voice

chips, used for executive voice memo pads, are for children placed in pens, balls and "YakBaks" (walkie talkies for talking to yourself); then there is the multitude of imitative toys that emulate cute animals, non-functional power tools and many trademarked personae from Tigger and Pooh to Disneys recent animation characters, Sampson and Delilah, Arial the mermaid, and others.

This listing demonstrates a cultural phenomenon that enthusiastically embraces children interacting with machine voices, and articulates the specific didactic attitudes that are projected onto products. These technological socialization devices have already been subject to analysis, for instances Turkles study of children attitudes towards interactive products.[31] Barbie, for instance, was taken very seriously for what she had to say about the most polarized notions of gender she embodies. Since Barbie's introduction in 1957 she has been given a voice three times (each with slightly different technology), her most controversial voice during the 1980s was censored for saying "Math is hard." This controversy rests on the assumption that voice chips are social actors and do have determining power to effect attitudes, in this case a young Barbie players attitude to math.

Although Barbie is currently silent, a myriad of talking dolls remain, from Tamagachi virtual pets, with their simple tweets, to crying dolls that ask to be fed, and an ever increasing vocabulary of robotic dolls creatures. The utility patent literature continues to award new and novel applications in this area. One of the new voice chip patents is for a doll that squeals when you pull her hair (dolls that cry when they are wet or turned upside down are technically differentiated by their simple response triggers).[32] There is also a new doll patent that covers electronic speech control apparatus and methods and more particularly for... talking in a conversational manner on different subjects, deriving simulated emotions...methods for operating the same and applications in talking toys and the like."[33] The functional categories at work here are not linguistic, nor do they resemble other ways in which the voice has been transformed into document, for example, as in the copyright of a radio show. It would, in other realms, be very difficult to get copyright on talking in a conversational way. In the material world the ownership of voice has been redefined.

Recording Chips

This category encompasses many of the most recent voice chips products. It is the existence of these products that tests the nature of the communication that we have with these technologies: do we, can we, converse with these products? The category draws from the other typologies but is distinguishable, for the most part, by the recording functionality that is raison dêtre of the product. This category includes those products that perform a more specific speech function that could not be alternatively represented by lights, beeps or visual display, i.e. perhaps they are more communicative. This category includes the products that seem to hold dialogue.

The range of products include the shower radio that reinterprets bathing as a time for productive work, an opportunity to capture notes and ideas on a voice chip, consistent with the theory that there is an ongoing expansion of the work environment into "private" life. It also includes both the recordable pen and its business card size counterpart, the memo pad. Both the pen and the pad have many versions on the market currently, and they seem to be becoming more and more populous. The "YakBak" is the parallel product for children, deploying the same technology with different graphics, and to radically different ends.

The growing popularity of this category compared to the others arouses a number of questions. Firstly, how do we understand why this category is popular? Is the popularity driven by consumers because these products are successful at what they do? And is what they do, dialogue? Or is it that the cost and portability of the technology makes it an affordable new tech symbol beyond what is attributable to their function alone? Is this is a popular category because they alone can be marketed as a work product?[34] And then conversely, why are these devices not more popular? Why is it that only a few types of products become the voice sites (i.e. pens, photoframes, memo pads are all documents of a sort, in contrast to switches or menu choices)? According to the patent literature the failure of the market place to find a need for voice capability on home appliances has discouraged the use of voice chips in other products[35] but lending the market agency for design assumptions is circular logic. This does express, however, the sentiment that many more products could have speech functionality then do.

Although miniaturization has made these products possible, the concept of embedding recording capability in products has been possible with other technologies. There has been no technical barrier to providing recording capability in cars for instance or in any of the larger products, a refrigerator for instance, certainly since the existence of cheap magnetic recording technologies. Why is it that now we want consumer products that talk to us?

It is striking that the majority of talking products on the market currently are for conversing with oneself. Although deeply narcissistic, this demonstrates a commodification of self-talk that transforms the conceptualization of the self into a subjectivity in relationship with our products. It suggest, without subtlety, that the relationship with these products is a relationship with the self. The constitution of personal and social identity by means of acquisition of goods in the market place,[36] the process of identifying products that provide the social roles we recognize and desire, can not be excluded from the consideration of the social role of products.

Where the voice chips speak
The above typologies focus on what the voice chips say rather than where they say it. However, because voice chips are distributed throughout the product landscape, where they appear (and disappear) is also interesting to examine. Although a detailed analysis could yield an interesting social geography, it is beyond the scope of a paper only intended to generate preliminary questions about why they say what they do where they do.

The automobile industry, a highly competitive, heavily patented industry that quickly incorporates cheap technical innovations (where they do not substantially alter the manufacturing process) is a place to expect the appearance of voice chips. Indeed there was early incorporation of voice chips in automobiles. A 1985 luxury car, the Nissan Maxima, came with a voice chip as a standard feature in every vehicle. The voice chip said: "your lights are on"; "your keys are in the ignition"; and "the door is ajar." There were also visual displays that marked these circumstances, yet the unfastened seatbelt warning only beeped. By 1987 you could not get a Nissan Maxima with voice chip, even on special request. In this case, the voice was silenced, but only for a time, reemerging with a very different role to play in the automobile.

By 1996, the voice chips reappeared in the alarm system of cars. Cadillacs standard alarm system uses proximity detection to warn you are too close, please move away. In this ten year period the voice shifted from notification to alarm, a trajectory from user friendly to a distinctly unfriendly position. It is also interesting to note another extension of the action/reaction voice chip logic, if not the voice itself. The current Nissan model no longer notifies that the lights have been left on, it simply turns the lights off if the keys are taken out of the ignition. The courtesy of notification has been dispensed with, as well as the need for a response from the user. The outcome of leaving the lights on is already known so the circuit will instead address that outcome. This indicates that when the results are exhaustively knowable, the need for interaction diminishes.

Of the seven patents specifically for vehicles[37] all bar one are intended for private and not public transportation. However in late 1996 voice chips began to appear in the quasi private/public vehicles of Yellow Cabs of New York. After debate about what ethnic accent[38] should be ascribed to the voice that reminded you to: "please fasten your seatbelt" and "please check for belongings that you may have left behind," a prerecorded (68k quality) voice of Placido Domingo and other celebrities won the identity contest, and since has proliferated into many well know New York characters, from sports stars, to "Sesame Street's" Elmo. The voice chip in this quasi-public sphere adopted a broadcast voice, albeit poor quality, or a micro-broadcast voice. Whether they are effective in increasing seatbelt wearing or reducing the number of items left in the cabs in any accent is less certain than the manner in which they articulate the social relations of the cab. The voice chips address only the passengers and assume that the drivers don't hear them, although it is the drivers who bear the brunt of their monotony.

Their usefulness delegates the human interaction of service and rests on the assumption that the chips are more reliable and consistent in repeating the same thing over and over, no matter the circumstance, and that the customer responds to Placido Domingo's impassive, recorded reminder more than they would a driver who may be able to bring some judgment to bear upon the situation. In the transformation of the passenger into a public audience (not unlike that of a radio station) the product or service itself is not attributed with the voice. Instead the voice becomes identified with a celebrity.

In the transportation sector alone we can see the voice chip develop from an anonymous to an identifiable voice, and from a polite notification to an alarm for deterring approach. Cars have struggled with the problem of talking to humans and seem to have exploited the non human qualities of their speech,[39] the things that the technology is better at doing, like the faithful repetition or their careful reproduction of the identity of another, rather than any particularly human attribute of their speech. It is also notably that they have not endured.

In another social sector highly saturated with electronic product, the health industry, the distribution of voice chips is almost exclusively on one side of the home/professional, expert/non-expert divide. Although in number, there are more products made for hospitals and clinics than the home market, the placement of voice chips is inversely represented. From the menstrual cycle meter to the Cardiopulmonary Resuscitation (CPR), the electronic voices seem to play the role of the health professional or "expert." In addition, the large number of products that are intended for the visually impaired, are intended for the visually impaired patients and not professionals (a demographic with more spending power); see, for example, the addition of a sound indicator to the syringe filling device for home use, which testifies that the user of this device is imagined at home, without the help of the professional for whom the product can stand in. Ironically, the most vocal equipment in this industry are the relaxation and stress reduction products, i.e. talking to yourself or being reassured and relaxed by the sounds of the ocean (see, e.g., Figure 7). The reassuring factuality of these techno-voices, focuses its attention on the lay audience.

These are preliminary observations of the voices introduced into transportation and in the health and medical areas, and are cursory at best. But they demonstrate that for the voice to make sense, the technological relationship itself needs to make sense. The speech from devices is as culturally contingent as language.

There are many other areas in which their introduction provides insight into what technological relationships make sense. Their incorporation into work products articulate the transformations and reorganization of work structure particularly into "mobile" work.[40] They speak to a cultures popular notions of where work gets done, a culture in which providing a product to take voice notes while in the shower makes sense. The voice chip

population of areas of novelty products, children toys and educational products, and of the safety, security and rescue products also maps the social relationships we engage in with our products. Conversely, where we don't find voice chips, for example in biomedical equipment for health professionals, also maps the social relationships that the technologies plays out. However, to understand the dialogue we are having with these voices requires us to also examine how we listen.

Discussion

Voices Chips as Music

The preceding categories survey what voice chips say, where it is they say it, and to whom they say it. To understand what the voice chips are saying, however, means engaging strategies for listening that may not be automatic. Products, with or without voices, are well camouflaged by what Geertz (1973) described as the dulling sense of familiarity with which ... our own ability to relate perceptively to one another is concealed from us. Modes and strategies for listening that can help us hear these voice chips can be borrowed from music. Music, unlike machines, is commonly understood as culture, or a cultural phenomena and its analysis looks very different in comparison with the analysis of technology. Perhaps the most glaring difference is the concept of improvisation, which can describe much of interaction with machines, while prevalent in theorizing music, is unusual in the analysis of human machine interaction. For our examination of voice chips aligning with music is a strategy to avoid the contests over reality, progress and rational choice that usually inform the analysis of technology and can thus provide more emphasis on the interpretative experience. Additionally, some of the voice chip products themselves that demonstrate an indifference to the distinction between speech / music, by blurring the distinction between words and beeps (see the Speech as Music category of products).

Music, like product, is also easily recognized as involved in the production of identity. That is, subcultures identify through and with music.[41] Where technological product is presented to the consumer, at what Cowan call the "consumption junction," we are at such an identity-producing site.[42] For this reason it is difficult to ascribe any one particular meaning or mode of listening to the voice chips. In the wide spectrum of musical styles available each piece of music can and does exist in widely different listening situations. This means that each listener has a variety of listening experiences and an extensive repertoire of modes of listening. The hearing person who listens to radio, TV, the cinema, goes shopping to piped music, eats in restaurants, or attends parties, has built up competence in translating and using music impressions. This ability does not result from formalized schooling, but through the everyday listening process in the soundscape of modern city. Stockfelt asserts that mass media music can be understood as something of a nonverbal lingua franca,[43] without of course denying the other more specialized musical subcultures to which we may simultaneously belong.

Listening modes are not, of course, limited to music, and nor for that matter is a musical experience limited to music. Even so, teasing out the musical modes of listening from listening modes that focus toward the sounds quality, its information carrying aspect, or other nonverbal aesthetic modes is difficult. The cultural work of using unmusical sounds as music is not uncommon, for example, Chicago's Speech Choir, John Cage's "433," the "Symphony of Sirens"[44] and the sounds created with samplers, particularly for percussive effects. At the same time the sirens, speech choirs, etc. do not lose their extra-musical meaning as they become music. Conversely, using musical sounds for nonmusical ends is the conceit of many voice chip applications.

The two products above demonstrate the confusion of musical listening vs. other modes of musical sound consumption. The Soother uses unmusical sounds for musical effect while the Funny Animal Piano using musical sounds to respond to toddler's feet. The alignment of voice chips with music has interesting implications for their linguistic claims, if they produce meaningful speech why don't they differentiate between music and speech?[45] Is it that the social position of the product determines the meaning of the sounds and utterances? Indeed if the speech they produce is linguistic, then when the voice of the alarm system warns us are we altering the meaning of the sound whether it resembles speech or siren? Or can we expand linguistic theories to accommodate all meaningful sounds that humans or machines make? These questions about how we understand the sounds that the voice chips produce, complicate the attribution of agency to these things with voices. Voice chips seem to frame sound as a prepackaged cultural product, the identity of which is located in the manufactured materiality. At the consumption junction these voices are heard in the buzz and squeal of products, but can we call it language?

Voice Chips as Speech

What do the voice chips tell us about our understanding of language? The voice chips stabilized language in material form provide a picture of our on-the-ground, in-the-market operationalization of language. Even though some voice chips use music and speech indistinguishably, the words that they say cannot be overlooked. Voice chips talk and say actual words, but how do we understand these voices as communicative resources? Are they speech acts, as defined by linguistic theorists?[46]

Speech acts[47] are used to categorize audible utterances that can be viewed as intending to communicate something, to make something happen or to get someone to do something. To construe a noise or a mark as a linguistic communication involves construing its production as a speech act (as opposed to a sound that we decide is not communicative). Categories of speech acts are given below (examples quoted from voice chips):

Commissives: speaker places him/herself under obligation to do something or carry something out, promises for example, or in a telephone system, "I will transfer you to the operator";

Declaritives: making a declaration, that brings about a new set of circumstances, when your boss declares your are fired or when the car states the lights are on; Directives: tells the listener to do something for the speaker, please close the door," "move away from the car";

Expressives: without specific function except to keep social interactions going smoothly, like "please" and "thank you," or the more expressive "I love you."

Each of these categories is performed by the voice chips examined in this paper, as are other verbs and verb phrases that are associated with the wider category of elocutionary acts: to. . . state, assert, describe, warn, remark, comment, command, promise, order, request, criticize, apologize, censure, approve, welcome, express approval, and express regret.[48]

Searle defines the "speech act" as utterances (actions) intended to have an effect on the hearer, with preconditions and effects. This has been criticized by other theorists who have pointed out that meaning is imparted by the work of an "interpretative community."[49] The limitation of speech act theory in explaining voice chips is that it ascribes the most intention to the least animate thing in the interaction. In its failure to elaborate on interpretation it provides no place for information about the significance of any particular assertion, warning, or more generally, any speech act. Voice chips amplify this problem because they can inhabit so many different situations yet repeat the same thing. Because the voice doesn't change, all flexibility in understanding to accommodate the changing circumstances needs to be accounted for by the listener's interpretation. The case of the Cadillac's alarm voice illustrates this.

In a demonstration of the Cadillac's alarm system the salesman instructed me to move away from the car and then approach the car. Despite coming as close as I could to the car the voice did not sound. On hearing no voice, the demonstrator toggled the key fob switch. I approached again and the voice sounded. In the first approach the voice chips silence was interpreted as the alarm is not working or is not on. In the second approach the voice communicated "now the alarm is on and functioning." By staying in the proximity range of the alarm system the voice answered several questions despite it repeating the same words "move away..." What is the area range in which we are detected? Will the alarm keep repeating or will it escalate its command? Although moving away from the car stopped the voice, we also came to understand the types of motions that it detected, the speed of approach, what happened when we physically shook the car, etc. The simple interaction with the car and its voice demonstrates the interpretative flexibility that transcended the directive of the words stated and how, as hearers, we respond to the voices imperatives. So in asking how we understand the significance of speech performed by the voice chip we are asking whether speech is abstractable.[50] In other words, is there a difference between talking with a voice chip and talking with something (human) with which we share capacities other than speech?

Is speech abstractable?

Speech in action, rather than in theory, is conversation. If we are to claim that we interact with voice chip speech then we need to examine the fundamental structure of conversation as the primary model for interaction.[51] One of the voice chip patents claims the rights for electronic apparatus(es) for talking in a conversational manner on different subjects, deriving simulated emotions which are reflected in utterances of the apparatus. While the other voice chip products make no explicit claim to be conversing they do claim to be "interactive."[52]

The work of Lucy Suchman may prove more appropriate to describing the interactive "speech" of voice chips. Her work focuses on the inherent uncertainty of intentional attributions in the everyday business of making sense via the conversational interaction with another machine, the photocopier. Like voice chips, she characterizes machines by the severe constraints on their access to the evidential resources on which human communication relies. She elaborates the resources for constructing shared understanding, collaboratively and in situ, rather then using an a priori system of rules for the meaningful behavior. Suchman shows that the listening process of situated language is dependent on the listener to achieve the shared understanding of successful communication. The listener attends to the speakers words and actions in order to understand. Although institutional settings can prescribe the type, distribution and content of talk, for example, cross examinations, lectured, formal debates, etc., they can all still be analyzed as modifications to conversations basic structure. Suchman characterizes interactional organization as (a) the preallocation of turns: who speaks when and what form their participation takes; (b) the prescription of the substantive content and direction of the interaction, or the agenda.[53] Thereby a system for situated communication, conversation is:

1. An organization designed to support local endogenous control over the development of topics or activities and to maximize accommodation of unforeseeable circumstances that arise; and
2. Resources for locating and remedying the communication troubles as part of its fundamental organization.

Conversation with a voice chip?
Prerecorded voices of voice chips are ill equipped to detect communication troubles, and although they are usually triggered by local inputs the content of what is said does not change. They will repeat the same thing or a set of prerecorded phrases over the indefinite range of unpredictable circumstances. While localizing control they, for the most part, do not localize the direction of speech.

The type of application that seems closer to Suchman's characterization are the products that include "dialogue chips." These chips quite literally hand over control of the content of talk to the listener, fulfilling Suchmans characterization of conversational interaction in this respect. The listener literally controls the speaker and sets up a relationship with the device. Further, the dialogue chip products uses the turn taking of conversations collaboration, not as the alternation of contained segments of talk in which the speaker determines the units boundaries, but in the manner illustrated by the joint production of single sentence.[54] The "turn taking system for conversation demonstrates how a system for communication that accommodates any participants, under any circumstances, may be systematic and orderly, while it must be essentially ad hoc."[55]

Therefore, the response to voice chips, like the applause at the end of a play, is not a response to the final line uttered, or the fact that it just stopped. "the relevance of an action...is conditional on any identifiable prior action of event, insofar as the previous action can be tied to the current actions immediate local environment." The conditional relevance does not allow us to predict from an action a response but only to project that what comes next will be a response, and retrospectively, to take that status as a cue to how what come next should be heard. The interpretability therefore relies on "liberal application of post hoc ergo prompter hoc."[56] The response that a listener can have to the voice of the train defect annunciation system is not only a response to the words uttered by the product. It will also involves a complex series of judgments that includes assessments of the information available and how to integrate into what else the listener can know of the event at hand.

The understanding of talking products does not come so much from the words at what is popularly conceived as the human-machine interface, but beyond this. The voice is a voice embedded in a network of local control, sequential ordering, interactional organization and intentional attribution.

But it is the recordable chips with which we can have a dialogue with ourselves that best demonstrate this. These products literally frame the understanding that we are talking with ourselves through our products. While dialogue is conversation with another agent, one whom is there somehow, monologue is characterized as written speech, inner speech or rehearsed speech. Dialogue implies immediate unpremeditated utterances, whereas monologues are written speech lacking situational and expressive support that therefore require more explicit language. Questioning the abstraction of speech in voice chips does not demonstrate that speech is uniquely human. On the contrary, the stabilized voices of hardware based speech are subject to reinterpretation and rediscovers the listeners capacity, not the speakers incapacity. It may simply be viewed as a distinction between dialogue and monologue, neither of which are more or less human. Because we inhabit both sides of a dialogue we can understand the voice chips position and compensate so as to perform dialogue with ourselves.

From Voice Chips to Speech Recognition
This paper has so far developed the unique position of voice chips products, differentiating them from the background noise of contemporary culture and other technological configurations that deliver speech. These hardware bound voices are not broadcast and have no stable identity. The survey of what the voice chips say produces typologies that suggest further investigations of how we understand and use these voices, where they appear and what their voices mean. The short product life cycle of the consumer electronic devices they inhabit position these products as the E-coli of socio-technical relations and can demonstrate the formation of product identities, products voices, in the shifting understandings of machine interaction. The appearance of voice chips in some types of products and not others, some social sectors and not others is open to further investigation. Detailing these would reveal the voice chips oral history of the process by which the very ephemeral social device of the speech becomes stabilized and entered into systems of exchange.

Before concluding I introduce a complimentary examination of speech recognition chip sets, around which there is much more recent product development activity. While the voice chips applications seemed to have peaked around 1997, the equivalent low power, distributed speech recognition function may be just beginning. Watching their development and deployment carefully, asking now that we can talk to our products, what do we say? may allow us to hear the social scripts they presume. However, because we are more self-conscious about speaking than listening this may be an instrument through which to observe our own roles in socio-technical interaction. In order to prime this investigation, and because speech recognition chip sets are not yet (and may never be) widely available, the author hosted a competition to survey a range of applications. The competition was advertised on a large mailing list (12,000), the Viridian list owned and carefully managed by science fiction writer Bruce Sterling. The list is a forum for discussing technological futures with an emphasis on addressing environmental problems. Entrants were asked to propose a speech recognition interfaces to an existing product (the prize was a voice note taker and the prototyping of the proposed device), just under three hundred designs were

submitted and are available on the Web site <www.cat.nyu/neologue>. While these entries cannot be claimed to represent the conceptions of human computer interaction distillated by the social forces of the market, manufacturing and advertising we see crystallized by the voice chips, they can be treated as evidence of technological desires, expectations and hopes, that may or may not be observable in the market. Now that we can talk to our device, what do we say? The most striking feature the competition entries demonstrated is the explicit intention to effect social change with technological change. This may or may not be peculiar to this list (which can be tested by hosting a similar competition in other contexts) however, this is consistent with a popular techno-determinism that attributes social change to technological change and under-represents the dominant forces of product innovation that can be attributed to sustaining and continuing a corporate entity.[57] This also contradicts other popular understandings and lay rationalizations that new products arise to address preexisting social needs or profit opportunities, follow fashion or to optimize existing applications.

We can briefly summarize the trends illustrated by the proposed products and product interfaces[58] (a longer analysis in Jeremijenko forthcoming) which is predominantly the desire for social and individual envisioning and regulation. This is apart from the ultimate (and theatrical) control fantasies that this particular type of interface engages (e.g. on saying "showtime" the lights come dim and the television and VCR turn on),[59] or the suggestions that substituted buttons without explicating the word, e.g. dispensing with the TV remote,[60] but not explicating what words exactly to use. Entries that do not explore what happens in the translation from finger-button to voice-button and the social (and observable) spectacle this makes do not render the socio-technical relationship this investigation is trying to identify. There were also the applications that were similar to the voice chips — with a similar use of speech/buzz interchangeably in the applications that called attention to itself, e.g. the cookie container that recognizes childrens footsteps to trigger singing, or the TV remote that calls out polo when it hears marco.[61] The self-observation, regulation and control, take on and moral, physical, emotional, and consumption monitoring and regulation in such forms as: a wallet that recognized words and dispensed consumption regulation advice;[62] a pocket device that recognizes "now what am I supposed to do?" and responds "with a gentle reminder to adhere to the users selected ethical set"[63] (regulation of consumption); coffee maker that recognizes "good morning", "when you respond the chip analyzes your tone of voice" [for sluggishness].... "adjusts the "strength of the coffee... " (automating the physical regulation on which Starbucks has successfully capitalized); or the more extreme circumvention of your own self judgment, in monitoring bloodflow and detecting stress the "device whispers "relax", dims the lights a bit, and releases soothing aromatherapy";[64] or the very opposite of an alarm clock which would be a device that on hearing "why am I still up?" "should cause every light and entertainment system in my house to shut off for four hours." An example of the self-observation, was a voice triggered "nocturnologue"[65] which would record any sleeptalking. These devices to regulate the self, toward social synchronization presumably, do not necessarily imagine the devices as "companion" and attribute it a more social performance, although there is a small subset that do. This subset of entries realize the "technology-should-be-more-human-like" expectation, that reflects a similar school of Human Computer Interface (HCI) designers working towards adaptive interfaces, that can recognize and respond to different emotive state[66] as an explicit strategy to be "user-friendly." The best example is a comedic sidekick (Jerry Lewis), ready with smart rejoinders on recognizing phrases and built into the watch[67] (when it hears "nice hair," the device says "cha cha cha"). This functionality would have to be described as reinforcing social performance.[68] This seems both similar to other identification relationships (cars, furniture, home) and different insomuch as it is directly inserted into the conversation.

The promise of emotive interfaces to recognize and respond to how you are feeling,[69] if these imagined interfaces are any evidence, was demonstrated and expressed in words that describe an ambivalence, even resentment, of technological relationships: for example being able to say "shut up" to your television set[70] or to your telephone[71] (not "turn off," not "close/finish" or other ending command). Clearly, this complicates the sort of understanding we can develop about a persons relationship to a product from the purchase of it. And this is of course the predominant form of "feedback" that companies and designers get about products. These voices make audible a strongly polarized ambivalence. There was no suggestion of saying "I love my TV" to turn it on, that is otherwise invisible.

Another device was proposed for automated prayers, triggered by saying "pray for me," it is customizable to different religious "preferences,"[72] took this further. Prayers suggested included excerpts from Psalm 23 to "Cynical hipster types [who] might want their in-dash prayer boxes to recite William S. Burroughs Thanksgiving Prayer (Thanks for Indians, to provide a modicum of challenge and danger... thanks for a nation of finks... etc.) and some guilty white liberals (some Viridians, even) might want theirs to apologize for driving around in a vehicle spewing noxious fumes into the atmosphere."[73] This is more than an interface to recognize and respond appropriately to user emotional states; actually the entertainment is in delegating the emotionality or at least religiosity itself to the device. This impulse is replicated in the delegation of care, social niceties and other arational and non-calculative tasks to the computational devices. For instance, a speech recognition chip that recognizes the sound of flatulence and politely apologizes to the room,[74] relieving the responsibility of any one person to bear the embarrassment; another entry, as an extension of Tamagachi-like automation care, suggested using a voice recognition chip to train the parrot to speak.[75] There were actually several other entries exploring information technology for animals which seems to be evidence against a voice interface imagined as "humanizing" the computer, and more a demonstration that the ready treatment of animal noises as recognizable sounds imagines these as functionally equivalent in every way to English words. Speech recognition, reinterpreted as sound recognition.

Finally, and perhaps the most interesting or novel constellation of projects, are the designs that use the opportunity to script interactions as a form of propaganda, propaganda that is distributed (enacted) beyond traditional and corporate monopolized media channels. The portable idealogue was suggested to play the role (and potentially look like) the soapbox.[76] The BackTalk is a portable billboard for one's car. It is triggered by the use of simple trigger words and suggested deep set LEDs to display specifically to the driver behind a message of "thanks for letting me in," "baby on board," or presumably any other bumper sticker expression. This is intended to influence others and begins to populate this category of the regulation (or at least influencing) of others. This has very direct and explicit forms: many in fact directed at those currently not well socialized cell phones, which, for example, cut out if they hear you say "yeah, I am on the cell phone," "yeah, I am in the village," "Dude"[77];or monitor for swear words[78] and other efforts to silence loud or otherwise "inappropriately" private voices in public spaces; to quite many suggestions directed at rendering massified phenomena. This social observation impulse is illustrated by an entry that is a museum display designed to collect responses (what the entry called clichés) so that "will grow as an open ended accretion or demonstration of the clichés uttered by thousands, tens of thousands, millions of art consumers", and that this collection itself is the spectacle. The museum exhibit is rethought as an instrument for the collection of comments and the desire is to see the massified phenomena. This is the desire for seeing a social spectacle that is repeated often and I would like to argue is a recurrent theme in the networked context of information technology. Another suggestion was the "crowd morality barnacle" which is a device intended to influence mass behavior, in this example in a riot. This CMD is intended for distribution throughout a crowd and will respond to key riot phrases, e.g. "smash," with "be careful," "burn" with "it might explode"; or "get them" with "where are the children."[79] This is a different conception of regulation than the examples that illustrated the control of self. To effect self control the designs went beyond turning electronic devices off or regulating the self with insistent and unrelenting reminders, e.g. correcting a habit of speech or cutting the "umms" out of the story, to quite novel punishment. These punitives enacted on the self included squirting water in your ear, triggering electric shocks, dribbling water down ones leg. There were few viable designs that offered a simple reward rather than punishment. To effect the social body, while there were no physical punitives, the reward seems to have been the social behavior itself, or at least the evidence of it (as in the spectacle of clichés).

The final category to describe is one that relies on the double entendre of words, simultaneously using several meanings of the words. This was explored by some of the entrants and is important to understand that it demonstrates that the speech interface cannot be understood as making the machine more human. Rather, it is clearly exploiting the different parsing, context sensitivity and repeatability of human vs machine models of cognition. For example, to trigger the discrete recording of conversations one entry describes a recorder that is triggered by "what's up amigo." This deployment of an unusual (relative to the user and context of use - i.e. no one else is likely to say it) filler is used to initiate conversation and direct attention of the people being addressed but simultaneously being used for instrumental purposes as the on button. Likewise the "don't hurt me, just don't hurt me" cellphone/gps position locator/911 dialer proposal[80] uses a self defense phrase to dial for help without alerting the presumed attacker, who is presumed to hear the plea on face value – second guessing a reasonable or usual response in a threatening situation. The interaction here is the user being able to employ simultaneous meanings of the words they use. And that clearly the speech chip is being used so that the words used to interact with the machine, are understood to be different from the speech used to interact with humans.

It is also notable that there were categories of speech not explored by these interfaces. Consider the linguistic communication defined as a performative. A performative, such as "I do," is a highly codified and stabilized utterance that communicates a future commitment or social contract.[81] Because it is a stabilized social technique it would be technically pragmatic, the problem of unlimited variation of phrasing is solved, were not subject for speech recognition chips. The absence of designs to address this sort of statement is curious, and worth further investigation.

These categories of interaction demonstrated by this brief survey of voice chips are not discontinuous or radically different from other contemporary consumer technologies. The observation of self (or ones own property) is embodied in the consumer video camera market, and surveillance systems; self regulation has extended from alarm clocks once a day to alarming cell phones carried with you and ready for all alarming occasions; handhelds directly regulating sleep and activity, to vcr/tivo to capture, regulate (in order to extend) and meter out media program consumption; social observation is also embodied by surveillance systems but although surveillance looms large in the popular imagination it has not been used to see or envision the mass or each other. The problem of seeing the social body has remained an architectural problem, solved by spectacles of plaza, and malls — public and quasi-public places. What the voice chips most clearly demonstrate is that it is this area in which there seems to be the most interest — literally being able to see the massified behavior. The traditional broadcast (e.g. television) media had very little interest in rendering the public to itself, and as such the rise of phone in, and reality television genres suggest that even in the context of high-production value broadcast media there is a cultural appetite to "see" each other, no matter how contrived. The collaborative filtering models, such as popularized by the Amazon people-who-bought-this-book button show each others behavior, to make it the shared experience— to see where others have been. Like the micro-casting of speech

recognition triggered rear window car display, we see this desire expressed through the car — and the cars peculiar access to the public space of freeways. This is a public space where the rules of communication between and amongst people are highly constrained (cf: plaza). This is not the interactive experience of the self with the self, or the self with the machine, but the machine as a proxy for interacting with the social. This is a peculiar and interesting way to think about human machine interaction.

Conclusion

The interactions we hear with the voice chips do not disambiguate the buzzes and beeps used by speechless machines, but the speech recognition products do reinforce that we use speech for machines and speech for humans differently, and simultaneously. The other applications also re-imagine how we understand their functions. The products discussed do not exploit the mechanistic, logical and fully controllable functions of machines but treats them as complicated multifarious social actors. There is a clearly stated desire to enlist these new technologies and product interfaces to promote explicit desired social transformations. We also here the ambivalent relationship we have with and for our current technological devices.

This paper has explored why listening to voice chips and speech recognition chips might give us a way to examine human machine interaction in situ. Much real complexity of social and technical interactions is lost in the tradition of examining this within controlled laboratory context, and ethnographic analysis can be too rich. However the theoretical perspective that has developed from the ethnographic insights, that privileges the improvisational nature of real world applications, enable us to focus on how speech and turn taking is used to coordination of the interaction between machines and humans.

This initial analysis is presented in order to set up some the preliminary ideas and interpretation, so that as (if) the speech recognition chips become more widely distributed we can tune-in to this particular historical moment and hear what it is we expect, want and bring to our human machine interaction. There are few instruments that give us this viewpoint. Listening to our daily interactions with products can work to contest and complicate the dominant methods used to describe technological trends and patterns of product innovation: demographically driven and massified market research and the capture of consumption behaviors at point of purchase. The examination of the speech recognition applications give unique access to the assumptions, expectations and the imaginative work of products and the interactions they script.

Further examinations of voice chip and speech recognition products and patents can extend what has only begun. Firstly, in understanding how voice chips abstract speech we can examine what we understand interaction to be and hence how we design and frame interactions in products of daily use, reproducing our understanding of human technical relations. The products make obvious the design assumptions with which they are built, but further investigation of the details of their use will help to elaborate how these micro-interactions perform and realize actual social roles and social structures. A detailed use analysis of any one of the products can provide further insight into this sort of investigation. The voice chips raise other questions too. Because they slice through many social and economic sectors but are still a manageable population of products, they can be used to illustrate the iterative and continuous process of technical change that is intimately involved in a technologies sociality, in contrast to the radical discontinuities of technological change through discovery and paradigm shifts.[82] They realize a recombinant model of technological change. Furthermore, for the same reasons they can be used to examine the changing social position of these products in relation to the configuration of power and work relations,[83] and the transformations of the market groups and users that these products presume. Finally, in the tradition of Turkles examination of children understanding of their interactive machines, childrens products with voice chips can illustrate what child care roles we delegate to machines, and articulate clearly the hard-wired (per hardware not neurons) expression of consumption identity of children. For these reasons this paper marks the beginning of a project to collect an ongoing database of products with voices or speech recognition that appear on the market, or receive patents.[84] As a longer archive of product voices may prove a valuable resource for the examination of changing socio technical relations, even in the event of the products falling silent and voice chips and speech recognition being abandoned altogether.

The voices of the products reflect back the voices and interactions we have projected and programmed into them, reflecting them back for our reinterpretation. Therefore, as the title of this paper suggests, a mode of interaction we have with the consumer products that exist and are imagined at the time of this paper, is a dialogue with a monologue. By literally listening to what hardware has to say, and what we say to it, we may better ground our assumptions of interaction in reflexive reinterpretation. Furthermore, we can see from this examination that scripts of human machine interactions are used to extend the predictability of individuals and coordinate their interactions, but that there is an opportunity and expectation that this gives us a method to hear and understand these massified interactions, and see these technologies as voice and ears of the social body.

References

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2. While most communication theorists account for the social world, building a framework for understanding communication is often at odds with accounting for the diversity of possible experiences of language and the modulation of each social position. Austins work that looks at not how a language is composed but what it does, from where it does it. See Austin, J. (1980). *How to do things with words*. Oxford: Oxford University Press; or Volosinov, V. (1973). *Marxism and the philosophy of language.* New York: Seminar Press.
3. Quoted from the North American Patent literature.
4. Pacific Bell voice mail system 1996, 1997, and AT&T automated customer help.
5. Benveniste, E. *The nature of pronouns problems* (1956) showed how linguistic categories not only allow human subjects to refer to themselves but actually create the parameters of human self-consciousness. " Ego is he who says ego. That is where we see the foundation of subjectivity which is determined by the linguistic status of person. Consciousness of self is only possible if it is experienced by contrast. I use I only when I am speaking to someone who will be a you in my address." p. 225 The linguistic category such as "I" relies wholly on the identity of the speaker for its meaning.
6. Latour, B. and J. Johnson. (1988). *Mixing humans and nonhumans together: The sociology of the door-closer, social problems*, Vol. 35, 298-310; Callon, M. *Four models for the cynamics of science*. In Sheila Jasanoff, Gerald E. Markle, James C. Petersen and Trevor Pinch (eds). (1995). *Handbook of science and technology studies*. Thousand Oaks, CA, London & New Dehli: Sage Publications, 29-63.
7. Callon, M. and J. Law. (1982). On interests and their transformations: Enrollment and counter-enrollment. *Social Studies of Science*, Vol 12, 615-25.
8. Latour published the book *Science in action* (Cambridge, MA: Harvard University Press, 1987) in 1987, while in Dallas, June 11 1978, Texas Instruments Incorporated announced the launch of its speech synthesis monolithic integrated circuit in the new talking learning aid, SPEAK &SPELL(tm). The speech synthesizer IC accurately reproduced human speech from stored (a capacity of 200 seconds in dynamic ROM) or transmitted digital data, in a chip fabricated using the same process as that of the TI calculator MOS ICs.
9. See M. Patons forthcoming Social Studies of Science paper for a detailed examination of the initial construction of the virtues and values of the phonograph recording technology.
10. Minneman, S. (1991). *The social construction of engineering reality*. (PhD dissertation, Stanford University.
11. Hallmark card first included voice chips in their cards in 1988. Five years later they introduced a recordable card on which you could record your own voice.
12. Nissan Maxima 1986.
13. Barbie said three things when she was given a voice in late 1980s: "Meet me at the Mall," "Math is Hard," and "I like school, don't you?"
14. Machina R , a San Francisco based company, had on the market in 1997 several talking pens or "Pencorders," talking keyring, several talking photoframes and many "Cardcorders," including "Autonotes."
15. Saccahrin is claimed to be the first product to be parasite marketed, i.e. "this product uses saccharin."
16. Turkle, S. (1984). *The second self*. New York: Simon and Schuster, 31.
17. A complete list of the collected products and patents is attach in the appendix. A full list is available at http://cdr.stanford.edu/~njj/vcprods. This is being updated constantly.
18. Patent # 4863385 Sept 5 1989.
19. Patent # 5313557 May 17 1994.
20. Patent # 5014301 May 7 1991.
21. Patent # 4812968 Mar 14 1989.
22. Patent # 4951032 Aug 21 1990.
23. Patent # 4863385 Sept 5 1989.
24. Patent # 5315285 May 24 1994.
25. Patent # 4987402 Jan 22 1991.
26. Patent # 5117217 May 26 1992.
27. Patent # 5254805 Oct 19 1993.
28. Patent # 5275285 Jan 4 1994.
29. Patent # 5481904 Jan 9 1996.
30. Patent # 5555286 Sept 10 1996.
31. Turkle op. cit. note 16 demonstrates how children enter into social relationships with their computers and computer games in which they thinking of it as alive and get competitive, angry, they scold it, and even want revenge on it. She finds that they respond to the rationality of the computer by valuing in themselves what is most unlike it. That is, she raises the concern that they define themselves in opposition to the computer, dichotomizing their feeling and their thinking.
32. Patent # 5413516 May 9 1995.
33. Patent # 5029214 July 2 1991.
34. Work and the products of work can be shown to take on meaning that transcend their use value in commodity capitalism see Willis, S. (1991). *Primer for daily life*. New York: Routledge.
35. Patent # 5140632 Aug 18 1992. Telephone having voice capability adapter.
36. Shields, R. ed. (1992). *Lifestyle shopping: The subject of consumption*. New York: Routledge.
37. Within the patent literature what appeared in relation to transportation were: 5555286 Cellular phone based automatic emergency vessel/vehicle location system: translates a verbal rendition of latitude and longitude to cell phone; 5509853 Automobile interior ventilator with voice activation: which queries the driver when door closes and gives menu options; 5508685 vehicle and device adapted to revive a fatigued driver: a voice reminder combined with spray device; 5428512 Sidelighting arrangement and method: voice warning of impending obstacle; 5045838 Method and system for protecting automotive appliances against theft; 5278763 Navigation Aids(presumably for application in transportation); 4491290 Train defect detecting and annunciation system.
38. See *The New York Times* discussion.
39. This is in contrast to the popular depiction of cars with voices on mainstream television, in programs such as "My Mama was a Car" or "Night Rider" on CBS, the voice was used to lend the car personality.
40. Zuboff, S. (1984). In the age of the smart machine: *The future of work and power*. New York: Basic Books. In particular, see The abstraction of industrial work, 58.
41. See Fabbri, F. (1981). A theory of musical genres: Two applications. In *Popular music perspectives*, eds. David Horn and Phillip Tagg. Gothenburg and Exter: International Association for the Study of Popular Music.
42. See Oswald, L. (1996). The place and space of consumption in a material world. *Design issues*, Vol. 12 (1), who describes the site for purchasing product as the staging of the subject in consumer culture.
43. Stockfelt supports her work with Tagg and Clarida studies on listeners responses to film and television title themes that demonstrate common competence of adequately understanding and contextually placing different musical structures. That listeners for the most part understand the musical semiotic content in such situations in similar ways, across cultural areas that are more dissimilar.See also Tagg, P. (1979) Kojak, *50 seconds of television music: Toward the analysis of affect in popular music*.
44. The symphony of the "Sirens" first performed in 1923, Arseni Avraamov.
45. In particular, the products that use speech and music interchangeably: the childrens applications, bells and whistles substitute for spoken encouragement, or the alarm systems that will use vocal warnings or sirens sounds, the pen patent #4812068.
46. To relate the voice chip to the socio-linguistic universe and its emphasis on the place of language within it, interprets the social system as a semiotic, and stresses the systematic aspects of it. We cannot simply assume that the concept of a system itself and the concept of function (of language) within that system is the most appropriate starting point. However this assumption underlies most of the guidelines developed for computational models of speech is thus appropriate for discussion of the voice chip.

47 Austin, J.L. (1980). *How to do things with words*. Oxford: Oxford University Press. The general point of which was not to look at how language is composed but what it does.
48 Searle uses this list to introduce his paper: Searle, J. (1972). What is a speech act? In P.P. Giglioli ed. *Language and social context*. Harmondworth: Penguin.
49 Stanley Fishs essay How to do things with austin and searle. In *Is there a text in this class? The Authority of Interpretative Communities*. Cambridge, MA: Harvard University Press, 1980, 244 analyses Coriolanus as a speech-act play. When Coriolanus responds to his banishment from Rome by stating a defiant "I banish you" the discrepancy in the illocutionary force in both the performatives of banishment is obvious. Rome, embodying the power of the state and community vs. Coriolanus sincere wish to banish Rome, i.e. his intentionality, is illustrative.
50 Broadcast voices and prerecorded voices although abstracted onto technologies still belong to an identity, however it is the combined sense of abstraction that connotes the identity of the voice as that of the car. This could be interpreted alternatively as an abstracted voice of authority performed by the car or the abstraction of the car itself.
51 "If certain stable forms appear to emerge or recur in talk, they should be understood as an orderliness wrested by the participants from interactional contingency, rather than as automatic products of standardized plans. Form, one might say, is also the distillate of action and interaction, not only its blueprint. If that is so m then the description of forms of behavior, forms of discourse...included, has to include interaction among their constitutive domains, and not just as the stage on which scripts written in the mind are played out," (E. Schegloff). Discourse as an interactional achievement: some uses of "uh huh" and other things that come between sentences. In Georgetown University Round table on language and linguistics: Analyzing discourse text and talk. D.Tannen, ed. (1982). Washington, DC: Georgetown University Press, 73.
52 Patent # 4517412 the card actuated telecommunication network is an example of this. "Local processor 11 controls a voice chip 15 coupled to telephone set 10 which interacts with the caller during the card verification process."
53 L Suchman, L. (1987). *Plans and situated action: The problem of human machine communication*. Cambridge: Cambridge University Press. Suchman explains that this interpolation of verbal nuances and the coherence that the structure represents is actually achieved moment by moment, as a local, collaboratively, sequential accomplishment. The actual enactment of the interaction is an essentially local production, accomplished collaboratively in real time rather than born whole out of the speakers intent of cognitive plan, 68-98.
54 Ibid.,81, 125. Suchman uses the example of the joint production of a single sentence to demonstrate the fluid division of labor in speaking. and listening.
55 Ibid., 78
56 Ibid., 83.
57 product innovation for corporate continuity — assessing the life expectancy of corporate products.
58 A longer analysis in Jeremijenko forthcoming.
59 A.M.Dixon@shu.ac.uk MikeyMoneyMinder.
60 Ibid.
61 zoeluna@bellsouth.net.
62 Ibid.
63 Ibid.
64 Afrench@iss.net (Andre French).
65 nocturnologue.
66 mit emotive interaces again - brooks; this is in contrast to the Shneiderman et al work that argues that this works against control.
67 Wristwatch sidekick.
68 This is a version of the gestural value of handheld and portable devices identified and described in a study involving the ethnographic examination of filmic depictions of the use of handhelds. Jeremijenko (1992) XEROX PARC internal publication.
69 For example – MIT media lab – emotive recognizing facial expression.
70 vbar@comp.cz (Vaclav Barta).
71 butler@comp-lib.org (Michael Butler).
72 The peculiarity of referring to a religious preference as if it were another consumption category – that religious and addictive behavior is subject to the same economic characterization....?
73 jon@lasser.org (J. Lasser).
74 butler@comp-lib.org (Michael M. Butler).
75 wapel@tc.cac.edu.eg.
76 xiane@entech.com.
77 spiff@bway.net.
78 monitoring for swear words.
79 zoeluna@bellsouth.net (Dave Whitlock).
80 zoeluna@bellsouth.net.
81 see Judith Bulter (1996).
82 Dosi, G. (1985). *Technological paradigms and technological trajectories research policy* 11 :1982) 147-162; and Clark, K. The Interaction of design hierarchies and market concepts in technological cvolution. In *Research policy* 14, 235-251.
83 See for instance Zuboff op. cit. note 40.
84 This list is available at cat.nyu.edu/neologues and is being updated constantly. It includes images and product literature and when possible an audio file recording of the voices.

Metaphoric Networks in "Lexia to Perplexia"

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As leading theorists and practitioners such as Marvin Minsky, Daniel Hillis and Brian Antwell Smith have been telling us, computers are much more than hardware and software.[2] In their most general form, computers are environments of varying scope, from objects that sit on desktops to networks spanning the globe. Indeed, in Edward Fredkin's interpretation, computational processes ultimately generate the fabric of the universe.[3] It comes as no surprise, then, to find researchers arguing that computation is fundamentally altering the ways in which humans conceive of themselves and their relations to others. There are of course many approaches to this issue, from sociological studies to human factor analysis. Among these approaches are artistic works that tell new stories about the formation of human subjects, instantiating these stories in images as well as words. To explore this systemic shift, I will take as my tutor text Talan Memmott's "Lexia to Perplexia."[4] In this complexly coded work, human subjectivity is depicted as intimately entwined with computer technologies.

Memmott's work reveals the co-originary status of subjectivity and electronic technologies. Instead of technologies being created by humans, this work imagines digital technology as present from the beginning, with subjects and technologies producing each other through multiple recursive loops. To develop this idea, Memmott devises an idiosyncratic language, a revisioning of classical myths, and a set of coded images that invite the reader to understand herself not as a pre-existing self with secure boundaries but as a permeable membrane through which information flows. Three principal strategies enact this transformation. The first category is linguistic. Rather than writing standard English, Memmott devises a wide range of neologisms — coinages made from existing words that express new syntheses. In addition, he also creates a creole discourse (a creole is a new language that arises when two different language communities come into contact) showing code erupting through the surface of the screenic text, infecting English with programming languages. The second category of strategies is mythic. Drawing on a range of classical materials from the story of Echo and Narcissus to Minoan funeral practices, Memmott rewrites this material to make it enact narratives about how human subjects misunderstand themselves as autonomous agents when in fact they cannot be separated from the information technologies that, more than expressing them, co-create them. Finally, Memmott develops a symbolic visual language that images the interactions and structures leading to the "cyborganization" of human subjects and resulting in mutations that fundamentally alter what counts as human.

One way to bring these issues into focus is to notice at what points the screen displays cease to be legible as readable texts. These occluded representations create visual images that mark the limits of what human perception can discern (Figure 1). Illegible texts hint at origins too remote for us to access and interfaces transforming too rapidly for us to grasp. The text announces its difference from the human body through this illegibility, reminding us that the computer is also a writer, and moreover a writer whose operations we cannot wholly grasp in all their semiotic complexity. Illegibility is not simply a lack of meaning, then, but a signifier of distributed cognitive processes that construct reading as an active production of a cybernetic circuit and not merely an internal activity of the human mind.[5] When "Lexia to Perplexia" hovers at the border of legibility, it hints that our bodies are also undergoing metamorphoses. What we read when we cannot read is not so much the disjunction between ourselves and the computer (for it is always possible to access the underlying code and hack our way into a readable version of the non-readable text). Rather, the occluded display signifies a trajectory in which we become part of a cybernetic circuit. Interpolated into the circuit, we metamorphose from the individual interiorized subjectivities to actors exercising agency within the extended cognitive systems that include non-human actors. In this broader context, illegible text reminds us of the changes our bodies are undergoing as they are remapped and reinterpreted by intelligent machines working within networks that bind together our flesh with their electronic materiality. In this posthuman conjunction, bodies of texts and bodies of subjects evolve together in complex configurations that carry along the past even as they arc toward an open and unknown future.

Typical is the opening screen locating the origin of the self in a specular play with an Other: "The inconstancy of location is transparent to the I-terminal as its focus is at the screen rather than the origin of the image. It is the illusory object at the screen that is of interest to the human enactor of the process – the ideo satisfractile nature of the FACE, an inverted face like the inside of a mask, from the inside out of the screen is the same <HEAD>{FACE}<BODY>, <BODY>FACE>/BODY rendered now as sup/posed other."

Read as html, <HEAD>{FACE}<BODY> has two opening tags but no closing tags, which would indicate that FACE is part of HEAD but is not included in BODY. A different interpretation is suggested by <BODY>FACE</BODY>, which indicates that FACE is tagged as being the BODY. These puns make a serious point, for they allude to the mind/body split in which the face, the most intensely signifying part of the human form, is alternatively tagged as separate from the body and part of it.

Parsing body parts as textual components initiates a connection between flesh and electronic materiality that is further underscored by the electronic signature "Sign.mud.Fraud." Inserting the dot references its use in program names to delimit a file extension. The dot also divides the name so it functions both as an allusion to Freud (Fraud), announcing its ironic appropriation of this seminal thinker, and also punctuating (or as one of Memmott's neologism would have it, "puncturating") the signature so it performs what "cyborganization" implies by

transforming a proper name into creolized sign. This performance of hybridity is further reinforced by the passage's content, where the self is generated through a reflection on the inside of the screen, as if in "the inside of a mask." This specular dynamic generates the subject as an "I-terminal," an expression that conflates the self with the screen and recalls Scott Bukatman's punning phrase "terminal identity."[6]

A note about creole. Typically first-generation speakers who encounter another language community develop a pidgin, which is not a true language but an amalgam using a reduced vocabulary and simplified verb forms to communicate. By the second and third generations, a creole generally emerges. Unlike pidgin, a creole has its own syntax, verb forms, and vocabulary, thus qualifying as a language in itself, uniquely different from the two communicating languages of which it is a hybrid. "Lexia to Perplexia" can be seen as moving toward a creole devised from the merging of English with programming code. Creole expressions include cell...f, a homophone for self that conflates identity with a pixilated cell and the notation for a mathematical function; inTents, a pun that collapses intensity into intentionality and also references the programming practice of using interior capitalization to make clearly visible two functions in a variable name that allows no spaces; exe.stream, another pun that references and inverts the usual use of the exe.extension to denote an executable program; and *.fect, a neologism that alludes to the programming practice of using * as a wild card, so *.fect could be read as infect, defect, disinfect, etc.

To what purpose is this creole concocted? Compounded of language and code, it forms the medium through which the (Imaginary) origin of subjectivity can be re-described as co-extensive with the technology. Just as this language does not exist apart from its penetration by code, so the subject does not exist apart from the technology that produces it and that it also produces. Appropriately, the creole writes itself as a re-visioning of the myth of Echo and Narcissus—Narcissus who mistakes himself for an Other through the mediation of a reflective surface, here figured as the inside/outside of a screen, and Echo who reacts to her exclusion from this specular circuit by losing her flesh and becoming only a mediated repetition of what others say, here figured as a collapse in an electronic environment of the original into the simulation, so that there is no longer an ontological distinction between "real" and "artificial" life. The creolization of the myth appears as follows:

> From out of NO.where, Echo appears in the private space of Narcissus.tmp to form a solipstatic community (of 1,ON) with n.tmp, at the surface. The two machines—the originating and the simulative—collapse and collate to form terminal-I, a cell.f, or, cell...(f) that processes the self as outside of itself, in realtime.

This narrative process, which (re)describes the self as the terminal-I, extends from "local" to "remote" bodies. "The bi.narrative exe.change between remote and local bodies is con.gress and compressed into the space between the physical screen and the Oculus of terminal-I." As a result, the progression into the "solipstatic original" is countered by the "cyborganization of any/every para.I-terminal," so that the individual is subsumed into the "greater X-terminal" formed by "component I-terminals." Thus human community becomes indistinguishable from the global network of the World Wide Web. "The completion of this circuit is an applied communification—synamatic programs and values shared by… other applications and detached machines." "Synamatic," a homophone for cinematic, perhaps alludes the Symantic (semantic) Corporation, creator of the Norton Anti-Virus and Norton Utilities, in a conflation that implies computer health is integral to the reproduction of screen image and therefore to subjectivity. "Communification," which can be read as a neologism conflating commodification and communication, arises when the circuit is completed, that is when humans and intelligent machines are interconnected in a network whose reach is reinforced by naming the few exceptions "detached" machines.

The graphics accompanying these texts include terminals, eyes, E.C.H.O. dispersed across underlying text, and animated rollovers that appear in quick succession, sometimes occluding portions of the texts. Particularly significant is the image of double funnels with the small ends facing each other (see Figure 2), a sign that Memmott associates with "intertimacy," the process by which two selves (cell...fs) meet in the computer "apparatus" and, through their interactions with the apparatus, reconstitute from bits and bytes an impression of an other. Seen from one perspective, Memmott points out, the cone with an elongated end is a funnel condensing the cell....f so it can circulate through the network; seen in mirror inversion, the cone becomes a megaphone, an amplifying device that lets the receiving cell...f construct an image of the sending cell...f. As this icon illustrates, made explicit in the companion work "Delimited Meshings: A White Paper",[7] "Lexia to Perplexia" as a whole must be considered not only as text but as what W. T. J. Mitchell in Picture Theory has called textimage, a fusion of text and graphic into signifiers that function simultaneously as verbal signifiers and visual images.[8] Memmott, who came to graphic design from a background as a painter, notes that "much of the writing is integrated with the screen design.

In addition to this, much of what was written prior to the development of the hypermedia work has in fact been incorporated into the functionality of the work. Portions of the text that I thought may be better served as screen interactions do not appear at the superficial text level but inspired some of the animations as actions that occur in the piece."[9] One of the primary effects of the animation is to render the text verbally and visually unstable, so that it is often difficult to finish reading a block of text before it is partially obscured by an animation that covers it over with images or other texts. This dense layering of the screen display, insofar as it interferes with reading, manifests itself as a kind of noise that is simultaneously a message.[10] A subtle implication of the screen design is conveyed through the linking structure, which works not by conveying the reader from lexia to lexia — the standard form used by first-generation literary hypertexts such as Michael Joyce's "Afternoon"— but rather through rollovers that reveal new layers of text and image as the cursor moves over the screen. Thus the action of choosing that first-generation hypertext theory attributed solely to the reader here becomes a distributed function enacted partly by the reader but also partly by the machine. Memmott interprets this design in *Delimited meshings: agency\appliance\apparatus* as creating "a text that does what it says-confronting the user as it mimes the User's actions."[11] The co-creation of subjectivity is thus at once a theme within the work and a performance jointly produced by the computer and the user. Additional implications underlying the frenetic transformations enacted by the rollovers are hinted at in the screen displaying five "minifestos." The first reads in part, "Bi.narrative communification is rendered in the wreck, the mess in the middle, the collision of incompatible transmissions, arising from the eroded ruins of miscommunication."

Recalling the phrase that circulated through the post-World War II Macy Conferences on Cybernetics of the "man in the middle" (i.e., between two automated cybernetic machines), the "mess in the middle" promises to self-organize into a new kind of message, a revolutionary arising caused by subversive "Secret(e) agents" who "produce narrative singularities throughout the apparatus." The "apparatus" here names not only the technology but also the interpolated subjects who have become indistinguishable from electronic messages. "The earth's own active crust we are," the second "Minifesto" proclaims, "building—up and out—antennae, towers to tele.*. We *.fect the atmosphere as we move through it, striving toward communification. Our hyperlobal expectations sp.read knowledge into no.ledge, far, wide, thin… I cannot contain myself and so I spread out–pan–send out signals, smoke and otherwise, waiting for Echo. Waiting for logos to give me a sine." "Hyperlobal" neatly sutures lobes—presumably of the brain—into the hyperglobal expectations of a world wide communication system, creating a techno-human hybrid. A similar conflation resonates in logos as a mathematical (sine) function and a word capable of signification (sign).

The creole thus performs what it describes, creating a narrative that reaches back to an origin already infected (or *.fected) with technology from the beginning and arcs forward into a future dominated by "communification." As we learn to make sense of the creole, we are presented with an ironic description of our attempts to make everything "crystal clear and susynchronized," to reduce its polyvocality so that the "passage of meaning through the bi-narrative conduit is smooth, without catches or serration and the doubled trans/missive agent(s) never meet, combat, or challenge. The combined inTents perform as components of a single ideocratic device, de.signing, de.veloping, and exe.cuting the mechanism that permits their passage." At times the "doubled trans/missive agent(s)" of code and language cooperate to yield a consistent meaning, as in the neologism "hyperlobal." But these moments of clarity are embedded in screen designs where they are transitory at best, flashing on the screen in quick bursts broken by animated graphics that intervene to obscure text and layer one image over another.

As the transformation of subjectivity into technology, self into cell...f continues, the work imagines flesh becoming digitized into binary signs. "From here, the analog and slippery digits of the real are poured into the mouth of the funnel… Flowing further, the variable body, the abstracted and released continuum of the body is com/pressed, reduced and encoded, codified… made elemental… Now we are small enough, we hope—it is the hope of "communification" that we minimize the space of the flesh." Significantly, there are no intact bodies imaged at the site, only eyes and terminals (I-terminals), along with creolized text, mathematical functions and pseudo-code.

Of course, everything is already code in the programming levels of the computer, so in this sense the human body has already been "reduced and encoded, codified… made elemental." If the body of this text aspires not merely to represent the bodies of writers and readers but also perform them, then they too become code to be compiled in a global dynamic of "communification." In a startling literalization of the idea that we are bound together with the machine, this vision implies that at some point (or many points) our flesh will circulate through the cybernetic circuit, miniaturized so that it can slip through the "mouth of the funnel" and merge with other subjectivities into a collective "we."

Amidst these complexities, what is clearly established is not the superiority of code to flesh but metaphoric networks that map electronic writing onto fluid bodies. "Lexia to Perplexia" intervenes at beginnings and boundaries to tell new stories about how texts and bodies entwine. The shift in the materiality of writing technologies that electronic textuality instantiates is registered on skin as well as screen. To create new kinds of textual bodies is inevitably to write new human bodies, as we continue to produce the technologies that produce us.

Figure 1. Occluded text and layered complexity.

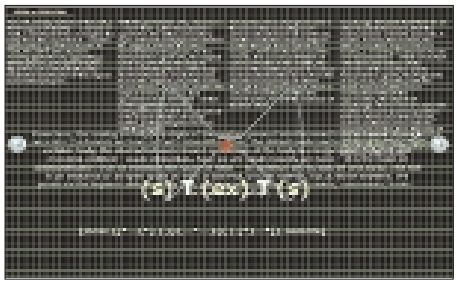

Figure 2. Double funnels and layered text. Note double funnels in center of image, suggestive of self (cell...f) and other meeting in the apparatus.

Endnotes

1. I am grateful to Nicholas Gessler for help with technical details of my analysis, Carol Wald and Michael Fadden for help in researching sources; and Marjorie Luesebrink for consultation and ideas.
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3. Fredkin, E. (1990). Digital mechanics: An information process based on reversible universal cellular automata" *Physica D,* 45 (1990): 254-70.
4. Memmott, T. (2001). Lexia to perplexia: hypermediation/ideoscope. URL: http:www.memmott.org/talan/dac2001/index.html.
5. The effect of cybernetic circuits on narrative patterns is explored in more detail in Chapter 2 of N. Katherine Hayles. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics*. Chicago: University of Chicago Press.
6. Bukatman, S. (1993). *Terminal identity: The virtual subject in postmodern science fiction*. Durham: Duke University Press.
7. Memmott, T. *Delimited meshings*. (2001). URL: www.memmott.org/talan/dac2001/delimited_meshings/meshings/0.html.
8. Mitchell, W. T. J. (1995). *Picture theory: Essays on verbal and visual presentation*. Chicago: University of Chicago Press.
9. Email communication, Talan Memmott, Nov. 14, 2000.
10. Email communication, Talan Memmott, November 14, 2000.
11. Memmott, T. (2001). *Delimited Meshings. agency/appliance/apparatus.* URL: memmott:org/Talan/dac2001/memmott/memmott.html.

notime: Identity and Collaboration

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Abstract
Although communication networks offer the possibility of a distributed community that can collaborate and exchange vital information, there is little time for these collaborations and exchanges to occur. Ironically, the same technology that makes distributed community a possibility and promises to save us time prevents us from actually having time to build community. Distributed presence inevitably moves us towards group consciousness, which shifts our perception of time and even productivity. This essay uses a large collaborative networked art piece, "notime," as an example of how the creative process shifts when working on the networks. The project attempts to rethink the idea of the avatar as a physical representation and compares it to that of energetic bodies carrying information and evolving with the time people devote to participating, onsite and online. "notime" is conceived to raise questions about our perception of time and identity as we extend our personal networks through technology.

Introduction
Against this dream or nightmare of the body as information, what alternatives exist? We can see beyond this dream, I have argued, by attending to the material interfaces and technologies that make disembodiment such a powerful illusion. By adopting a double vision that looks simultaneously at the power of simulation and the materialities that produce it, we can better understand the implications of articulating posthuman constructions together with embodied actualities.[1]

Three qualities are necessary for work on the networks: a need to connect, a willingness to collaborate, and the ability to embrace the fact that the work may change form and be re-appropriated in the process. In other words, this type of work requires letting go of the idea of "control" that we inherited from the cybernetic/industrial approach to computing. As we move into the age of bio-informatics, these systems are clearly not working for the advancement of social consciousness or collective intelligence. Social networking, online or offline, is directly connected to our relationship to time. "notime" is conceived to raise questions about our perception of time and identity as we extend our personal networks through technology. It is designed to address problems most specific to the Western human condition, which seems to be entering a crisis because of its particular stress on productivity and efficiency in structuring time.[2] The very technology that has promised to save us time has overextended us beyond what we are biologically equipped to handle, and there is less and less time to socialize, to think, to be in a space where there is no constructed time related to efficiency and productivity.

Much of time measurement, including the calculation of minutes and seconds, has moved into an abstract realm that is a figment of our collective imaginations. But it is the atomic clock that truly illustrates the height of the rationalistic subdivisions of time. It measures how long it takes an electron to pass from one energy state to another. Since no one is able to see individual atoms, they are measured collectively and statistically. Furthermore, energy levels, even electrons and atoms, are metaphors devised as a way of explaining microscopic behavior of nature. The atomic second became the official world time standard in 1967, dividing time into milli, micro, pico, and femto seconds. This concept of natural oscillation of microscopic matter as a time standard has entered the everyday public life in the form of digital watches and computing.

As we approached the year 2000, The End of the World as We Know It (teowawki) was pronounced on the net. But the millennium-bug paranoia was different from millennial movements in the past. It was a tangible problem hardwired into the very fabric of our society, directly connected to communication networks[3]. Yet in its fatalistic premise, it certainly overlapped with many religious movements, and, ironically, may be what raised our consciousness of connectivity and the complexity of global networks we are all part of. It was disappointing to find that most discussion on the subject largely revolved around bug fixes, remedies, and reports, rather than exploring the meaning of that collective fear. This moment that threatened to create havoc by disconnecting parts of the system made many acutely aware of our interdependency on computer networks. Financial systems and global corporate structures, arguably the most tangibly related to computing networks, were particularly worried because of their inherently shaky foundations. It is well known that most market oscillations are based on purely psychological aspects. There are many instances where the market is thrown off balance in one direction or other by rumors, not fact. Although the fatalistic visions of the millennial bug did not come true, it is quite possible that a collective realization and the resulting fear of being disconnected could have ever so slightly shifted our perception of time and networks. Perhaps because so many predictions now seem silly, the discussion around this phenomenon has been muted. It is, after all, embarrassing when one considers the stories, rumors, and large amount of resources allocated to "fix: this problem in the West. To me, it remained an inspiring moment, particularly when conceptualizing a piece that deals with social networks and time. In fact, the core of the "notime" project is rooted in that "Y2K moment." I wondered how to approach developing a work that prompts questions of our relation to time in connection to technology and points to how fragile our systems are? And the real challenge was to develop a way in which audiences become aware of the fact that one fearful thought, one rumor, one meme[2] can spark a ripple of change in our consciousness.

Physicists Per Bak and Kan Chen wrote a decade ago that systems as large and complicated as the earths crust, the stock market, and the ecosystem are not only impacted by the force of a mighty blow but also a drop of a pin[5]. Large interactive systems perpetually organize themselves to a critical state in which a minor event starts a chain reaction that can lead to a catastrophe.[6] Along with their colleague Chao Tang, they proposed a theory of self-organized criticality: many composite systems naturally evolve to a critical state in which a minor event starts a chain reaction that can affect a number of elements in the system. Chain reactions are an integral part of a dynamic system. Y2K, then, was a symptom of such a reaction, and it was directly

related to computing and time. It was a meme. Memes, as coined by Dawkins, are ideas that are passed on from one human generation to another. They are the cultural equivalent of a gene, the basic element of biological inheritance. They are contagious ideas that replicate like a virus, passed on from mind to mind. Meme is the root word of "memetics," a field of study that postulates that the meme is the basic unit of cultural evolution. Memes function the same way genes and viruses do, propagating through communication networks and face-to-face contact between people. A meme is a cognitive or behavioral pattern that can be transmitted from one individual to another one. Since the individual who transmitted the meme will continue to carry it, the transmission can be interpreted as a replication: a copy of the meme is made in the memory of another individual, making him or her into a carrier of the meme. This process of self-reproduction, spreading over a growing group of individuals, defines the meme as a replicator, similar in that respect to the gene.

Biological Time

"Life," materialized as information and signified by the gene, displaces "Nature," pre-eminently embodied and signified by the old-fashioned organisms. From the point of view of the gene, a self-replicating auto-generator, "the whole is not the sum of its parts, [but] the parts summarise the whole"[7].

In 1944, Erwin Schrödinger (1887-1961), an Austrian physicist who developed wave mechanics[8] and received a Nobel prize as a result, wrote a short book entitled *What is Life?* In that book, Schrödinger advanced a hypothesis about the molecular structure of genes, stimulating biologists to think about genetics in novel ways and ultimately opening a new frontier of science known as molecular biology. This new field has played a key role in unravelling our genetic code, ushering us into an age where we began perceiving our own physical architecture as "information." That same year, George R. Stibitz of Bell Telephone laboratories produced the very first general-purpose, relay-operated, digital computer[9]. We are now at the threshold of entering an age of biologically driven computers and can only anticipate that this will entail an enormous paradigm shift from industrial-based digital mechanics to ubiquitous computing that could become true extensions of our bodies. But we are also inheriting a technology that is dangerously repeating the Western notions of separation of mind and body, often privileging information over flesh.

Alan Turing's classic paper "Computer Machinery and Intelligence," in which he proposed the famous "imitation game," marked the beginning of many experiments that blur flesh and machine. Katherine Hayles called this an inaugural moment of the computer age when "the erasure of embodiment is performed so that intelligence becomes property of the formal manipulation of symbols rather than enaction of the human life world"[10]. That same year, Norbert Wiener envisioned a day when a human being could be telegraphically transported[11]. Forty years later, Hans Moravec proposed that machines become repositories for human consciousness. And Stelarc, a performance artist who had been exploring the boundaries of his body since the late 1960s, moved seamlessly into experimentation with the Internet. Stelarc's artistic strategy revolved around the idea of "enhancing the body" in both physical and technical ways. His work encompassed polar opposites: the "primal desire" to defeat the force of gravity using primitive rituals and hi-tech technologies like the third arm. Stelarc makes radical statements, such as "the body is obsolete."[12]

In a post-human paradigm, humans are perceived as information, as evidenced by both the Visible Human and Human Genome Projects, or as information-processing entities. In both cases, the "human" is abstracted. If we juxtapose these assumptions with late capitalism moving away from durable product to information, we can easily translate this to the art worlds dematerialization of object. This could be celebrated as a victory of conceptual movements or seen as a dangerous intersection where information about us is being collected, stored, and databased, without the opportunity for us to choose or to know or accept either its worth or its consequences.

The most human-related project dealing with the genome is intricately connected to power of computing. Watson and Crick explicitly described DNA in computer terms as the genetic "code," comparing the egg cell to a computer tape. This school of thought is perpetuated in even more extreme terms by proponents of artificial life such as Chris Langton, who speaks of separating the "informational content" of life from its "material substrate."[13] As Richard Coyne notes: "Information is thought to be the essence of life, as in the DNA code. To record and break the code is to have mastery over life."[14]

Haraway, on the other hand, identifies gene mapping as a particular kind of spatialization. She calls it "corporealization," which she defines as "the interactions of humans and non-humans in the distributed, heterogeneous work processes of technoscience… The work processes result in specific material-semiotic bodies – or natural-technical objects of knowledge and practice – such as cells, genes, organisms, viruses, and ecosystems."[15]. Information topographies are emerging in the biological sciences to map the human body or the genome, and the computer sciences are mapping the information activities on the networks. Turning to biological principles in relation to our social interactions may be the key to a more organic, human way to look at information. For instance, biologists such as Francesco Varela and Lynn Margulis are questioning what relationships our own bodily architecture and our societal organizations have to underlying biological principles. An entire field of consciousness studies is questioning what we know now about neurons in our brain and their relationship to consciousness. In January 1998, Donald E. Ingber[16] published an article in Scientific American in which he makes the extraordinary claim that he has recognized a universal

set of building principles that guide the design of organic structures, from simple carbon compounds to complex cells and tissues. In his article, Ingber states: "identifying and describing the molecular puzzle pieces will do little if we do not understand the rules of their assembly"[17]. For two decades, he discovered and explored the fundamental aspects of self-assembly. For example, in the human body large molecules self-assemble into cellular components known as organelles, which self-assemble into cells, which self-assemble into tissues. Ingber discovered that an astoundingly wide variety of natural systems, including carbon atoms, water molecules, proteins, viruses, cells, tissues, humans, and other living creatures, are constructed by a common form of architecture known as tensegrity.

Tensegrity takes us back to Black Mountain College in 1948, where Buckminster Fuller taught. It was at this innovative college where Fuller met and worked with Kenneth Snelson, now an internationally renowned sculptor, then a young student who came under his spell along with John Cage and many others. Deeply inspired by Fuller, Snelson came up with a prototype employing discontinuous compression, which Fuller later coined tensegrity. Tensegrity (tensional integrity) was at the heart of Fuller's universe. After some time passed, Fuller ceased to credit Snelson for the prototype, causing a deep rift between the two for decades.

Donald Ingber writes: "…in the complex tensegrity structure inside every one of us, bones are the compression struts, and muscles, tendons, and ligaments are the tension-bearing members. At the other end of the scale, proteins and other key molecules in the body also stabilise themselves through the principles of tensegrity"[18]. Using a simple tensegrity model of a cell built with dowels and elastic cords, he shows how tensegrity structures mimic the known behavior of living cells. A tensegrity structure, like that of a living cell, flattens itself and its nucleus when it attaches itself to a rigid surface and retracts into a more spherical shape on a flexible substrate. Understanding the mechanics of cellular structures could lead to new approaches to cancer therapy and tissue repair, and perhaps even to creation of artificial tissue replacements[19].

Ingber talks about Fuller in his article and about the molecule that was named after him, the buckminsterfullerene or the buckyball, and has been well acquainted with the work of Snelson as well as Fuller. In 1983, he wrote a letter to Fuller in which he stated: "The beauty of life is once again that of geometry with spatial constraints as the only unifying principle. It is of interest to note that, as presented in the accompanying paper, cancer may be then viewed as the opposite of life resulting from a breakdown of this geometric hierarchy of synergetic arrangements"[20].

In 1962, when chemist Sir Aaron Klug observed geodesic structuring of viruses and wrote to Fuller telling him of his discovery, Fuller wrote back immediately with the formula for the number of nodes on a shell (10f + 2, varying according to frequency) as confirmation of Klug's hypothesis, and Klug answered that the values were consistent with the virus research[21]. It is important to note that geodesic domes were utilized worldwide 15 years before electron microscopy enabled detection of virus capsids. In 1982, Klug won a Nobel prize for his "structural elucidation of important nucleic acid-protein complexes," and he has been described as a "biological map maker," a Magellan "charting the infinitely complex structures of body's largest molecules"[22].

Whereas cells were regarded as the basic building blocks of living organisms during the 19th century, the attention shifted from cells to molecules toward the middle of the 20th century, when geneticists began to explore the molecular structure of the gene. Biologists were discovering that the characteristics of all living organisms, from bacteria to humans, were encoded in their chromosomes in the same chemical substance and using the same code. After two decades of research, biologists have unravelled the precise details of this code. But while they may know the precise structure of a few genes, they know very little of the ways these genes communicate and cooperate in the development of an organism. Similarly, computer scientists may be well versed in networked technologies but have no idea as to why the Internet exploded as it did: naturally, spontaneously. No one does.

The most common organizational pattern identified in all systems is networking. All living systems are arranged in a network fashion. Since the 1920s, when ecologists began studying food chains, recognition of networks has been essential to many scholars, in different forms. Cyberneticists, in particular, tried to understand the brain as a neural network and to analyze its patterns. The structure of the brain is enormously complex. It contains about 10 billion nerve cells (neurons), which are interlinked in a vast network through 1,000 billion junctions (synapses). The whole brain can be divided into sub-networks that communicate with each other in a network fashion. All this results in intricate patterns of intertwined webs, of networks nesting within larger networks[23].

In parallel to major advances in gene mapping, a growing number of researchers are working on visualizing the network geographies on the Internet, mapping various data use. As the networks continue to expand with unbelievable speed, systems administrators increasingly look more to visual representation of data to give them a quick overview of the local or global network status. Martin Dodge at the Centre for Advanced Spatial Analysis, University College, London, has put together an impressive array of various research efforts to visualise the net.[24]

Network topology maps typically show things such as traffic information flow. But more and more, scholars are recognizing the value of visualizing network topologies for analyzing social, demographic, and political information flow. This is the beginning of mapping our online societies and viewing ourselves as a particular organism, clearly a rich territory for artists working on the networks.

Molecular biology has moved us toward a perception of our physical selves as information, and the genetic decoding of our bodies has further emphasized this tendency. The question is how to humanize the information once again and avoid viewing the graphical representations as pure pattern. As Katherine Hayles argues, information was defined as pattern by Claude Shannon, founder of information theory, and resulted in abstracting information from a material base that meant it was unaffected by changes or context.[25] Just as graphical representations of ourselves in cyberspace (avatars) are merely masks for our databases, so too these topologies can become abstracted maps, suffering the same fate of geographical maps. The problem I faced echoed Varelas question of emergent selves: "The paradox between the solidity of what appears to show up and its groundlessness." I decided to attempt to make a move from the graphical representation of the physical body to the energetic body, using the principles of "energetic geometry," tensegrity.

Collaboration Time

> Whether communication is by telephone or by wireless radio, what you and I transmit is only weightless metaphysical information. Metaphysical, information appreciative, you and I are not the telephones nor the wire or wireless means of the metaphysical information transmitting.[26]

Just as relationships are shifting due to networks, so too is the creative process for those working on the net, and the meaning of collaboration changes drastically. The word collaboration assumes a very different meaning when there is lack of time for synchronous communication while we are bombarded with too much information. Collaboration happens in many ways, and unfortunately for those who would like a clearly organized world, there is no one straight formula. As creative projects using technology get more elaborate, the need to work with others is simply a necessity. Remote collaboration with people who have never met physically is already widely practiced by the open-source community in particular. Programmers can easily offer service without being onsite, and artists can consciously plan projects in which the audience becomes an integral part of the piece and even plays an important role in its development. This, together with the fact that new generations who grew up with games and interactivity are expecting a different type of interaction, has great implications in the art world and in the academic environment at large, which has traditionally nurtured the idea of an "individual."

"notime" is a collaborative piece at its core, and it would have not taken on the form it did if it wasn't for the Internet. My research into tensegrity structures led me to believe that if this principle works in physical architectures (as in Buckminster Fuller's domes and Kenneth Snelson's sculptures) and is the basis of cellular and molecular architectures, as Ingber discovered, the same principles should be applied to networked information spaces. I started imagining how these spaces could look and function, and was very inspired to start experimenting with visualization of social networks. However, I was having enormous difficulty finding someone who could both program and understand this type of system. This was not simply a matter of programming skills. It was a philosophical issue. I was looking for an information architect who understood conceptually what I was interested in. While researching on the Web, I discovered the work of Gerald de Jong, a programmer-artist working in Holland. De Jong had authored software called "struck," which later morphed into "fluidiom" (fluid idiom), and was actively engaged in programming dynamic tensegrity structures. In this system, synergetic geometry or "elastic interval geometries," as de Jong calls them, are used to model arbitrary database information for visualization and decision-making purposes, as well as for creation of effective and aesthetic presentation graphics and Web applications. The fluidiom projects inspiration was directly linked with Buckminster Fuller's comprehensive scientific philosophy, Synergestics'.[27]

The fluidiom project was exactly what I was looking for, and in February 2000, I contacted de Jong via email, introducing my research and concept. Gerald was already thinking of creating networked human information architectures, using "energetic geometries." A month after our initial contact, he came to Los Angeles, and we spent a week working together on how our ideas could connect creatively. It seemed that some of my concepts and aesthetics were a perfect vehicle for the tensegrity structures he had been developing using the Java programming language. It was almost strange to both of us how we came to a similar place, although from very different angles, and we knew that both of us stood to gain something from working together. From that point on, we collaborated remotely and did not meet again until the opening of our first exhibition. At UCLA, I also had begun collaborating with David Beaudry, a PhD student in music who moved seamlessly between his clarinet and programming spatialized sound. David composed the soundscapes for the physical installation, programmed video tracking, and worked on the online sound, too. These two talented people started working together on the net on the sound, meeting for the first time just days before the exhibition to set up the work. The three of us are the core of the collaboration, which expanded when we started to install the physical site.[28]

"notime" evolved from an earlier online participatory project, Bodies INCorporated, which was audience-driven. Much of it was developed as a response to certain demands and comments that radically shifted my creative process and thinking about future work. This transition is enacted in the collapse of the avatar bodies from Bodies INCorporated to a tetrahedron, a minimum building block in nature.

Community

The most persistent demand from the growing number of people who created bodies in Bodies INCorporated (now at over 50,000) was the need for "community," and for a way for participating members to communicate with each other. This made me examine the meaning of community on the net and compelled me to extensively research the existing efforts to create communal spaces on the Web. What very quickly became apparent to me is that the recent efforts to build communities on the net are inexorably connected to e-commerce and that the architects of these spaces are following models of malls and credit card systems. Thus, people shopping and sharing similar tastes are the basis of such communities, and they are increasingly using agent technologies to search through endless data based on their personal information. Yet, while these agents are supposedly empowering us as users, we don't know how or where our information flows, and these information streams tend to remain out of reach and invisible. Few people realize how quickly entire histories can be reconstructed from credit cards and social security numbers that people submit for economic transactions. When I asked myself who the people are who I would like to create community with, I realized that they would largely be composed of people who have very little time. In fact, the more interesting the people, the less time they seem to have. Thus it seemed to me that the logical conclusion was to conceptualize an environment that would act autonomously, largely independent of direct real-time human interaction, and not requiring direct participation by those who are represented by the information they carry. In "notime," databases, and the resultant database aesthetics, would in fact become the representation of people and interaction in this community space. By exploring innovative ways of visualizing the trajectories of evolving human networks in relation to information, access, and navigation, we will explore our relationship to time and the meaning of community in networked public space. New methods of management, known as molecular and nano-political, shift focus from planned communities to emergent communities. These types of communities require the technical infrastructure that allows for collective intelligence work.

I was interested in working with Gerald to utilize these principles of tensegrity for envisioning a different type of body, an "energetic body," meaning a body that is networked and built from information, but not de-humanized. Together, we arrived at the idea of beginning to evolve a persons data body from an initial tetrahedron structure. The tetrahedron is a natural starting point, or "whole system," in Fuller's "Cosmic Hierarchy," and as such contains the axes of symmetry that characterize all the polyhedra of the isotropic vector matrix, or face-centered cubic symmetry in crystallography. Fuller refers to the six edges of a tetrahedron as one "quantum" of structure, because the number of edges in regular, semiregular, and high-frequency geodesic polyhedra is always a multiple of six[29]. I decided to embed some meaning in the intervals of the tetrahedron by connecting to the Eastern representations of the energy centers, specifically the Chakra system. "Chakras," which mean "wheels" in Sanskrit, are points of energy believed to run along our spine. Ancient Hindus formulated that

View of physical structure at the San Francisco Art Institute, February, 2001.

there were seven of these energy wheels, each a different color and spinning in a clockwise direction. Interestingly enough, the spacing of chakras actually matches major nerve or endocrine centers, while the colors correspond to the electromagnetic spectrum.

Gerald refers to the geometric lines as intervals of time when he discusses the structures he is programming in Java. Evolution only happens in time intervals as represented in the emerging shapes. The initial structure has all the base elements for the architecture of the project: six intervals related to time and four memes relates to the four letters of the genome project (ATCG). The six intervals of time connect perfectly to Freeman Dyson's thesis that every human being is a product of adaptation to the demands of six time scales: years (individual), decades (family), centuries (tribe/nation), millennia (culture), tens of millennia (species), and eons (whole web of life on our planet)[30]. It is based on the idea of constant evolution and change, just as the six intervals of the I Ching hexagrams.

Construction of the Initial Tetrahedron
Participants are invited to spend a few minutes to create their initial minimum structure, a tetrahedron, by determining the length of the six intervals that have a base color and meaning attached to them: red represents family, orange: finances; yellow: creativity; green: love; blue: communication; violet: spirituality. The time a person spends on deciding the length of a particular interval is registered and has an effect on the speed of replication. After determining the length, users input four memes in the nexus of the lines and then, as a last step, attach sounds from a library created by David Beaudry. When the structures are in motion, the combination of the chosen sounds with the determined lengths of intervals creates a unique composition for each person. The four initial ideas are meant as a starting point. Since those who initiated the building are too busy to spend time adding ideas, they invite people from their own personal networks to add memes to the structure. This becomes a natural filtering system. Only people whose ideas one trusts will most likely be invited to contribute to their "notime" body. Addition of memes takes place only online and cannot happen unless people viewing the structure on the physical site generate intervals. Each "notime" body becomes a chat room space where people can meet. Conversations are interrupted with random quotes dealing with time and the genome project.

Intervals replicate and keep evolving into a complex structure by the interaction of others who spend time in the museum or gallery, navigating the structures with their bodies, in "real time." Thus the physical and online spaces are interdependent. Because we are limited biologically to having a personal network of 300-500 people, it is programmed to implode when it reaches that point of information overflow. This moment is dramatized by an announcement to the entire communit. The old body is stored and can be accessed for view only, but is not dynamic anymore. It is archived. At that point, the person who owned the "notime" body has a choice: begin from the same initial tetrahedron, create a new one, or discontinue the cycle. The decision is also announced to the community via email.

Physical Installation
Initially there was no plan to build a physical structure for the piece, but as we progressed in our development, it became clear that there was a need to control the light and sound. Further, since the "notime" was scheduled to travel with the "Telematic Connections" exhibition,[31] it became necessary to consider that the spaces will change with each location. The idea of simply building a box was not only unsatisfactory but ran contrary to the entire philosophy of the informational architecture. I summoned sculptor Tim Quinn to help build a structure that would reflect the work rather than simply be a "black box." Although I would have preferred to have a true tensile structure that is lightweight and easily transportable, we had to settle for using steel for the spiral structure. With the addition of this massive structure, the project made a major shift towards deliberately making the connectivity and dependency on networks a physical experience.

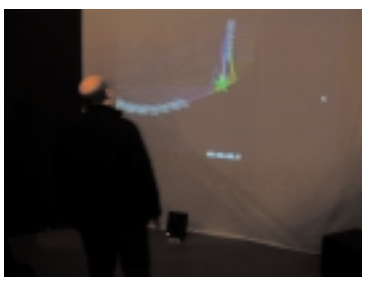
For physical installations, in addition to the undetermined online audience, specific people are highlighted depending on the specific site and context. The physical installation of "notime" allows the audience to navigate these structures with their bodies via sensors. The experience of time and no time is heightened in the physical structure, whose base is shaped as a spiral and creates an enclosed atmospheric space with projections and a reactive 3D sound environment working in conjunction with the elastic interval geometry. By spending time navigating, participants add intervals that replicate from the initial tetrahedron shape.

"notime" is a long term project with many phases envisioned.[32] The description of the project in this paper is merely in relation to what inspired its concept, and the foundation of the piece based on time intervals, memes, and tensegrity principles embodied in a tetrahedron (the minimum structure that nature employs in many of its architectures). The main goal is to move towards embodied information, with all its human qualities, no matter how messy and problematic they may be. As the physical installation moves from site to site, new groups of people connected to that particular space and time will be highlighted. They will include their personal network by design and necessarily involve the audience who will also join in building a community of people with no time. Eventually, new lighter materials will be used for the physical structures that will reside in many locations simultaneously. Extreme experiences are planned: complete immersion in "notime" data bodies together with others in physical locations and instant updates on hand-held devices.

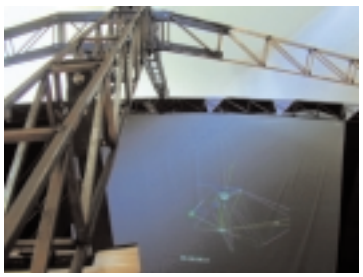
Although inspired by the Y2K moment and a basic question of how we can build community when we are all so busy, "notime" is really moving toward a space of n 0 time. It is a project to which authors, whether they are artists and programmers collaborating to develop the architecture or people who participate, breathe life into it with their attention and time.

The human looking avatar dissolves to a tetrahedron.

Audience physical presence affects the tensile java structures.



Audience physical presence affects the tensile java structures.



View of physical structure.

Notes

1. Hayles, K. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics.* Chicago: University of Chicago Press, 47.
2. For instance, the year 2000, anticipated with great fear in the West, was year 6236 according to the first Egyptian calendar, 5119 according to the current Mayan Great Cycle, 2753 according to the old Roman calendar, 2749 according to the ancient Babylonian calendar, 2544 according to the Buddhist calendar, 1997 according to Christ's actual birth (circa 4 B.C.), 1716 according to the Coptic calendar, 1378 according to the Persian calendar, 208 according to the French Revolutionary calendar, and the Year of the Dragon according to the Chinese calendar.
3. Poulsen, K. (1998). The 2YK solution: Run for your life! *Wired Magazine*, August, 6.08:168.
4. The term was coined in 1976 by Richard Dawkins in his book *The selfish gene.* Dawkins speculated that human beings have an adaptive mechanism that other species don't have. In addition to genetic inheritance with its possibilities and limitations, humans, said Dawkins, can pass their ideas from one generation to another, rather than through the longer process of genetic adaptation and selection. Examples of memes might include the idea of God, the importance of the individual as opposed to group importance, the belief that the environment can to some extent be controlled, or the idea that technologies can create an electronically interconnected world community. Today, the word is sometimes applied ironically to ideas deemed to be of passing value. Dawkins himself described such short-lived ideas as memes that would have a short life in the meme pool.
5. Bak, P. and K. Chen. (1991), 46.
6. In 1990, Glenn A. Held and his colleagues at the IBM Thomas J. Watson Research Center devised an ingenious experiment with sand piles that put this theory to the test. They constructed an apparatus that added one grain of sand at a time to a pile of sand. The balance had a precision of .0001 gram and a capacity of 100 grams. Each grain of sand weighed about .0006 gram; a sand pile whose base was four centimeters in diameter weighed approximately 15 grams. The group used a personal computer to control the motor and to monitor the balance. Held and his group ran the experiment for two weeks, dropping more than 35,000 grains of sand on the four-centimeter plate. They observed avalanches in a range of sizes (Held et al., 1990, 1120-1123).
7. Haraway, D. (1998). Deanimations: Maps and portraits of life itself. In *Picturing science, producing art.* A. Jones and P. Galison, eds. New York: Routledge.
8. Wave mechanics is the version of quantum physics that was developed initially by Erwin Schrödinger in 1926. The idea came from the work of Louis de Broglie via Albert Einstein. De Broglie pointed the way to wave mechanics with his idea that electron waves "in orbit" around an atomic nucleus had to fit a whole number of wavelengths into each orbit, so that the wave neatly bit its own tail, like the alchemical symbol of thw worm Ouroboros (Gribbin, J., 1999, 427).
9. Goldstein, (1993), 115-16.
10. Hayles, K.
11. Wiener, Norbert (1954). *The human use of human beings: Cybernetics and society.* New York: Doubleday, 103.
12. Stelarc's work can be seen at: stelarc.net
13. Langong, C. (1989).
14. Coyne, R. (1995). *Designing information technology in the postmodern age.* Boston: MIT Press, 80.
15. Haraway, D. (1998), 186.
16. In addition to being a professor in pathology and a member of the bioengineering faculty at MIT, Donald Ingber is the founder of Molecular Geodesics, Inc., a company that creates advanced materials with biologically inspired properties.
17. Ingber, D. (1998). *Scientific American*, 30.
18. Ibid., 32.
19. Ibid., 30-39.
20. Edmonson, C. Amy (1987). *A Fuller explanation: The synergetic geometry of R. Buckminster Fuller,* 257.
21. Ibid., 239.
22. Associated Press. (1982).

23. Varela, F. et. al. (1991). *The embodied mind*. Cambridge: MIT Press, 94.
24. Cyber Geography can be accessed at: www.cybergeography.org
25. Claude Shannon, along with Warren Weaver, laid the foundation of modern information theory. See Shannon, Claude, and Warren Weaver. *The Mathematical Theory of Communication*, 1949. Foreward by Richard E. Blahut and Bruce Hajek. Urbana: University of Illinois Press, 1998.
26. Fuller, R.B. (1962). *Synergetics Dictionary*. Citing Oregon Lecture #9, July 12, 326.05.
27. Synergestics shows how we may measure our experiences geometrically and topologically, and how we may employ geometry and topology to coordinate all information regarding our experiences, both metaphysical and physical. Information can be either conceptually metaphysical or quantitatively special-case physical experiencing, or it can be both. The quantized physical case is entropic, while the metaphysical generalized conceptioning induced by the generalized content of the information is syntropic. The resulting mind-appreciated syntropy evolves to anticipatorily terminate the entropically accelerated disorder (Fuller, Synergistics Dictionary, 200.06).
28. We were joined by Ruth West, a graduate student in Design | Media Arts who was a geneticist for eight years before starting her graduate studies; Ingo Tributh, a student in information studies in economics from Germany; and Burt Peng, a student from the film department at UCLA.
29. Edmundson.
30. Dyson, F. (1992). *From Eros to Gaia*. New York: Pantheon, 341.
31. Telematic Connections: the Virtual Embrace is curated by Steve Dietz.
32. "Notime" is commissioned by the Walker Art Center and sponsored by the Independent Curators International and the UCLA Academic Senate.

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3. Haken, H. (1987). Synergetics: An approach to self-organisation. In *Self-organising systems,* Yates, F.E., ed. New York: Plenum.
5. Harvey, D. (1989). *The condition of postmodernity*. Oxford: Blackwell.
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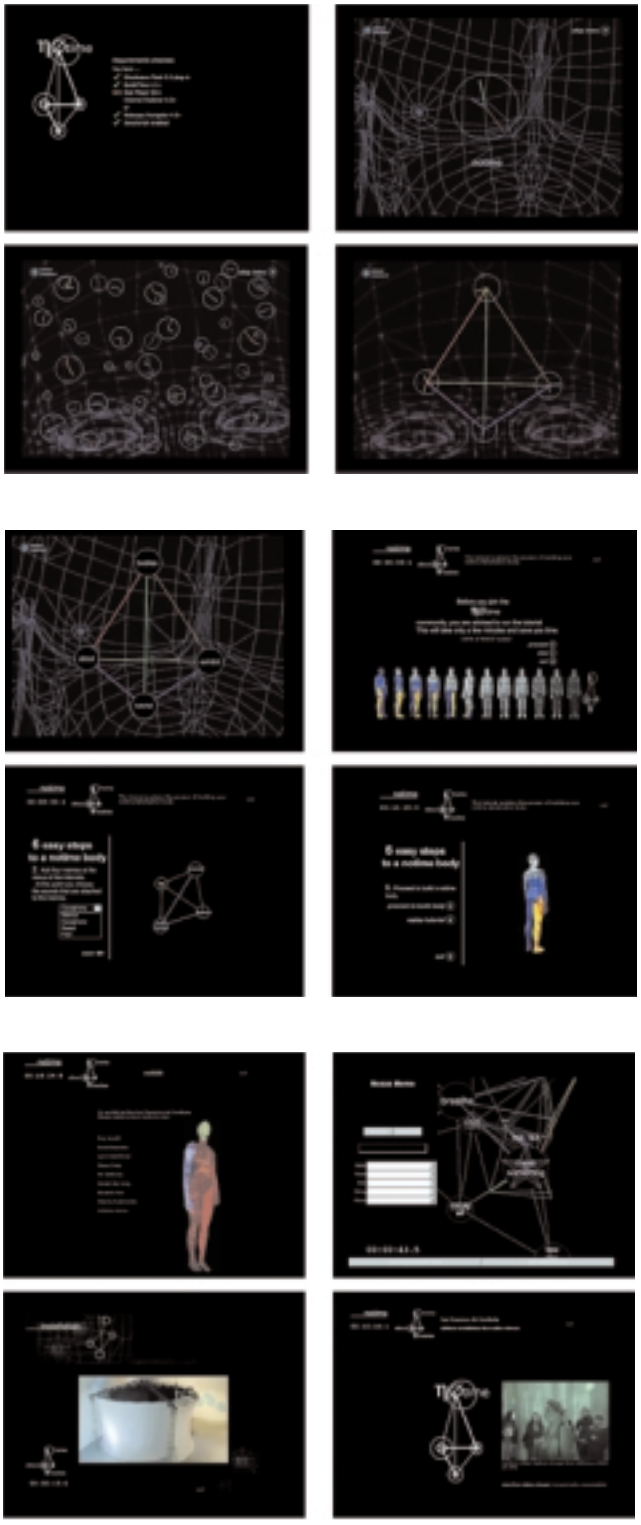
10. Rifkin, J. (1987). *Time wars*. New York: Touchstone Books.
11. Varela, F. (1995). The emergent self. In John Brockman ed. *The third culture*. New York: Touchstone.



Screen shots from "notime" website, version 1.
For current version, see: http//notime.arts.ucla.edu.

The Pleasures of Immersion and Engagement: Schemas, Scripts, and the Fifth Business

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Abstract

Presently, designers of interactive narratives and video games have only a slender understanding of the aesthetic experiences their audiences and users seek. Using schema theory, this study articulates the two varieties of aesthetic pleasures that users of interactive works enjoy: immersion and engagement. It uses schema theory to define the characteristics of immersion and engagement in both conventional and new media. After examining how readers' experiences of these two different aesthetics may be enhanced or diminished by interface design, options for navigation, and other features, the essay concludes by looking beyond immersion and engagement to "flow," a state in which readers are both immersed and engaged.

> It must be granted that there is some value in mystification, labyrinth, or surprise in the environment… This is so, however, only under two conditions. First, there must be no danger of losing basic form or orientation, of never coming out. The surprise must occur in an overall framework; the confusions must be small regions in a visible whole. Furthermore, the labyrinth or mystery must in itself have some form that can be explored and in time apprehended. Complete chaos without hint of connection is never pleasurable. *–Kevin Lynch, The Image of the City*[57]

> Those roles which, being neither those of Hero nor Heroine, Confidante nor Villain, but which were nonetheless essential to bring about the recognition or the dénouement, were called the Fifth Business in drama and opera companies organized according to the old style; the player who acted these parts was often referred to as Fifth Business. *–Robertson Davies, The Fifth Business: The Deptford Trilogy*[22]

Introduction: Schemas and the Pleasure Principle

Oddly enough, after decades of theorizing about texts, their authors (or lack thereof), and their relationship to readers, economics, and culture, we know comparatively little about the affective pleasures of reading. Why do we read for pleasure? What keeps us turning the pages between an author's name on the title page and a novel's last gasp on its very last page? How are we able to turn a sprinkling of abstract symbols on a white page into scenarios and vignettes so arresting that we can shut out turbulence and the roar of aircraft engines on a red-eye merely by reading a flimsy paperback book? Few critics have dared tackle the affective aspects of reading, although many critics have pointed out the importance of pleasure to the act of reading itself.[4,15,39,69,81] Moreover, few critics would have thought the topic worthy of scrutiny, since the conventions shaping the acts of writing and reading print narratives alike are so well-established and so familiar that we can function perfectly well without the faintest inkling of how the whole enterprise works, just as we do with so much of the technology that surrounds us.

Enter interactive narratives, hypertext fiction, and video games that offer scenarios, tools, plots, and characters that demand input from their users. Writers and designers of interactives must work in relatively uncharted territory. First, we do not entirely understand where precisely interactives fall on the continuum of pleasurable (or ludic) pursuits. Second, we must also grapple with a paucity of conventions, fixed genres, and precedents that tell us the sorts of interactions users expect, how to flag meaningful options or tools, or even how to signal closure. At every turn, we are dogged by unresolved, sticky questions. On the continuum of ludic pleasures, do interactives fall somewhere, say, between a game of chess and watching "The Sixth Sense?" Or do they, too, occupy a range of positions on that continuum, each interactive offering an affective pleasure as distinctive from one another as chess itself is from watching films? How much freedom do users want when it comes to plotting strategy or getting acquainted with characters? And is a cut-scene that signifies closure a reward for working your way through a video game's myriad of fire-fights, kung-fu contests, and puzzles? Or do cut-scenes nullify the openness of both narrative and plot seemingly promised by the entire concept of interactivity? If we can understand our audience's affective experiences in reading hypertext fiction or playing interactive games, we can begin to determine the types of stories, tools, and even interfaces that lend pleasure to the act of reading and interacting with hypertext and hypermedia.

To date, most studies of reading and hypertext have focused almost entirely on readers' physical and cognitive encounters with texts,[7,8,9,23,25,74] not on the affective pleasures readers derive from their encounters. Yet we can explore the affective dimension of interactive narratives without invoking arguments about either hard-wired or socially engendered aesthetics by using schema theory to analyze hypertexts and exploring how these frustrate or play off readers' schemas of other texts. Long employed by linguists,[3,77] cognitive psychologists,[15] art historians,[36] and AI researchers,1[11,75,76] schema theory charts how information processes can shape perception and action alike, focusing our expectations and even determining the fine grain of our interactions with objects.[4] Defined simply, schemas are the building-blocks of information-processing, a cognitive framework that determines what we know about the world, the objects it contains, the tasks we perform within it, even what we see.[76]

Schemas enable us to perceive objects and occurrences around us and to make efficient sense of them by consulting our ready-made store of similar occurrences and understandings, which we gain from reading, personal experience, and even advice we receive from others.[3] Schemas may be as simple as the series of understandings and actions that enable us to both recognize what a car is and how to drive one, or as complex as our understanding of the specific roles characters play in, say, teen slasher flicks, where we expect basements to be hotbeds of horror or peril and teenagers having sex to become victims. Schemas also entail scripts, sets of tasks, or actions appropriate to certain

schemas. In Schank's famous "restaurant script," people entering restaurants understand, seemingly automatically, what to do with a menu, how to order, and how to behave throughout the restaurant experience.[77] Scripts, moreover, are flexible, as we can rapidly and easily modify existing scripts to accommodate new scenarios. A single restaurant script easily covers a visit to McDonalds, Le Cirque, a sushi bar, even a Roman antipasti restaurant, where you merely help yourself to whatever dish is being handed around.

Once we have identified a single schema, we begin calling on relevant scripts that shape our perception, navigation, and interaction within a scenario, whether it exists in life, on a page, or in a stroll on the decks of Titanic in the interactive game "Titanic: Adventure Out of Time."[84] We watch the trials and travails of a couple in a romantic comedy with considerably less trepidation than we would the eponymous couple in the likes of "Romeo and Juliet," which we know to be a tragedy, because our schemas for romantic comedies tell us that, in the end, the obstacles exist merely to make the final union all the more satisfying. We know we must treat all clues as potentially relevant when we read a Patricia Cornwell mystery, just as our schemas for mysteries also tell us that the author will dangle as many false leads, innocent suspects, and red herrings as she possibly can before us, all tactics to delay our resolving the mystery's central puzzle until the book's ultimate pages.

Schemas are, moreover, such vital perceptual tools that, when objects or works violate long-held conventions, we become frustrated and fail to understand them. Films like "Jacob's Ladder"[58] become box office bombs because they begin by inviting viewers to latch onto a single schema—initially, a thriller involving war games in the Mekong Delta and psychotropic drugs—then rapidly deploy elements from contradictory schemas. The film, by turns, shuttles through a series of schemas, becoming a horror film complete with the requisite demons and aliens in nurses uniforms, a thriller about a government conspiracy, and a horror film about madness. Throughout, the film remains too slippery for readers to understand it through a single schema. Not surprisingly, its resolution could never prove satisfying to any audience. The film ultimately can resolve the dilemma posed by only a single schema, which turns out, unfortunately, to belong to a fifth schema that is not revealed until the film's final scene. "Jacob's Ladder" ends with an "oh-it-was-all-a-dream" schema that accounts for the illogical and fantastic nature of events by situating them inside a dream or, in this case, a dying man's last hallucinations.

Pleasure: Immersion and Engagement

When aesthetic objects invite us to rely on certain schemas, they are not, however, necessarily guaranteeing us an entirely predictable experience. Schemas may enhance our pleasure in, say, reading a John Grisham paperback, because they provide a detailed framework that frees us to focus intently on the minutiae of the narrative by providing us information about what, roughly, to expect from the characters, events, and plot generally, as well as, of course, its eventual outcome.[4] The presence and nature of schemas in a work, moreover, dictate not only the type of genre the work belongs to, but also both the sort of audience the work attracts and the kind of affective experience that audience may expect. Genre fiction generally hews tightly to highly normative schemas, while postmodern novels tend to invert narrative conventions and rupture the stock developments and resolutions of mainstream fiction. Not surprisingly, the predictability afforded by genre schemas makes them ideal fodder for the trance-like reading cognitive psychologists like Victor Nell,[70] note is the hallmark of the immersive reading experience. And, of course, as we might expect, immersive affective experiences also tend to garner the largest audiences, as readers pursue immersion to temporarily escape the stresses of everyday life or vicariously enjoy the exploits of fictional characters as an antidote to the mundanity of their own lives.[81] Contrary to expectations, however, our immersion in what some critics might scoff at as "light reading"[70] stems from the steady, unbroken rhythm of our reading, which fully occupies our cognitive capacities.[13] Conversely, readers plowing through more demanding texts, works by what Robert Coover[17] has dubbed "difficult" writers, enjoy no such spell, as the cognitive demands of grappling with the text tend to be discontinuous, involving shuttling between competing schemas, prospecting and retrospecting through the text, and pausing over obscure passages.[13,70] Highly normative schemas enable readers to "lose" themselves in the text in what we might call an *immersive* affective experience. When immersed in a text, reader's perceptions, reactions, and interactions all take place within the text's frame, which itself usually suggests a single schema and a few definite scripts for highly directed interaction. Conversely, in what we might term the *engaged* affective experience, contradictory schemas or elements that defy conventional schemas tend to disrupt readers' immersion in the text, obliging them to assume an extra-textual perspective on the text itself, as well as on the schemas that have shaped it and the scripts operating within it.

Immersive Interactives: Beyond Shoot Outs and Hunt-Quests

> [T]oday's most successful interactive artists ultimately see interactivity as an evolutionary (rather than revolutionary) step for storytelling. *Brent Hurtig, "The Plot Thickens"*[41]

Not surprisingly, the earliest digital interactives—video games—drew their cues heavily from a singular schema, turning the early commercial computer games into jazzed-up versions of video arcade games. Whether by accident or design, early game developers hit digital pay dirt by founding their first ventures on the bedrock of two essentials: a recipe for interaction that all but guaranteed a deeply immersive experience and strong, normative schemas borrowed from already-familiar forms of entertainment. The history of invention is, after all, littered with dazzling innovations that either withered rapidly into obscurity or, at best, hibernated for decades before their eventual adoption, mostly due to the object's very newness.[2] Inventions that are discontinuous with earlier devices and tools tend to offer users few familiar schemas. The fax, phonograph, answering machine, tape player,

and VCR all languished for decades before becoming household fixtures, largely because each of these inventions required users to develop new schemas to accommodate them. Conversely, technologies like Edison's incandescent light were adopted at the technological equivalent of light-speed—despite potentially crippling problems with the limitations of wiring and distribution of centralized electricity—almost entirely because the new innovations essentially invited users to rely on long-familiar, comfortable schemas and scripts[40] derived from the very forms of technology the innovations were designed to replace. Ironically, innovations seem to be adopted most rapidly when their newness is domesticated, so to speak, by design features that invite us to treat the new object as if it were merely an extension—albeit an improved one—of a familiar object or device. Early video games like Pong stuck to the simple, rigid schema of a ball game with the ball batted between players or against walls. Later successful video games drew off arcade staples that involved escaping through mazes—an approach drawn loosely from the pinball schema—or raining bullets on would-be protagonists, a schema drawn from that staple of county fairs everywhere, the shooting gallery. The result: a game that imposed rigid rules, drawn from already familiar games which could thus be immediately grasped by users, a game featuring fresh local details like gobbling mouths or souped-up weapons, requiring a steady rhythm of interaction. Ironically, the reader paging through Balzac or Dickens, or, for that matter, Judith Krantz, has entered into roughly the same immersive state, enjoying the same high, continuous cognitive load as the runty kid firing fixedly away at Space Invaders.

Later generations of video games have colonized the same turf with notable success. Both Sonic the Hedgehog and Super Mario Brothers, for example, drew off familiar arcade schemas. Yet video and PC game designers have encountered difficulty whenever they have attempted to stray into territory where no dominant schemas reign. Chief among any designers difficulties is how to invite users to interact with the text itself. While the shoot-out is always immediately comprehensible, that particular schema doesn't easily offer designers sufficient local details to completely differentiate their latest game from the droves of other shoot-outs that have preceded it. Perhaps not terribly surprisingly, game designers have mostly mined only a single other schema: the treasure-hunt-cum-grail-quest, familiar to users of "Myst,"[64] "Titanic,"[84] "Grim Fandango,"[37] and, for that matter, any other interactive that doesn't require users to shoot anything that moves. Yet the hunt-quest remains a remarkably hardy genre, as its schema, unlike the shoot-out, permits a wealth of local detail, sufficiently rich that its users can become immersed in grappling with both its intricacies and what to do with it.

Scripts, Voice-Overs, and the Fifth Business

In immersive interactives like "Myst" or Shannon Gilligan's "Virtual Murder" series,[32, 33, 34, 35] our pleasure stems from our ability to discern a single schema and the several scripts it offers us for both interpretation and directed action. Before we so much as glimpse the title screens of your typical hunt-quest, we already know we need to listen intently, collect everything we can lay our mitts on, and put together our tools and clues to solve the local challenges that confront us, which, in turn, will enable us to solve the interactive's grand challenge—usually something on the order of liberating a prisoner,[37, 64] altering the course of history,[84] or saving the planet.[87] Still, designers have no such clear choice of scripts for interaction. We all understand that guns or knives are essential to shoot-outs, but no such clear scripts exist for actions during the hunt-quest. Furthermore, how do you indicate readiness for action or differentiate the items your protagonist must collect from the normal detritus that makes an environment look convincingly realistic? Contrary to some theorist's belief,[55, 69] the existence of tools intra-frame or extra-frame does little to disrupt the user's immersion in the interactive. For example, solving a puzzle, pursuing a clue, or surviving a knife fight involves action that can potentially spill outside the narrative's frame, as in the multiple-choice replies "Titanic" offers as responses to characters conversations with you[84] or the inventory of items protagonist Robert Cath possesses in "The Last Express."[62] But the aesthetic remains largely immersive as long as the story, setting, and interface adhere to a single schema.

Users face further interface challenges from narratives like "Last Express" that attempt to stray from reliable gaming conventions that govern the user's actions, mostly decoding puzzles and dismembering enemies, all of which may frustrate more than engage users expecting well-defined scripts and a tight framework for directed action. In "Titanic," for example, if you fail to keep an assignation or meander through the ship, the narrative's clock-time halts abruptly, and all characters vanish, save your steward, who appears periodically to throw you out of the First Class Smoking Lounge or Verandah Café.[84] No agents, frames, or tools exist to jump-start the narrative again once you neglect to pick up the right clues. Even with its highly normative hunt-quest schema, "Myst" frustrates users searching vainly for clues into acts of desperate, random thrashing with the cursor on shrubbery, sundials, library walls, anything that looks like a candidate for the next puzzle challenge.[64] But even with better indicators for interaction, like "The Longest Journey's" [56] palette of annotated cursor and potential actions (eye, mouth, hand) that flag your potential actions with solid or broken lines and a variety of colors, users are simply left with more elegant weapons to thrash the simulated environment with. If the environment seems particularly bereft of clues or you don't happen to hit on the ingenious and incredibly improbable notion of using a twig and dinosaur scale to create a funnel, as in "Longest Journey," immersion evaporates, and you're left trying to vainly intuit what on earth the designers had in mind when they created the particular scene you're presently trapped in.

If anything, video game designers, more than their PC counterparts, have even thornier dilemmas awaiting them in interface design during their forays into territory outside the shoot and hunt-quest genres.[78, 83] With "Sydney 2000,"[83] Dreamcast users can train athletes, expose them to some extra coaching, test them in qualifying trials, and, finally direct them to compete in the Olympics. The problem for users and designers alike: how to provide the means for a potentially complex series of interactions using the same controller originally created for shoot-outs. The solution: users must toggle maniacally between the former "shoot" switches to provide athletes with the strength, say, to complete a 170 Kg clean and jerk. The greater problem: still to toss the javelin, shoot skeet, triple jump, kayak, or dive, frenetically toggling between the same switches you've just used to provide a sprinter with speed in the 100 meters and to give a weight-lifter, at least theoretically, enough gas to complete a dead lift. The script for interaction shifts with every event and sometimes, even between training mode and trial/competition modes, leaving users in what promises to be the most immersive of interactive experiences—video games, after all, are direct descendants of the immersive arcade shoot-outs—paging angrily through the slender instruction pamphlet, trying to figure out what functions the "A" and "B" buttons will signify for the next 10 minutes.

For our affective experience to remain immersive, both narrative and interface alike need to overtly guide or curtail our possibilities for action. Interactive games fulfill their promise as immersive when they offer us an obvious schema for narrative structure and interface, and when they offer us predictable, tightly scripted interactions, enabling us to enjoy virtual experiences that are either unattractively risky or denied to us in everyday life.[81] In "Gadget,"[79] if an informant in the Museum train station has instructions for you to turn your quest around, the train idles helpfully in the station until you venture out of the car, stroll up to one or two likely looking characters, and receive the vital clue. In the "Virtual Murder" series, Gilligan[32, 33, 34, 35] provides a detective sidekick who summarizes the crime scene, provides thumbnail sketches on suspects, or weighs in with an opinion when queried. The series also includes the occasional voice-over by a police superior who harangues you with the work remaining to be completed and the time remaining on your "game" clock.

Both the voice-over and agent are fortuitous additions to Gilligan's series of interactives and, not coincidentally, both are drawn explicitly from film and stage. Beginning with the Greek chorus,–itself an early form of voice-over,–dramatists and directors have used voice-overs to guide their audiences through scenes, ensuring that audiences understood the significance of an action, the true nature of a cloaked villain, or the mental state of some characters. In cinema, writers and directors traditionally use voice-overs to establish conditions at the outset of a narrative or during substantial changes in location or time, or to voice interior monologues. But some directors have also used voice-overs to make entire narratives intelligible, a vital function in films that rely on a pastiche of images without heavy sequential continuity or on narratives that defy conventions or logic. Famously, Francis Ford Coppola was troubled by the 1.5 million feet of film shot for "Apocalypse Now," believing he had only "about a 20-percent chance" of assembling the elements intelligibly into a successful feature. Furthermore, sneak-preview audiences remained puzzled by the logic and significance of several of the film's key scenes, most troublingly, the film's conclusion. When Coppola, however, commissioned writer Michael Herr to create a voice-over interior monologue for the protagonist – a voice-over narrative that spanned virtually the entire film – audiences immediately understood the film's events, and "Apocalypse Now" reaped over $100 million at the box office.[20] Remarkably, voice-overs have been all but unused in interactives: in "The Last Express,"[62] you understand Robert Cath's feelings via the occasional voice-over, and both April Ryan in "Longest Journey"[56] and "Grim Fandango's Manny Calavera"[37] use voice-overs. But both Ryans and Calaveras voice-overs exist simply to inform you what their characters cannot do. When you point either character toward an item that doesn't function as a tool or potential clue, both essentially tell you, "I wouldn't do that" or "I don't think that will work." Game designers, by eschewing the use of anything approximating a voice-over, are forcing users to face challenges akin to understanding the events in a narrative without benefit of either first-person, third-person, or omniscient narration—which is achieved in cinema via first-person or omniscient point-of-view camera—a challenge even in the comparative cozy familiarity of the print novel.

Gilligan's sidekick, a nameless help-mate portrayed initially by Gilligan herself and, in later additions to the "Virtual Murder" series[34,35] by actress Sherilyn Fenn, is also an apt throwback to earlier narrative forms. While her cropping up in a police procedural is, perhaps, unremarkable, she remains the lone example in interactives of what Robertson Davies termed "the Fifth Business"[22] or the agent who exists solely to chivvy the characters and plot toward its conclusion. In police procedurals, detective novels, and mysteries of all stripes, of course, the Fifth Business is usually the protagonist's sidekick. Sherlock Holmes, famously, had Watson to bounce ideas off and to help him unravel clues, often unwittingly, and even Inspector Morse had the much-put-upon Sergeant Lewis. Both Watson and Lewis performed, like every good agent, the function of sniffing down false leads and interviewing suspects while their respective bosses got down to the real detective work and eventually solved the case – significantly, never without some intervention from their sidekicks. Of course, both agents also function as narrative foils to their bosses. Watson and Lewis are famously dim where their superiors are quick-witted, badly read and poorly mannered where Holmes and Morse are educated, cultured men of the world. Yet the agent is also the mystery's unsung catalyst, a force who can usher the plot along efficiently precisely because he or she is an unobtrusive character never quite in the spotlight. Perhaps, given the paucity of scripts drawn from earlier media, the absence of agents from interactives should seem unremarkable. Yet the agent is such a potent tool, one that can clarify interface elements and possible actions, that we can only wonder why agents remain so strangely unused, apart from Microsoft's brief, mid-90s foray into plugging an obnoxious agent named Bob into its desktop interface. An agent in "The Longest Journey" could make suggestions about what April Ryan ought to do with the

dinosaur scale and twig, saving you from scrabbling for the cheat-sheet walkthrough—decidedly an immersion-busting experience—similarly, an agent or voice-over could tell you how to position "Grim Fandango's" forklift in the elevator before you embark on your 40th attempt at halting the elevator or risk losing any remaining vestiges of sanity. Or you could enlist an agent or toggle the voice-over mode on during the early stages of the interactive, when you're still determining the conventions and constraints governing the plot, characters' actions, and environmental cues, only to leave both these guides behind once you've fully grasped the details and immersed yourself in the narrative.

Pleasures of Immersion, Pleasures of Engagement

The pleasure of immersion in interactives stems from our ability to take guided action and see the outcomes from our choice of one or more scripts within a single schema. In contrast, the pleasure of engagement with hypertext fiction comes from users' access to a wide repertoire of schemas and scripts, our attempts to discover congruences between the hypertext and an array of often mutually exclusive schemas, and, ultimately, our ability to make sense of the work as a whole. Even though Janet Murray's[69] list of plots as symbolic actions include sensemaking and assembling fragments into a coherent whole, Murray's objection to what she calls "structured literary hypertext" reveals a criterion for aesthetic pleasure clearly founded only on immersion: "navigation unfold[s] a story that flows from our own meaningful choices."[69] Yet readers of modernist works like *Mrs. Dalloway*,[88] *The Good Soldier*,[29] *In the Labyrinth,*[73] and *Ulysses*[45] must actively wrestle with wandering narrative perspectives, tortuous representations of time, and deliberate disruptions in space, time, and causation, as well as the requirement that they ultimately understand the entire work relative to its spatial form. Anyone who confuses Great Works with an aesthetic of immersion should remember Joseph Frank's famous declaration about *Ulysses*, which, he claimed "could not be read, only reread."[30] These texts engage readers deeply because they do not follow schemas for which readers can unthinkingly apply ready-made scripts. Instead, they violate existing conventions, switch schemas, and, in the case of works like *In the Labyrinth*, violate even our assumptions about continuity from one paragraph or even sentence to the next.[73]

Not surprisingly, engagement tends to be pursued and enjoyed by those who are widely read, since they have access to a vast array of schemas and scripts. Readers who enjoy engagement also tend to enjoy confronting situations for which they lack scripts, as these provide opportunities for learning, as opposed to merely performing one of a series of scripts within a conventional framework. With a hefty repertoire of scripts to call upon, the well-read are also more likely to recognize when, and to guess how or why, narratives violate long-familiar conventions and patterns. The reactions of even well-intentioned critics—witness Murray's[69] "privileging confusion"—to hypertext fiction grows from confusing engagement with immersion, as well as from the fluid, still-evolving nature of schemas and scripts in hypertext narratives.

Yet even the earliest readers[25] of the first published hypertext narrative, "afternoon," experienced a kind of engagement that would have seemed familiar to readers of *Ulysses* or *The Wasteland*. First, readers bring to new media their schemas and scripts from older media,[40] just as hypertext fiction itself draws on conventions inherited from print for plot, character, intention, and tropes.[11] Second, published criticism which, in the cases of Joyce and Eliot, included symbolic "keys" to their work, aided readers in developing schemas to fit the new material. Joyce circulated notes that mapped Stephen's and Leopold Bloom's day in Dublin onto the adventures of Odysseus,[38] while Eliot extensively footnoted his own poem.[28,71] Readers of hypertext fiction, like Joyce's and Eliot's audiences, are more likely to seek out secondary sources to supplement their array of schemas for understanding the text. These "engaged" readers are also more likely to employ these schemas as simply part of a repertoire, rather than as sources for controlling scripts that determine singular interpretations of a work. Such secondary sources include Joyce's own extensive criticism on hypertext aesthetics,[47,48,49] as well as a growing body of criticism on the narrative significance of navigational mechanisms in hypertext.[5,6,23,39,69] Third, even in a relatively new genre, some of its newly minted "grammar" and tropes are accessible to early audiences: cross-cutting, special effects, and the shot-reaction shot sequence all appeared during cinemas nickelodeon era.[31] In complex hypertexts, immanent structures include proximity signifying causal or relational connections between lexias in spatialized text,[59] as well as recurrence to remind readers of previously encountered lexias or to situate already encountered lexias in new contexts where they take on new meanings.[6,26] Mark Bernstein[8,9] has also identified cyclical repetition broken to signify closure,[25,46] contour, where cycles coalesce or collide,[6,50] and montage that establishes connections across the boundaries of nodes or links, as used by Landow, [51,52] Jackson[43] and Paul.[71] Readers engaged with hypertext fictions like "Victory Garden" or "Twelve Blue" make hypotheses about the relationships between lexias and the significance of links, layering onto the print readers engagement with character, continuity, time, and space, further interpretations of the significance of spatial relationships and links between lexias, of link types and their conditions. Long-term engagement with the texts – the necessary rereading Michael Joyce describes[47] – makes some relations immanent, nullifies some hypotheses, thwarts some navigational strategies, and generally enables readers to enlarge their repertoire of textual aesthetics still further. Finally, when hypertext episodes[46] also represent causally linked lexias that generate narrative tension, readers may become immersed in the narrative. Even when immersion gives way to engagement, the immersive lexias or episodes can still act as a centripetal force that compels us to become engaged with the narrative.[26]

Immersion Into Engagement Into Flow

The "episode vortex," as Jim Rosenberg notes, however, can just as easily frustrate readers, launching them into "foraging" for the next episode.[74] While immersion may easily lure readers into interactive narratives and organize their initial engagement, replacing promised immersion with engagement can also frustrate readers, even when they can develop a script that situates their frustrated immersion as strictly intentional, a deliberate effect designed by the author.[5]

Even in the throes of engagement, disorientation in hypertexts is potentially more disconcerting than the momentary discomforts we experience in other media, notwithstanding our budding repertoire of effects and gambits that signify. The dreaded "lost in hyperspace"[27] problem is due partly to our awareness that hypertexts exist in virtual, 3D space—which may or may not be represented to readers via maps or spatial navigational tools—partly to our awareness that links often involve recursion and complex conditionals, seldom making visiting every lexia or link once the equivalent of experiencing the entire work. When we consider the affective dimension, however, the absence of guides for the length of time occupied by our engagement or immersion may be still more significant. When we sit down with a novel or settle ourselves into a Broadway theater or our local cinema, we know approximately how long our immersion or engagement will last. Book chapters, like film running times, often owe as much to the length of time writers require to develop stories and episodes as they do to publishers' and producers' perceptions of the attention span and disposable time common to contemporary audiences. While audiences can prove equally adroit at immersing or engaging themselves in lengthy narratives fanning out over weeks and even years in radio and television serials[7,23] as well as in professional sports,[7,8] they require clear-cut guides on the duration of each local session. Football, basketball, and hockey are clock-determined. Baseball has nine regular innings. Plays have either three or five acts. Serials occupy 30 or 60 minutes of airtime. Time can also increase the signifying power of narrative developments and tropes: cues about a character's impending mortality that may not seem particularly significant in Act III acquire dramatic significance when revealed to us in the final moments of Act V.

Not coincidentally, designers of interactives frequently build into games central metaphors or tools that rely on time. All the "Virtual Murder" interactives use a conceit about the seven hours that generally elapse between the discovery of a crime and the swearing out of a warrant for the suspected perpetrators arrest.[32,33,34,35] Both "Titanic"[84] and "Last Express"[62] unfold against time constraints imposed by, respectively, the sinking of the liner and the onset of World War I. Further, in both the "Virtual Murder" series and "Titanic," agents periodically surface both to remind you of time passing and to nag you to keep assignations, ensuring that your immersion doesn't shade quickly into frustration. Other interactives rely on stages that signal reader's progression through the text: "ages" for "Myst,"[64] "realms" for "Obsidian."[87] Hypertext fictions, however, lack such clear signals to readers, making it difficult for readers to determine if their script-acquiring and developing have been successful in helping them understand the hypertext as a structure of narrative possibilities, or if they need to accommodate, modify, and generate still more scripts. Some writers have built forms of closure into hypertexts that enable readers to pause in their reading or leave it completely.[24,46,54,67] But link conditions in complex hypertexts can yield different juxtapositions of lexia and fresh narrative possibilities, just as a familiar episode may branch in several unexpected directions the next time out, mitigating the cues potentially offered by these approximations of closure.

Finally, while immersion may shade into engagement — now an imminent development with recent calls in the interactive game industry for more backstory and narrative[14,80] — and engagement into immersion, neither of these affective dimensions maps all that tidily onto most definitions of interaction.[12] As Joyce[47] and Aarseth[1] have noted, readers of most hypertext fiction are merely exploring the narrative, not constructing its links and rearranging its structure, or even generating lexia and links themselves. While the advent of the World Wide Web and collaborative structures like Browns Hypertext Hotel[18] suggest that hypermedia's contribution to aesthetics may be a blurring of the line between reception and creation, the relatively limited interactions of immersive or engaging interactives should not likewise limit our quest for features, metaphors, and conventions that enhance our affective experiences.

Given the enhanced immersive possibilities of full-motion video, not to mention virtual reality, coupled with hypertext fiction's complex possibilities for engagement, future interactives could easily enable casual readers to experience what Mihaly Csikszentmihalyi calls "flow," a condition where self-consciousness disappears, perceptions of time become distorted, and concentration becomes so intense that the game or task at hand completely absorbs us.[21] Since flow involves extending our skills to cope with challenges, a sense that we are performing both well and effortlessly, this state hovers on the continuum between immersion and engagement, drawing on the characteristics of both simultaneously. Presciently in the early 1980s, Sherry Turkle[85] noted something like flow states in teenagers grappling with computer games. Where immersion involves identification with characters and narrative elements—the local details that keep us involved even when we know the plot's trappings intimately—

engagement involves deciphering the author's or game designer's intentions. During a flow state, Turkle noticed, teenagers both identified utterly with the objects they were manipulating—the equivalent of "becoming the pinball," unthinkable to the player of the analog arcade game—and became deeply involved in determining the constraints built into the game. Most vitally, however, she noted that player after player was obliged to keep up with a rhythm dictated by the game itself, a "relentless… demand that all other time stop… and that players take full responsibility for every act."[85] The combination of all three conditions, she realized when she interviewed inveterate game players from teenage social misfits to stressed-out banking executives, enabled players to experience the same characteristics of flow first identified by Csikszentmihalyi. All players attested to a sense of stepping outside both the real world and its time, while at the same time retaining an acute perception of the constraints of the game world and game time and an ability to play strategically within its constraints.

Flow is, however, elusive, fleeting, and intensely problematic. The social misfits and uptight executives Turkle interviewed most likely achieved flow states during gameplay at least as much due to their desires to achieve mastery over something, however brief and fictive, and not necessarily because they identified intensely with the all-but-non-existent characters or environment in the video games they played. Artists, writers, professional athletes, and musicians can experience flow states during practice or performance, as can connoisseurs of music, film, dance, or sports. For example, film critics may notice how deep focus, changes in film stock, and oblique angles frame a sequence or allude to other films, an extratextual perspective on the film that is characteristic of engagement, even as they remain deeply immersed in the characters and plot developments of the narrative playing before them. Further, since engagement tends to focus our attention on the frame and materials themselves, texts like "Ulysses" or "afternoon" tend to immerse us only for short periods before demanding our engagement. As interactives, however, begin offering us worlds that increasingly resemble the one outside the text,[14,78] and writers begin introducing into them complex plots, characters, and orienting devices like voice-overs or agents, even casual readers may one day experience the flow that today only a privileged few enjoy when watching or creating narratives.

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A Preliminary Poetics for Interactive Drama and Games

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Introduction

Interactive drama has been discussed for a number of years as a new AI-based interactive experience.[2,8] While there has been substantial technical progress in building believable agents[3,4,6] and some technical progress in interactive plot,[16] no work has yet been completed that combines plot and character into a full-fledged dramatic experience. The game industry has been producing plot-based interactive experiences (adventure games) since the beginning of the industry, but only a few of them (such as "The Last Express") begin to approach the status of interactive drama. Part of the difficulty in achieving interactive drama is due to the lack of a theoretical framework guiding the exploration of the technological and design issues surrounding interactive drama. This paper proposes a theory of interactive drama based on Aristotle's dramatic theory but modified to address the interactivity added by player agency. This theory both provides design guidance for interactive dramatic experiences that attempt to maximize player agency (answering the question "What should I build?") and technical direction for the AI work necessary to build the system (answering the question "How should I build it?"). In addition to clarifying notions of interactive drama, the model developed in this paper also provides a general framework for analyzing player agency in any interactive experience (e.g., interactive games).

This neo-Aristotelian theory integrates Murray's[12] proposed aesthetic categories for interactive stories and Aristotle's structural categories for drama.[1] The theory borrows from Laurel's treatment of Aristotle in an interactive context[7,8] but extends it by situating Murray's category of agency within the model; the new model provides specific design guidelines for maximizing user agency. First, I will give the definition of interactive drama that motivates this theory and situate this definition with respect to other notions of interactive story. Next, I will present Murray's three categories of immersion, agency, and transformation. Then I will present a model of Aristotle's categories, relating them in terms of formal and material causation. Within this model, agency will be situated as two new causal chains inserted at the level of character. Finally, I will use the resulting model to clarify conceptual and technical issues involved in building interactive dramatic worlds and briefly describe a current project informed by this model.

Defining Interactive Drama

Many game designers, writers, and theorists have wrestled with the vexing question: "What is interactive story?" This paper continues a specific thread of discussion with respect to this question, the thread begun by Laurel's adoption of an Aristotelian framework first for interactive drama[8] and then more generally for interactive experiences[7] and continued by Murray's description of the experiential pleasures and properties of interactive stories.[12] While Murray explores a variety of interactive story types, this paper will focus explicitly on the notion of interactive drama as defined in Laurel's thesis[8] and pursued by the Oz Project at Carnegie Mellon University.[3,16]

In this conception of interactive drama, the player assumes the role of a first-person character in a dramatic story. The player does not sit above the story, watching it as in a simulation, but is immersed *in* the story.

Following Laurel, dramatic (Aristotelian) stories are distinguished from narrative stories by the following properties:

- Enactment vs. Description
- Intensification vs. Extensification
- Unity of Action vs. Episodic Structure

Enactment refers to action. Dramas utilize action rather than description to tell a story. Intensification is achieved by arranging incidents so as to intensify emotion and condense time. In contrast, narrative forms often "explode" incidents by offering many interpretations of the same incident, examining the incident from multiple perspectives and expanding time. Unity of action refers to the arrangement of incidents such that they are all causally related to a central action. One central theme organizes all the incidents that occur in the story. Narratives tend to employ episodic structure, in which the story consists of a collection of causally unrelated incidents.

Certainly not all interactive story experiences must have the properties of Aristotelian drama. In fact, most interactive story experiences built to date have either been highly episodic (generally those narrative experiences built by the game industry, such as adventure games), have employed a hypertextual logic of association rather than a logic of dramatic probability and causality (generally those experiences built by fine artists and writers), or have focused on story not as a highly structured experience created by an author for consumption by an audience, but rather as a shared social construction facilitating human communication (multi-user worlds such as MUDs, MOOs, and avatar spaces, massive multi-player games such as "Everquest" and "Ultima Online," and games such as Purple Moons "Rocket" series or Will Wright's "The Sims"). Additionally, the interaction in an interactive story does not necessarily have to be first-person interaction as a character within the story. The neo-Aristotelian poetics developed here informs a specific niche within the space of interactive narrative and provides a principled way of distinguishing this niche from other interactive narrative experiences.

Murray's Aesthetic Categories

Murray[12] proposes three aesthetic categories for the analysis of interactive story experiences: immersion, agency, and transformation.

Immersion is the feeling of being present in another place and engaged in the action therein. Immersion is related to Colridge's "willing suspension of disbelief." When we are immersed in an experience, we are willing to accept the internal logic of the experience, even though this logic deviates from the logic of the real world. A species of immersion is telepresence, the feeling of being physically present (from a first-person point of view) in a remote environment.

Agency is the feeling of empowerment that comes from being able to take actions in the world whose effects relate to the player's intention. This is not mere interface activity. If there are many buttons and knobs for the player to twiddle, but all this twiddling has little effect on the experience, there is no agency. Furthermore, the effect must relate to the player intention. If, in manipulating the interface elements, players do have an effect on the world, but they are not the effects that the players intended (perhaps they were randomly trying things because they didn't know what to do, or perhaps they thought that an action would have one effect but it had another), then there is no agency.

Transformation is the most problematic of Murray's three categories. Transformation has at least three distinct meanings:

- Transformation as masquerade. The game experience allows players to transform themselves into others for the duration of the experience.
- Transformation as variety. The game experience offers a multitude of variations on a theme. Players are able to exhaustively explore these variations and thus gain an understanding of the theme.
- Personal transformation. The game experience takes players on a journey of personal transformation. Transformation as masquerade and variety can be seen as a means to effect personal transformation.

Integrating Agency into Aristotle

Murray's categories are phenomenological categories of the interactive story experience (categories describing what it *feels* like to participate in an interactive story). Aristotle's categories (described below) are structural categories for the analysis of drama (categories describing what *parts* a dramatic story is made of). The trick in developing a theoretical framework for interactive drama is integrating the phenomenological aspect of first-person experiences (what it feels like) with the structural aspects of carefully crafted stories. In attempting this integration, I will first discuss the primacy of the category of agency. Second, I will briefly present an interpretation of the Aristotelian categories in terms of material and formal cause. Finally, agency will be integrated into this model.

Primacy of Agency

From an interactive dramatic perspective, agency is the most fundamental of Murray's three categories. Immersion, in the form of engagement, is already implied in the Aristotelian model. Engagement and identification with the protagonist are necessary in order for an audience to experience catharsis. Transformation, in the form of change in the protagonist, also already exists in the Aristotelian model. Murray's discussion of transformation as variety, particularly in the form of the kaleidoscopic narrative that refuses closure, is contrary to the Aristotelian ideals of unity and intensification. To the extent that we want a model of interactive *drama*, as opposed to interactive narrative, much of Murray's discussion of transformation falls outside the scope of such a model. While immersion and transformation exist in some form in non-interactive drama, the audience's sense of having agency within the story is a genuinely new experience enabled by interactivity. For these reasons, agency will be the category integrated with Aristotle.

Aristotelian Drama

Following Laurel,[7] Aristotle's theory of drama is represented in Figure 1. Aristotle analyzed plays in terms of six hierarchical categories, corresponding to different "parts" of a play. These categories are related via material cause and formal cause. The material cause of something is the material out of which the thing is created. For example, the material cause of a building is the building materials of which it is constructed. The formal cause of something is the abstract plan, goal, or ideal toward which something is heading. For example, the formal cause of a building is the architectural blueprints.

In drama, the formal cause is the authorial view of the play. The author has constructed a plot that attempts to explicate some theme. The characters required in the play are determined by the plot; the plot is the formal cause of the characters. The characters' thought processes are determined by the kind of character they are. The language spoken by the characters is determined by their thought. The patterns (song) present in the play are determined, to a large extent, by the characters' language (more generally, their actions). The spectacle, the sensory display presented to the audience, is determined by the patterns enacted by the characters.

In drama, the material cause is the audience view of the play. The audience experiences a spectacle, a sensory display. In this display, the audience detects patterns. These patterns are understood as character actions (including language). Based on the characters' actions and spoken utterances, the audience infers the characters' thought processes. Based on this understanding of the characters' thought processes, the audience develops an understanding of the characters, the characters' traits and propensities. Based on all this information, the audience understands the plot

structure and the theme. In a successful play, the audience is then able to recapitulate the chain of formal causation. When the plot is understood, there should be an "ah-ha" experience in which the audience is now able to understand how the characters relate to the plot (and why they must be the characters they are), why those types of characters think they way do, why they took the actions they did and said what they did, how their speech and actions created patterns of activity, and how those patterns of activity resulted in the spectacle that the audience saw. By a process of interpretation, the audience works up the chain of material cause in order to recapitulate the chain of formal cause.

Interactive Drama

Adding interaction to the Aristotelian model can be considered the addition of two new causal chains at the level of character.

In Figure 2, the gray arrows are the traditional chains of material and formal causation. The player has been added to the model as a character who can choose his or her own actions. This has the consequence of introducing two new causal chains. The players' intentions become a new source of formal causation. By taking action in the experience, the players' intentions become the formal cause of activity happening at the levels from language down to spectacle. But this ability to take action is not completely free; it is constrained from below by material resources and from above by formal authorial causation from the level of plot.

The elements present below the level of character provide the player with the material resources (material cause) for taking action. The only actions available are the actions supported by the material resources present in the game. The notion of affordance[13] from interface design is useful here. In interface design, affordances are the opportunities for action made available by an object or interface. But affordance is even stronger than implied by the phrase "made available;" in order for an interface to be said to afford a certain action, the interface must in some sense "cry out" for the action to be taken. There should be a naturalness to the afforded action that makes it the obvious thing to do. For example, the handle on a teapot affords picking up the teapot with your hand. The handle cries out to be grasped. In a similar manner, the material resources in an interactive drama afford action. Thus these resources not only limit what actions can be taken (the negative form of constraint) but cry out to make certain actions obvious (the positive form of constraint). Several examples of the material affordances in interactive drama are provided below.

The characters in an interactive drama should be rich enough that the player can infer a consistent model of the characters' thought. If the characters' thought (goals, motivations, desires) can be understood, then this thought becomes a material resource for player action. By reasoning about the other characters' thoughts, the player can take actions to influence these characters, either to change their thoughts or actively help or hinder them in their goals and plans.

The dialog (language) spoken by the characters and the opportunities for the player to engage in dialog are another material resource for action. Dialog is a powerful means for characters to express their thoughts; it is instrumental for helping the player to infer a model of the characters' thoughts. Conversely, dialog is a powerful means to influence character behavior. If the experience makes dialog available to the player (and most contemporary interactive experiences do not), this becomes a powerful resource for expressing player intention.

The objects available in the experience (I place the presence of interactive objects somewhere between spectacle and pattern) are yet another resource for player action.

Finally, the mechanics of interaction (spectacle) provide the low-level resources for player actions. The mechanics provide the interface conventions for taking action.

In addition to the material affordances (constraints) from below, players experience formal constraints from above. Of course, these constraints are not directly perceived by the players, but, just as in non-interactive drama, are understood by recapitulating the author's chain of formal causation by making inferences along the chain of material causation. In non-interactive drama, understanding the formal chain of causation allows the audience to appreciate how all the action of the play stems from the dramatic necessity of the plot and theme. In interactive drama, understanding the formal causation from the level of plot to character additionally helps players understand what to do (why they should take action within the story world *at all*). Just as the material constraints can be considered as affording action from the levels of spectacle through thought, the formal constraints afford *motivation* from the level of plot. This motivation is conveyed as dramatic probability. By understanding what actions are dramatically probable, the player understands what actions are worth considering.

Agency

We are now ready to propose a prescriptive, structural model for agency. *Players will experience agency when there is a balance between the material and formal constraints.* When the actions motivated by the formal constraints (affordances) via dramatic probability in the plot are commensurate with the material constraints (affordances) made available from the levels of spectacle, pattern, language and thought, then players will experience agency. An imbalance results in a decrease in agency. This will be made clearer by considering several examples.

Many puzzle-based adventures suffer from the imbalance of providing more material affordances than formal affordances. This results in the feeling of having many things to do (places to go, objects to fiddle with) without having any sense of why any one action would be preferable to another. For example, "Zork Grand Inquisitor" offers a rich world to navigate and many objects to collect and manipulate. Yet, since there is no unity of action, there is no way to relate current actions to the eventual goal of defeating the Grand Inquisitor. This leaves the player in the position of randomly wandering about trying strange juxtapositions of objects. This detracts from the sense of agency. Though the player can take action, this action is often not tied to a high-level player intention. Notice that adding more material opportunities for action would not help the matter. The problem is not a lack of options. The problem is having insufficient formal constraint to decide between choices.

"Quake" (and its ilk) induce agency by providing a nice balance between material and formal constraints. The proto-plot establishes the following formal constraints (dramatic probabilities):

1. Everything that moves will try to kill you.
2. You should try to kill everything.
3. You should try to move through as many levels as possible..

From these three principles, all the rest of the action follows. The material affordances perfectly balance these formal affordances. Players can run swiftly and smoothly through the space, pick up a wide array of lethal weapons, and fire these weapons at monsters to produce satisfying, gory deaths. The monsters' behavior is completely consistent with the "kill-or-be-killed" ethos. Everything that one would want to try and do given the formal constraints is doable. There are no extraneous actions available (for example, being able to strike up a conversation with a monster) that are not dictated by the formal constraints.

Note that though these example games are not specifically interactive drama, the model can still be used to analyze player agency within these games. Though the model is motivated by interactive drama, it can be used to analyze the sense of agency in any interactive experience by analyzing the experience in *terms of the dramatic categories* offered by the model. For example, though "Quake" has neither plot nor characters in the strict sense, there are top-down player expectations established by a "proto-plot." This "proto-plot" is communicated by the general design of the spectacle (e.g., the design of the creepy industrial mazes) as well as the actions of the characters, even if these characters do have primitive diction and thought.

In order to invoke a sense of agency, an interactive experience must strike a balance between the material and formal constraints. An experience that successfully invokes a sense of agency inhabits a "sweet spot" in design space. Trying to add additional formal constraints (more plot) or additional material constraints (more actions) to a balanced experience is likely to move it out of the sweet spot.

Relationship to Immersion and Transformation

Agency was taken as the fundamental Murray category to integrate with Aristotle. In this section, I examine what the new, integrated model has to say about immersion and transformation.

Immersion

Murray suggests three ways of inducing immersion: structuring participation with a mask (an avatar), structuring participation as a visit, and making the interaction conventions (the interface mechanics) seamless. These three mechanisms can be viewed in turn as a way to provide material and formal constraints, as a design suggestion for balancing the constraints, or as a design suggestion for providing effective material constraints at the level of spectacle. Agency is a necessary condition for immersion.

An avatar can provide both material and formal constraints on a player's actions. The avatar can provide character exposition through such traits as physical mannerisms and speech patterns. This character exposition helps the player to recapitulate the formal plot constraints. Through both input and output filtering (e.g. the characters in Everquest, the subjective avatars of[10]), the avatar can provide material constraints (affordances) for action.

A visit is one metaphor for balancing material and formal constraints when the material opportunities for action are limited. From the formal side, the conventions of a visit tell the player that they won't be able to do much. Visits are about just looking around, possibly being guided through a space. Given the limited expectations for action communicated by the formal constraints, the designer can get away with (and in fact, must only) providing limited material means for action.

The mechanics provide the material resources for action at the level of spectacle (the interface can be considered part of the spectacle). Providing a clean, transparent interface insures that agency (and thus immersion) will not be disrupted.

Transformation

Most of Murray's discussion of transformation examines transformation as variety, particularly in the form of kaleidoscopic narratives that can be re-entered multiple times so players can experience different aspects of the story. Agency, however, requires that a plot structure be present to provide formal constraints. An open-ended story without a clear point of view may disrupt the plot structure too much, thus disrupting agency. However, transformation as variety is necessary to make interaction really *matter*. If, every time a player enters the dramatic world, roughly the same story events occur regardless of the actions taken by the player, the player's interaction would seem inconsequential; the player would actually have no real effect on the story.

One way to resolve the apparent conflict between transformation and agency is to note that agency is a first-person experience induced by making moment-by-moment decisions within a balanced (materially and formally) interactive system, while transformation as variety is a third-person experience induced by observing and reflecting on a number of interactive experiences. Imagine an interactive drama system that guides the player through a fixed plot. As the player interacts in the world, the system, through a number of clever and subtle devices, moves the fixed plot forward. Given that these devices are clever and subtle, the player never experiences them as coercive; the player is fully engaged in the story, forming intentions, acting on them, and experiencing agency. Imagine an observer who watches many players interact with this system. The observer notices that no matter what the players do, the same plot happens (meaning that roughly the same story events occur in the same order, leading to the same climax). By watching many players interact with the system, the observer begins to discern the devices that *control* the plot *in the face of* player interaction. This observer will conclude that the player has no true agency, that the player is not able to form any intentions within the dramatic world which actually matter. But the first-time player within the world *is* experiencing agency. The designers of the dramatic world could conclude that since they are designing the world for the player, not for the observer, as long as the player experiences a true sense of interactive freedom (agency), transformation as variety is not an important design consideration.

The problem with this solution to the agency vs. transformation dilemma becomes apparent as the player interacts with the world a *second* time. On subsequent replays of the world, the player and the observer become the same person. The *total* interactive experience consists of both first-person engagement within the dramatic world and third-person reflection across multiple experiences in the world. In order to support the total experience, the dramatic world must support both first-person engagement and third-person reflection; it must provide both agency *and* transformation as variety.

A dramatic world supporting this total experience could provide agency (and the concomitant need to have a plot structure providing formal constraints) *and* transformation by actively structuring the player experience such that each run-through of the story has a clean, unitary plot structure, but multiple run-throughs have different, unitary plot structures. Small changes in the players choices early on result in experiencing a different unfolding plot. The trick is to design the experience such that, once the end occurs, any particular run-through has the force of dramatic necessity. The dramatic probabilities should smoothly narrow to a necessary end. Early choices may result in different necessary ends; later choices can have less effect on changing the whole story, since the set of dramatically probable events has already significantly narrowed. Change in the plot should not be traceable to distinct branch points; the player will not be offered an occasional small number of obvious choices that force the plot in a different direction. Rather, the plot should be smoothly mutable, varying in response to some global state that is itself a function of the many small actions performed by the player throughout the experience.

The Type of Experience Informed by the Model

This neo-Aristotelian poetics clarifies a specific conceptual experiment in the space of interactive stories. Specifically, the experiment consists of creating an interactive dramatic experience with the experiential properties of traditional drama, namely enactment, intensity, catharsis, unity, and closure. The Aristotelian analytic categories describe the structure (parts and relationships) of a story experience that induces these experiential properties. The way in which interaction has been incorporated into this model clarifies what is meant by *interactive* dramatic experience. Here, interaction means *first-person* interaction as a character within the story. Further, the essential experiential property of interactivity is taken to be agency. The interactive dramatic experience should be structured in such a way as to maximize the player's sense of agency within the story. The model provides prescriptive structural guidance for maximizing agency (namely, to balance material and formal constraints). So the conceptual experiment informed by this model can be more precisely stated as follows: build a first-person, interactive dramatic world that, in addition to the classical experiential properties of Aristotelian drama, also provides the player with a strong sense of agency.

Technical Agenda

In addition to clarifying conceptual and design issues in interactive drama, the neo-Aristotelian model informs a technical agenda of AI research necessary to enable this kind of experience.

The primary heuristic offered by the model is that to maintain a sense of player agency in an interactive experience, material and formal constraints must be balanced. As the sophistication of the theme and plot of an experience increases, maintaining this balance will require characters whose motivations and desires are inferable from their actions. In addition, these characters will have to respond to the player's actions. Believable agents, that is, computer-controlled characters with rich personality and emotion, will be necessary to provide these characters. Additionally, for many plots (e.g., domestic dramas in which the plot centers around relationships, trust, betrayal, infidelity, and self-deception), language is necessary to communicate the plot. In order to convey the formal constraints provided by the plot, the characters must have a rich repertoire of dialog available. In addition, the player must be able to talk back. One can imagine a system in which the characters can engage in complex dialog but the player can only select actions from menus or click on hotspots on the screen; this is, in fact, the strategy employed by character-based multimedia artwork and contemporary adventure games.

But this strategy diminishes agency precisely by unbalancing material and formal constraints. The characters are able to express complex thoughts through language. However, players are not able to influence their thought except at the coarse level provided by the mouse-click interactivity. Thus maximizing player agency requires providing at least a limited form of natural language dialog.

The function of interactive characters is primarily to communicate material and formal constraints. That is, the player should be able to understand why characters take the actions they do, and how these actions relate to the plot. Sengers[14] provides a nice analysis of how this focus on agents as communication vs. agents as autonomous, independent entities results in changes in agent architectures. When the focus changes from "doing the right thing" (action selection) to "doing the thing right" (action expression), the technical research agenda changes.[15] The neo-Aristotelian model indicates that action expression is exactly what is needed. In addition, an interactive drama system must communicate dramatic probability (likely activity given the plot) while smoothly narrowing the space of dramatic probability over time. This means that story action must be coordinated in such a way as to communicate these plot-level constraints. Thus it is not enough for an individual character's actions to be "readable" by an observer. Multiple characters must be coordinated in such a way that their joint activity communicates both formal and material (plot and character level) affordances. This requires a technical solution that blurs the firm plot/character distinction usually made in AI architectures for interactive drama.[5,16]

Façade: An Interactive Drama Guided by the Model

The author is currently engaged in a three-year collaboration to build Façade,[9] an interactive story world that seeks to carry out the conceptual and technical experiment informed by the neo-Aristotelian poetics. Together, we will:

- Create a compelling, well-written story that obeys dramatic principles, designed with many potential ways to play out.
- Build artificial intelligence that can control the behavior of real-time-animated computer characters that will perform the roles of all but one of the characters in the story.
- Create a user interface that allows the player to easily move within the world and converse and gesture with the computer characters.
- Build AI that can understand natural language and gestural input within the context of the story.
- Build AI that can integrate the player's interactions into the space of potential plot directions and character behaviors in the story.
- Collaborate with voice actors and animators to author spoken dialogue, character behavior, and story events within the engine, to construct the finished story world.

Story Requirements

The story requirements describe the properties we wish our story to have. These are not intended to be absolute requirements. This is not a description of the properties that all interactive stories must have. Rather, these requirements are the set of assumptions grounding the design of the particular interactive story we intend to build.

- Short one-act play. Any one run of the scenario should take the player 15 to 20 minutes to complete. We focus on a short story for a couple of reasons. Building an interactive story has all the difficulties of writing and producing a non-interactive story (film or play) plus all the difficulty of supporting true player agency in the story. In exploring this new interactive art form, it makes sense to first work with a distilled form of the problem, exploring scenarios with the minimum structure required to support dramatically interesting interaction. In addition, a short one-act play is an extreme, contrarian response to the many hours of game play celebrated in the design of contemporary computer games. Instead of providing the player with 40 to 60 hours of episodic action and endless wandering in a huge world, we want to design an experience that provides the player with 15 to 20 minutes of emotionally intense, tightly unified, dramatic action. The story should have the intensity, economy, and catharsis of traditional drama.

- Relationships. Rather than being about manipulating magical objects, fighting monsters, and rescuing princesses, the story should be about the emotional entanglements of human relationships. We are interested in interactive experiences that appeal to the adult, non-computer-geek, movie-and-theater-going public.

- Three characters. The story should have three characters, two controlled by the computer and one controlled by the player. Three is the minimum number of characters needed to support complex social interaction without placing the responsibility on the player to continually move the story forward. If the player is shy or confused about interacting, the two computer-controlled characters can conspire to set up dramatic situations, all the while trying to get the player involved.

- The player should be the protagonist. Ideally, the player should experience the change in the protagonist as a personal journey. The player should be more than an "interactive observer" who simply pokes at the two computer-controlled characters to see how they change.

- Embodied interaction should matter. Though dialog should be a significant (perhaps the primary) mechanism for character interaction, it should not be the sole mechanism.

Embodied interaction, such as moving from one location to another, picking up an object, or touching a character, should play a role in the action. These physical actions should carry emotional and symbolic weight, and should have a real influence on the characters and their evolving interaction. The physical representation of the characters and their environment should support action significant to the plot.

- Action takes place in a single location. This provides unity of space and forces a focus on plot and character interaction.

- The player should not be over-constrained by a role. The amount of non-interactive exposition describing the player's role should be minimal. Players should not have the feeling of playing a role, of actively having to think about how the character they are playing would react. Rather, players should be able to be themselves as they explore the dramatic situation. Any role-related scripting[12] should occur as a natural by-product of their interaction in the world. Players should "ease into" their role; the role should be the "natural" way to act in the environment, given the dramatic situation.

Story

Our story, which satisfies these story requirements, is a domestic drama in which a married couple has invited the player over for dinner. (Assume for the moment that the player's character is male.) Grace and Trip are apparently a model couple, socially and financial successful, well-liked by all. Grace and Trip both know the player from work. Trip and the player are friends; Grace and the player have gotten to know each other fairly recently. Shortly after arriving at their house for dinner, Grace confesses to the player that she has fallen in love with him. Throughout the rest of the evening, the player discovers that Grace and Trip's marriage is actually falling apart. Their marriage has been sour for years; deep differences, buried frustrations, and unspoken infidelities have killed their love for each other. How the façade of their marriage cracks, what is revealed, and the final disposition of Grace and Trip's marriage, and Grace and the player's relationship, depends on the actions of the player. The story's controlling idea: To be happy, you must be true to yourself.

The above story description assumes a male player. Ideally, players will be able to choose whether they wish to be a male or female player (important to support the "player should not be over-constrained by a role" story requirement). In the case of a female player, the story would play itself out symmetrically, with Trip confessing his love for the player. For the purposes of this story, we are assuming heterosexual relationships. Ideally, sexual orientation would be selectable by the player as well.

Interface

The story world is presented to the player as an animated 3D environment. The environment and characters within the environment are rendered in an illustrative style reminiscent of graphic novels. The player is able to move about this environment from a first-person point of view, gesture and pick up objects, and converse with the other characters by typing. The computer-controlled characters look directly out of the screen to gesture and talk to the player. The conversation discourse is real-time; that is, if the player is typing, it is as if those words are spoken in (pseudo) real-time.

Story Structure

The story is structured as a classic Aristotelian plot arc. The AI plot system explicitly attempts to change dramatic values (e.g., the love between Trip and Grace, the trust between the player and Trip) in such a way as to make a well-formed plot arc happen. In the theory of (classical) dramatic writing, the smallest unit of value change is the beat.[11] Roughly, a beat consists of an action/reaction pair between characters. Beats are sequenced to make scenes, scenes to make acts, acts to make stories. The AI plot system contains a library of beats appropriate for our story. The system dynamically sequences beats in such a way as to respond to player activity and yet maintain a well-formed plot arc. For the player, each run-through of the story should have the force of dramatic necessity. Explicit decision points, which would highlight the non-linearity of the story, should not be visible. However, in multiple run-throughs of the story, the player's actions have a significant influence on which events occur in the plot, which are left out, and how the story ends. Only after playing the experience six or seven times should players begin to feel they have "exhausted" the interactive story. In fact, full appreciation of the experience requires the story to be played multiple times. In Façade, our goal is to create an interactive story experience that provides the player with the agency to have an effect on the trajectory of the story, yet has the feel of a traditional, linear, dramatic experience.

Conclusion

In this paper, Murray's concept of agency was integrated into Laurel's Aristotelian structural model to yield a proposed Aristotelian interactive poetics. This model illuminates the general conditions under which a user will experience agency in any interactive experience and provides design and technology guidance for the particular case of building interactive dramatic experiences.

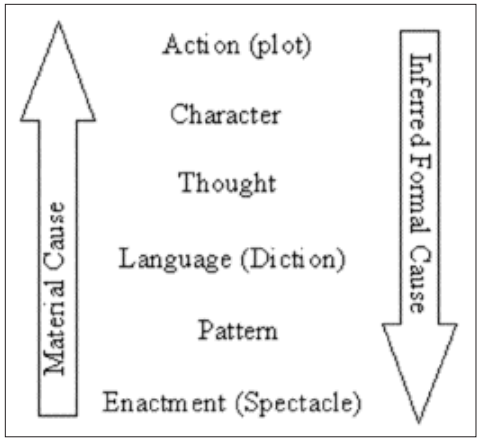

Figure 1. Aristotelian theory of drama.

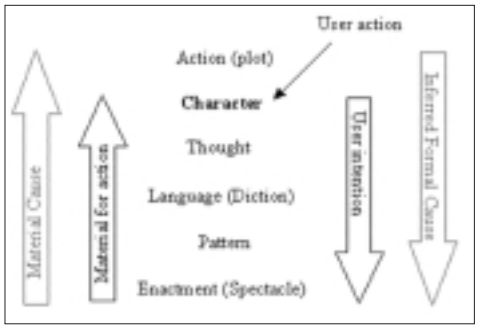

Figure 2. Neo-Aristotelian theory of drama.

Figure 3. The Façade interactive dramatic world.

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Rethinking Agency and Immersion: Videogames as a Means of Consciousness-Raising

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Abstract

Until recently, most videogame characters did not reflect our everyday life for the simple reason that most of them were trolls, aliens, and monsters. However, this has changed since the introduction of "The Sims," the people simulator. Nevertheless, characters in this game are still flat since "The Sims" simulates life in a Disneyland-like way, avoiding ideological conflicts.

Encouraged by authors like Brenda Laurel and Janet Murray, videogame designers have been taking for granted that a high level of agency and immersion are desirable effects. However, I will show that alternative, non-Aristotelian techniques could be used to develop character-driven videogames that enhance critical thinking about ideological issues and social conflicts while keeping the experience enjoyable. I will do this by borrowing some concepts from Bertolt Brecht's and Augusto Boal's ideas on non-Aristotelian theater and applying them to videogame design.

In this paper, I propose that a modified version of "The Sims" would allow players to create behavioral rules for their characters that reflect their personal opinions. Like in Boal's Forum Theater, this game would foster critical discussion about social and personal problems.

Rethinking Agency and Immersion: Videogames as a Means of Consciousness-Raising

Do you think videogames are state-of-the-art? Think again. The basic rules for videogame design were written more than 20 centuries ago. At least, this is literally what Brenda Laurel argued in her now classic Computers as Theater, where she applied Aristotle's *Poetics* to software and videogame design.[10] In the same tradition, Janet Murray describes "immersion" (understood as suspension of disbelief) and "agency" (the ability of the computer user to participate in simulations) as two of the desired effects that interactive narrative designers should incorporate in their products.[11]

As Murray pointed out, there is a clear similitude between adventure games such as "Mario Bros." or "Tomb Raider" and folk tales. Both are plot-centric products with a clear goal ("rescue the princess," "find the treasure"), where the main character has to overcome problems in order to complete a quest. My goal in this paper is to suggest alternative techniques for creating character-centric videogames that allow players to explore their own reality. In order to do this, I will drop the traditional Aristotelian design conventions and use Augusto Boal's drama theory, creating videogames that enhance players' critical thinking and understanding of their society.

The Logic Behind Games

Nobody really cares if Lara Croft has a kidney disease or if Mario is a bit paranoid. The monsters in "Doom" are simply mean: nobody is interested in knowing why they behave in that particular way. It may be genetic, or maybe they are just fed up with intergalactic imperialists who keep sending space marines to kill them all.

According to E.M. Foster's classification for literary characters, most videogame characters would be flat:

Flat characters are 2D in that they are relatively uncomplicated and do not change throughout the course of a work. By contrast, round characters are complex and undergo development, sometimes sufficiently to surprise the reader.[5]

Just like what happens in folk tales, videogame characters are flat for functional reasons: what is important is to get the plot moving forward. The question that needs to be answered is "what happens next?" and not "why the character behaved in such a way?"

I wonder if it is fair to analyze videogame characters with rules that are designed for literary ones. Actually, it is even possible that videogame characters are not characters at all, as game designer Rob Fullop suggests:

When you play a game 10,000 times, the graphics become invisible. It's all impulses. It's not the part of your brain that processes plot, character, story. If you watch a movie, you become the hero - Gilgamesh, Indiana Jones, James Bond, whomever. The kid says, I want to be that. In a game, Mario isn't a hero. I don't want to be him; he's me. Mario is a cursor.[8]

I think that Fullop's observation is right. While videogame characters do have certain particular traits, it is hard to argue that they have a personality. The more freedom the player is given, the less personality the character will have. It just becomes a "cursor" for the player's actions. However, certain games, such as "The Sims," have characters (known as Sims) that are not controlled from a first-person perspective. Players do not assume the role of one particular Sim. They are able to control many Sims.

Welcome to the Suburbs

The best-selling videogame of the year 2000 was a suburban American life simulator. Drawing on his previous works, notably "Sim City," the urban simulator, game designer Will Wright created a complex game that put videogames on a less fantastic representational track, dealing with family life and human relationships. Players control Sims, the inhabitants of a virtual American suburb, according to their own goals: there is no "winning" scenario in the game. Characters' personalities are described through five different traits (Neat, Outgoing, Active, Playful, Nice), and players can chose from a fixed set of actions, such as cleaning, eating, sleeping, etc. The personality of the Sims is shown through their mood. They totally lack bias and any sort of philosophical, political, or religious beliefs.

One of the most interesting features of the game, which is coherent with the recent "mod" videogame culture, where designers provide tools for players to expand the original game, is the ability

to create and exchange customized features. For example, players can create their own "skins" to make their Sims look like their favorite superhero, or even like themselves. It is also possible to create custom wallpapers and download new objects. However, players are not allowed to design new functional objects or behaviors.

"The Sims" is an excellent example of how videogames can convey ideology. Even if this title represents a clear breakthrough for the industry, the consumerist principles behind the simulation are nothing short of disturbing. Literally, the number of friends you have is in direct proportion to the amount of things that you own. Of course, it is possible to argue that this is not the designer's fault, but rather that the simulation is simply too realistic. The role of ideology in videogames is more complex than in traditional media because videogames not only represent actions, but they also model behavioral rules. If narrative is about description, then simulation is about legislation. In his study of urban crisis, anthropologist Julian Bleeker shows how the racial factor is excluded from the "Sim City 2000" urban simulation. While riots happen in "Sim City 2000," they are always triggered by causes such as heat or high unemployment. However, there is no direct reference to race problems as one of the possible co-factors that may influence riots. The virtual city has no room for a "Rodney King" incident. As simulations strive to be more realistic, they need to include more rules, and this can not be done without the designers conveying their particular view of how the system, in this case society and human relationships, works. Actually, the most radical claim made by "The Sims" is not its consumerist creed but the fact that it is arguing that human life can be described as a set of rules.

In her study on how people deal with simulations, Sherry Turkle imagines the possibility of using simulations for players to analyze and question their ideological assumptions:

But one can imagine a third response. This would take the cultural pervasiveness of simulation as a challenge to develop a more sophisticated social criticism. This new criticism would not lump all simulations together, but would discriminate among them. It would take as its goal the development of simulations that actually help players challenge the model's built-in assumptions. This new criticism would try to use simulation as a means of consciousness-raising.[12]

This alternative that Turkle envisions for simulation exactly matches the work that Augusto Boal has been doing in theater during the last decades.

Brecht, Boal, and Non-Immersive Acting

It is common to think that "immersion," or "willing suspension of disbelief," describe the audience's experience in a narrative or dramatic setting. In other words, the readers or viewers accept suspension of their disbelief (or actively create belief).

In theater, immersion affect both spectators and performers. Traditional acting schools encourage actors to get immersed in their characters: to get "into their skins" in order to feel and act like them. While I do not believe that "playing" in videogame terms is equal to "acting", it is easy to see that the distance between the gamer and the videogame character is minimal. The player just moves the joystick and the character jumps: there is no subtle performance in this action; players are not trying to convey any feeling through the jumping, and they definitively have no means to "perform" their own jumps.

However, some drama theorists do not promote immersion as a desired goal. German playwright Bertolt Brecht developed a theory of drama that was clearly against Aristotle's ideas; he argued that Aristotelian theater keeps the audience immersed without giving them a chance to take a step back and critically think about what is happening on the stage. Brecht created several techniques, known as A-effects, in order to "alienate" the play, reminding the spectators that they were experiencing a representation and forcing them to think about what they were watching.

Brecht's "epic" techniques were not just targeted to the audience. He also encouraged performers to follow them. Brecht wanted the actors to be completely aware of their actions. Instead of being "inside the skin" of the character, he wanted them to be a critical distance that would let them understand their role.

Brazilian dramatist Augusto Boal took Brecht's ideas even further by creating a set of techniques, known as the "Theater of the Oppressed" (TO), that literally tears down the stage's "fourth wall." Boal's main goal is to foster critical thinking and break the actor/spectator dichotomy by creating the "spect-actor," a new category that integrates both by giving them active participation in the play. The repertoire of techniques of TO is extremely large and includes, among others, the "invisible theater," where actors work "undercover" in public spaces- and the "Forum Theater."

Forums are created around a short play (five to 10 minutes long), usually scripted on-site based on the suggestions of the participants. The scene always enacts an oppressive situation, where the protagonist has to deal with powerful characters that do not let her achieve her goals. For example, the play could be about a housewife whose husband forbids her to go out with her friends. The scene is enacted without showing a solution to the problem. After one representation, anybody in the public can interrupt the play and take over the place of the protagonist and suggest, through her acting, the solution that she envisions would break the oppression. Since the problems are complex, the solutions are generally incomplete. This is why the process is repeated several times, always offering a new perspective on the subject.

In Boal's own words: "It is more important to achieve a good debate than a good solution."[2] It is important to stress that Boal uses theater as a tool, not as a goal per se. In other words, the ultimate objective of Forum Theater plays is not to produce beautiful or enjoyable performances, but rather to promote critical discussions among the participants. Unlike traditional theater that offers just one complete, closed sequence of actions, Forum Theater sessions show multiple perspectives on a particular problem. They do not show "what happened," but rather "what could happen." It is a theater that stresses the possibility of change, at both social and personal levels.

Non-Immersive Videogame Playing

I propose expanding the concept of third-person characters, such as the ones in "The Sims." In traditional videogames, the player "is" the character. In "The Sims," the player can control the character in a less direct way. However, "The Sims"' characters are generally flat, since most of their differences are based either on their moods, or on visual traits that do not affect their behavior. This would be solved if players had more control over character creation by deciding their behavioral rules instead of just picking their clothes.

My intention is to take a Boalian approach to videogame playing, based on the construction and discussion of characters as a videogame equivalent of Forum Theater. This approach has similarities with some of the constructivist work based on "learning by doing", particularly Yasmin Kafai's work on science learning through videogame design.[9] This is no accident, since Boal's work is based on Paulo Freire's Pedagogy of the Oppressed, which shares some basic ideas with constructivism. Both constructivism and Freire's pedagogy were created around Piaget's idea that learning is not transmitted but constructed. However, while constructivism has focused on education in general and science in particular, Freire and Boal offer a more robust set of techniques for dealing with personal and social issues, which are the kind of problems that I want to address through videogames.

It is important to state that my goal is not to do a literal translation of Boal techniques, but rather to use them as a source of inspiration. I will use, then, Boal's theory as a guide rather than as a blueprint. Since TO has such a rich set of different techniques, my approach would just represent a small glimpse of what could emerge from the collaboration between TO and videogames.

The Sims of the Oppressed?

The idea for a videogame that I will describe is based on "The Sims" and takes the "mod" concept (videogame modification by amateur designers) to its extreme by allowing players to modify the simulation itself. This is similar to what Boal's Forum Theater does. It simulates an event and allows participants to play within those defined rules but also to create, try, and discuss alternative models.

I have been playing "Sim City" for several years now and I never thought about how racial issues are modeled in the simulation. I did notice, though, that the FIFA series of soccer videogames do not include my home country, Uruguay, even though it won the World Cup twice. Thankfully, this was easy to fix. Some Uruguayan player used one of the features of the game that allows you to create teams. He simply included the list of current Uruguayan soccer players, along with their uniforms color. However, to expand "Sim City" to deal with the issues that Bleeker pointed out would be a much more complex task. Firstly, its design does not allow modifying the inner rules of the simulation. And even if the program had such a feature, it would require a good deal of programming. It would demand much more work than is needed to create a new "skin."

In order to allow the discussion of social issues, simulations like "The Sims" should allow players to modify the internal rules of the simulated model. The basic gameplay of this modified version, which I will call "The Sims of the Oppressed," would be similar to "The Sims." The main difference would be that, in addition to downloadable objects and skins, it would also be possible to get user-designed characters with different personalities and particular sets of actions. These characters would be created with a special programming tool. Players would be able to rate the different characters and even create their own versions, based on behavioral details that they think need improvement in order to attain a higher level of reality.

A Sample Scenario

The following is a sample scenario of a particular session, based on the rules that I am proposing:

Agnes has been playing with "The Sims of the Oppressed" for a while now. She knows the basic dynamics of the simulation and enjoys it. Nevertheless, she feels that it would be great if family relationships were more realistic. So, she goes to the "Character Exchange" Web site and browses through different characters. She finds one that looks interesting. It is called "Dave's Alcoholic Mother version 0.9," and it is described by its author as:

This mother spends a lot of time working, and she is very tired when she gets back home. Still, every night she has to fix dinner and do some cleaning. She can get very annoyed by children and pets and may become violent. In order to escape from her terrible life, the mother drinks a lot of bourbon. Her behavior includes new actions for the player to use, such as "induced vomiting" for faster reduction of the character's drunkenness.

Agnes considers giving it a try and downloads it into one of the houses with which she has been playing.

Agnes' virtual household is composed of a couple, three children, and a cat. After the downloads, the original mother character is replaced by "Dave's Alcoholic Mother version 0.9". Agnes finds the character quite interesting. After playing with it for a while, she realizes that when the mother reaches a certain degree of fatigue, she starts drinking. The more she drinks, the less she will care about her family. She remains calm unless her husband insists on cuddling or giving her a back rub.

While Agnes thinks that the character is pretty well depicted, there are details that she does not agree with. For example, the character always gets her drinks from the little bar in the living room. Agnes knows that, in general, alcoholics hide their bottles around the house and try not to drink in public. So, she goes back to the "Character Exchange" and looks for another alcoholic mother. She finds one that seems promising: "Dorothy's Alcoholic Methodist Mother version 3.2." After trying it, she realizes that the behavior of this character is much more closer to her concept of an alcoholic mother. She is really intrigued by why the designer insisted on the fact that the mother would be a Methodist, since it does not seem to be related to the character's alcoholism. She checks back on the character designer's Web page, where she finds a short narrative that explains that the character is actually based on a real person who happened to be a Methodist. Even if Agnes finds the story interesting, she thinks that the alcoholic part of the behavior should be separated from the character's religious beliefs. So she uses an editor to modify the character's code and removes the religious references. She also adds some small details, like the fact that the mother loves a certain brand of whisky. Then, she posts it online as "Agnes' Alcoholic Mother 1.0 - Based on Dorothy's Alcoholic Methodist Mother version 3.2," along with a short description of the main behavioral rules. A couple of weeks later, she finds out that her behavior has become quite popular. Actually, some players have posted some modified versions. Some of them have even emailed her with some remarks and criticisms. She downloads some of these new versions and finds a couple that she likes a lot.

Some weeks later, Agnes gets a little tired of playing with the alcoholic mother and wants to give her some more personality. So, she decides that it would be great if the mother became an ecologist. Agnes downloads a character described as "Peter's Radical Greenpeace activist version 9.1." After some editing and modifications, Agnes introduces this behavior to her alcoholic-mother character. Now the mother takes more care of the plants and does not kick the cat anymore when she is drunk.

Building Rules, Crafting Characters

Before even commenting on this design, it is essential to repeat that programming simulated behaviors such as the ones described above is not an easy task. Even if the design tool involved templates or some kind of visual object-oriented programming, it is likely that the average player would consider the task overwhelming. Still, as Amy Bruckman's work on "Moose Crossing" (an object-oriented, multi-user dungeon where participants can modify the environment by creating new objects.) suggests, participants can become involved with programming simulated features and will exchange tips and help with others who are less skilled programmers.[4]

While it is possible that certain players, such as Agnes, could deal with the programming of new behaviors, it is likely that most players would become "lurkers" (people who read online message boards but rarely or never post any message; by extension, this term is applied to any person who is involved in some kind of online community without actively participating. Would this fact necessarily go against the principles of TO, which stress active participation? As Boal states:

In a Forum Theatre session, no one can remain a "spectator" in the negative sense of the word. It's impossible. In Forum Theatre, all the spect-actors know that they can stop the show whenever they want. They know that they can shout "Stop!" and voice their opinions in a democratic, theatrical, concrete way, on stage. Even if they stay on the sidelines, even if they watch from a distance, even if they choose to say nothing, that choice is already a form of participation.[2]

Still, "The Sims of the Oppressed" is not an exact replica of Forum Theater, and it is not enough to simply shout "Stop!" to actively participate. However, I believe that both the multiplicity of behaviors and the fact that amateur designers would create most of its content would foster a critical attitude even in those players who do not create behaviors. Even if the players do not create their own characters, they will not take the simulation rules for granted because they know that different players have alternative opinions about how these rules should work.

The most radical idea behind "The Sims of the Oppressed" is the fact that it is a meta-simulation, which also is one of the characteristics of Forum Theater. By meta-simulation I mean that it is a simulation that allows participants to create simulations. Of course, it does not let players change everything. If it did, it could not be considered a unique product at all. Even if the "Sims of The Oppressed" could be really open-ended, it would still have a model and its own rules that would reflect a biased vision of the world.

In my alternative version of "The Sims," the software publisher does not create characters but instead the players construct them using open-source building blocks. Even if the program would still be biased, the kaleidoscopic availability of different behaviors would give players the opportunity to experiment with a wide range of different constructions. Since many different versions would exist for one single behavior, as we have seen for "alcoholism," the system would help players realize that the concept of behavior, and particularly deviant behavior, is not a fixed entity, but rather a social construction.

The ability of players to modify behaviors posted by others is in fact the ability to exercise criticism through programming, because the simulation rules are changed to match the

programmer's personal view of reality. And, even if most of the players may not code their own behaviors, they would be able to combine existing ones in order to create more complex characters and then share them among others.

The fact that amateur designers can create behaviors means that some behaviors would be buggy or, at least, not very complex. These "bugs" would make players more aware of behavior construction and could behave as equivalents to Brecht's alienation effects, which were intended to break immersion in order to make the spectators view the representation from a more distant, critical distance.

Nevertheless, a simulation like "The Sims of the Oppressed" implies several design issues. The most obvious one is that such an open-ended system would make it easy for players to create certain characters and behaviors that may be problematic, such as "Benny's Pedophile Clown version 1.2." Other behaviors could even be illegal in some countries such as Germany, Canada, or France, where "Adolph's Holocaust-denier Neo-nazi version 6.66" would be prohibited by law. Personally, I think that since the goal of this technique is to encourage critical thinking, I would not censor any opinion. Still, this would be a major problem for the company that produces the software package. No matter how much you stress the fact that the content is created by the users, I do not think that there is any company on Earth that wants to be known as the "one that provided a platform for creating a simulator where you force young children to work in factories for 10 cents a day." The only way that I can think of overcoming this problem would be to release the whole package as a collaborative, open-source project.

Playing with Tolerance

"The Sims of the Oppressed" is just an example on how current simulations could be enhanced to allow more room for discussion and critical thinking by changing the way games deal with character use and design. As I previously said, this is just one example among many that could be possible just by drawing on TO ideas.

Critical thinking is not simply a feature of "The Sims of the Oppressed." It is a requirement. If videogames are to become a space for experimentation, their rules should be open enough to allow players to try different possible approaches. Unlike traditional representational forms, such as narrative, which deliver products as a closed package, videogames have the potential to let players participate in an active way. However, this does not mean in any way that players would become authors They would simply have more freedom to participate, but the system that would serve as their playground would still be authored and would, therefore, carry its own assumptions.

I think that, by introducing human beings as believable, human videogame characters, "The Sims" has opened an ideological Pandora's box. If designers try to ignore this fact, videogames will remain simply toys. However, if they realize that dealing with different models of reality requires a critical attitude, videogames could become a medium for exploring and discussing our personal and social realities.

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Schizophrenia and Narrative in Artificial Agents

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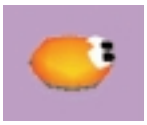
In recent years, computer graphics has turned to AI techniques in order to simplify the problem of modeling moving objects for rendering.[4,19,21] By modeling the minds of graphically represented creatures, their movements can be directed automatically through AI algorithms and need not be directly controlled by the designer. But what kind of baggage do these AI algorithms bring with them? Here I will argue that predominant AI approaches to modeling agents result in behavior that is fragmented, depersonalized, lifeless, and incomprehensible. Drawing inspiration from narrative psychology and anti-psychiatry, I will argue that agent behavior should be narratively understandable and present an agent architecture that structures behavior to be comprehensible as narrative.



The approach I take in this essay is a hybrid of critical theory and AI agent technology. It is one example of a critical technical practice [1]: a cultural critique of AI practice instantiated in a technical innovation. In the final section of this paper, I will describe the theoretical and practical foundations of the critical technical practice pursued here, which I term socially situated AI.

Introduction

The premise of this work is that there is something deeply missing from AI, or, more specifically, from the currently dominant ways of building artificial agents. This uncomfortable intuition has been with me for a long time, perhaps from my start as an AI researcher, although for most of that time I was not able to articulate it clearly. Artificial agents seem to be lacking a primeval awareness, a coherence of action over time, something one might, for lack of a better metaphor, term "soul."

Roboticist Rodney Brooks expresses this worry eloquently:

Perhaps it is the case that all the approaches to building intelligent systems are just completely off-base, and are doomed to fail.... [C]ertainly it is the case that all biological systems.... [b]ehave in a way which just simply seems "life-like" in a way that our robots never do.

> Perhaps we have all missed some organizing principle of biological systems, or some general truth about them. Perhaps there is a way of looking at biological systems which will illuminate an inherent necessity in some aspect of the interactions of their parts that is completely missing from our artificial systems.... [P]erhaps at this point we simply do not get it, and... there is some fundamental change necessary in our thinking... [P]erhaps we are currently missing the juice of life.[6]

Here, I argue that the "juice" we are missing is narrative. The divide-and-conquer methodologies currently used to design artificial agents result in fragmented, depersonalized behavior, which mimics the fragmentation and depersonalization of schizophrenia in institutional psychiatry. Anti-psychiatry and narrative psychology suggest that the fundamental problem for both schizophrenic patients and agents is that observers have difficulty understanding them narratively. This motivates a narrative agent architecture, the Expressivator, which structures agent behavior to support narrative, thereby creating agents that are intentionally comprehensible.

The Problem

Building complex, integrated artificial agents is one of the dreams of AI. Classically, complex agents are constructed by identifying functional components (natural language processing, vision, planning, etc.), designing and building each separately, then integrating them into an agent. More recently, some practitioners have argued that the various components of an agent strongly constrain one another, and that the complex functionalities that classical AI could come up with could not easily be coordinated into a whole system. They offer other construction methodologies instead. In particular, behavior-based AI proposes that the agent should be split up, not into disparate cognitive functionalities, but into behaviors, each of which integrates all of the agent's functions for a particular behavior in which the agent engages. Examples of such behaviors include foraging, sleeping, and hunting.

Even such systems, however, have not been entirely successful in building agents that integrate a wide range of behaviors. Rod Brooks, for example, has stated that one of the challenges of the field is to find a way to build an agent that can integrate many behaviors, and he defines many to be more than a dozen.[5] Programmers can create robust, subtle, effective, and expressive behaviors, but the agent's overall behavior tends to gradually fall apart as more and more behaviors are combined. For small numbers of behaviors, this disintegration can be managed by the programmer, but as more and more behaviors are combined, their interactions become so complex that they become at least time-consuming and at worst impossible to manage.

In both cases, divide-and-conquer methodologies lead to integration problems. With classical agents, who are split up by functionality, there are often problems with a functional underintegration. This underintegration manifests itself in various kinds of inconsistency between the different functions, such as not being able to use knowledge for one function that is available for another. For example, the agent may speak a word it cannot understand or visibly register aspects of the world that do not affect its subsequent behavior. In behavior-based agents, under

integration manifests itself on the behavioral level. These agents generally have a set of black-boxed behaviors. Following the action-selection paradigm, agents continuously redecide which behavior is most appropriate. As a consequence, they tend to jump around from behavior to behavior according to which one is currently the best.[28]

What this means is that the overall character of the agent's behavaior ends up being deficient; generally speaking, its behavior consists of short dalliances in individual, shallow, high-level behaviors with abrupt changes between behaviors. It is this overall defective nature of agent behavior, caused by under-integration of behavioral units, that I term schizophrenia and propose to address here.

Schizophrenia is a loaded term. I use it here to draw attention to important connections between current approaches to agent-building and the experience of being schizophrenic in institutional psychiatry. In the next two sections, I draw out those connections, then show how an alternative approach to psychiatric schizophrenia can motivate changes in AI practice. These changes form the basis for narrative agent architecture.

Schizophrenia

Schizophrenia's connection to AI is grounded in one of its more baffling symptoms: the sentimente d'automatisme, or subjective experience of being a machine.[12] This feeling is the flip side of AI's hoped-for machinic experience of being subjective, and is described by one patient this way: "I am unable to give an account of what I really do, everything is mechanical in me and is done unconsciously. I am nothing but a machine."[23] R. D. Laing describes how some schizophrenic patients experience or fear experiencing themselves as things, as its, instead of as people.[13] Schizophrenia is, for some, a frightening feeling of being drained of life, of being reduced to a robot or automaton.

This feeling of mechanicity is correlated with a fragmentation of the affected patient's being; sometimes, a schizophrenic patient's very subjectivity seems to be split apart.

> In listening to Julie, it was often as though one were doing group psychotherapy with the one patient. Thus I was confronted with a babble or jumble of quite disparate attitudes, feelings, expressions of impulse. The patient's intonations, gestures, mannerisms, changed their character from moment to moment. One may begin to recognize patches of speech, or fragments of behaviour cropping up at different times, which seem to belong together by reason of similarities of the intonation, the vocabulary, syntax, the preoccupations in the utterance or to cohere as behaviour by reason of certain stereotyped gestures or mannerisms. It seemed therefore that one was in the presence of various fragments, or incomplete elements, of different "personalities" in operation at the one time. Her "word-salad" seemed to be the result of a number of quasi-autonomous partial systems striving to give expression to themselves out of the same mouth at the same time.[13]

Laing goes on to describe Julie's existence in ways that are eerily similar to the problems with autonomous agents we discussed in the last section: "Julie's being as a chronic schizophrenic was ... characterized by lack of unity and by division into what might variously be called partial 'assemblies,' complexes, partial systems, or 'internal objects.' Each of these partial systems had recognizable features and distinctive ways of its own.[13] Like the parts of behavior-based agents, each subsystem exists independently, with its own perception and action. Subsystems communicate, in Brooks' phraseology, "through the world," not by being integrated as a unified whole:

> Each partial system seemed to have within it its own focus or centre of awareness: it had its own very limited memory schemata and limited ways of structuring percepts; its own quasi- autonomous drives or component drives; its own tendency to preserve its autonomy, and special dangers which threatened its autonomy. She would refer to these diverse aspects as "he," or "she," or address them as "you." That is, instead of having a reflective awareness of those aspects of herself, "she" would perceive the operation of a partial system as though it was not of "her," but belonged outside.[13]

In this sense, there is a direct link between schizophrenia and behavior-based methodology – and symptomatology.

Depersonalization

While we can presume that artificial systems do not particularly care about being fragmented, for schizophrenic patients this feeling of coming apart, of losing life, of being reduced to a machine, is intensely painful. It is therefore ironic that, as a number of critics have argued, psychiatric institutions themselves reinforce this feeling of mechanicity and lack of autonomous self. For example, Erving Goffman, in his ground-breaking anthropological study "Asylums",[11] argues that a major feature of psychiatric institutions is the "programming" of each inmate "into an object that can be fed into the administrative machinery of the establishment, to be worked on smoothly by routine operations."[11]

One of the signs of this mechanization is the reduction of patient to symptomatology. Patients are constantly monitored, their behavior continuously examined for and interpreted as signs of illness. The patient's actions only function insofar as they are informational. They only act as ciphers, which it is then the responsibility and right of the doctor to decode. Rather than being taken seriously as such, a patient's words are used to place the patient in the narrative of the doctor's diagnosis. "When you spoke, they judged your words as a delusion to confirm their concepts.[22]

Understood symptomatically, the patient's subjective experience is ignored. Susan Baur describes this limitation of the institutional approach to mental illness:

> I... believe that the medical model of mental illness excludes too much of the patient. Using this model, only parts of the patient are considered, and even when these parts are assembled by a multidisciplinary team into a manikin of a schizophrenic or of a manic-depressive, the spirit that animates the real person gets lost. Especially in chronic cases where mental illness and the desperately clever adaptations it inspires have become central to an individual's personality, the patient's own story and explanations – his delusions and imaginary worlds – must be included.[2]

The patient is formalized, reduced to a set of somewhat arbitrarily connected symptoms. The patient is no longer a living, unique, complex individual, but fragmented into a pile of signs: "She is autistic." "She shows signs of depersonalization." "She lacks affect."

This fragmentation into symptoms, Laing argues, actually reinforces, rather than treats, schizophrenia. When mechanistic explanations reduce the patient to a bundle of pathological processes, the patient as human is rendered incomprehensible. Laing argues that institutional psychiatric practice cannot fully understand schizophrenia because it actually mimics schizophrenic ways of thinking, depersonalizing, and fragmenting patients:

> The most serious objection to the technical vocabulary currently used to describe psychiatric patients is that it consists of words which split man up verbally in a way which is analogous to the existential splits we have to describe here.... [W]e are [then] condemned to start our study of schizoid and schizophrenic people with a verbal and conceptual splitting that matches the split up of the totality of the schizoid being-in-the-world. Moreover, the secondary verbal and conceptual task of reintegrating the various bits and pieces will parallel the despairing efforts of the schizophrenic to put his disintegrated self and world together again.[13]

By studying schizophrenics in isolation and in parts, psychiatry threatens to itself become schizophrenic, and schizophrenics incomprehensible.

This problem of conceptual splitting parallels closely the problem of AI, suggesting that mechanistic explanations of the sort necessary to build agents are also responsible for their de-intentionalized appearance. The symptomatology of institutional psychiatry is reflected in behavioral black-boxing in behavior-based AI. In the next section, we will explore alternatives to this fragmentation in psychiatry, searching for clues for dealing with the problem of schizophrenia in AI.

Anti-Psychiatry

In the 1960s and 1970s, Laing and other sympathetic colleagues, termed anti-psychiatrists for their opposition to mainstream psychiatry, suggested that the schizophrenizing aspects of institutional psychiatry can be avoided by changing our viewpoint on patients: instead of thinking of schizophrenics as self-contained clusters of symptoms, we should try to understand them phenomenologically, as complex humans whose behavior is meaningful. The schizophrenizing clinical approach reifies the patient's behavior into a cluster of pathological symptoms, with no apparent relation to each other or the patient's broader life experience:

> [S]he had auditory hallucinations and was depersonalized; showed signs of catatonia; exhibited affective impoverishment and autistic withdrawal. Occasionally she was held to be impulsive.[14]

The phenomenological approach, on the other hand, tries to understand the patient's experience of herself as a person:

> [S]he experienced herself as a machine, rather than as a person: she lacked a sense of her motives, agency and intentions belonging together: she was very confused about her autonomous identity. She felt it necessary to move and speak with studious and scrupulous correctness. She sometimes felt that her thoughts were controlled by others, and she said that not she but her "voices" often did her thinking.[14]

Anti-psychiatrists believe that statistics and symptomatology, the foundations of institutional psychiatry, are misleading because they reduce the patient to a mass of unrelated signs. Instead of leading to a greater understanding of the patient, the patient's subjective experiences are lost under a pile of unconnected data.

> It is just possible to have a thorough knowledge of what has been discovered about the hereditary or familial incidence of manic-depressive psychosis or schizophrenia, to have a facility in recognizing schizoid "ego distortion" and schizophrenic ego defects, plus the various "disorders" of thought, memory, perceptions, etc., to know, in fact, just about everything that can be known about the psychopathology of schizophrenia or of schizophrenia as a disease without being able to understand one single schizophrenic. Such data are all ways of not understanding him.[14]

Instead of trying to extract objectively verifiable data about the patient, anti-psychiatrists believe psychiatry should be based on hermeneutics, a subjective process of interpretation which aims for a better understanding of the way in which the schizophrenic patient experiences life. Laing finds that when schizophrenic patients are treated "subjectively" – that is to say, when attempts are made, not to catalog their symptoms, but to understand their phenomenological viewpoints, even when they include such apparently alien components as delusions or hallucinations – schizophrenia can be made much more comprehensible. In

Sanity, Madness, and the Family, Laing and Esterson give 11 case studies of schizophrenic patients whose behavior, initially incomprehensible and even frightening, is made understandable by putting it in the context of the patient's family life. For example, a patient with a delusion that other people are controlling her thoughts is found to live in a family where her parents undermine every expression of independent thought, telling her that they know better than she what she thinks.

This focus on hermeneutic interpretation rather than data extraction as a way of understanding intentional behavior can be applied to agent design. From this perspective, when we focus largely on the decomposition of agents' behavior into individually designed units, we will necessarily end up with fragmented and depersonalized agents. On the other hand, if we take an interpretive, wholistic perspective to agents, we may be able to build agents without undermining their intentionality. In solving the problem of schizophrenic agents, this is a lead, but only that. In order to make concrete changes in agent technology, we need to have a more exact understanding of what this change in"intentional stance"[9] means. We will use narrative psychology to specify the change in understanding suggested by anti-psychiatry; this, it turns out, will give us a toehold in agent design.

Narrative Psychology

Narrative psychology, an area of study developed by Jerome Bruner,[7,8] focuses on how people interpret specifically intentional behavior. Narrative psychology shows that, whereas people tend to understand inanimate objects in terms of cause-effect rules and by using logical reasoning, intentional behavior is made comprehensible by structuring it into narrative or "stories." Narrative psychology suggests that this process of creating narrative is the fundamental difference between the way people understand intentional beings and mechanical artifacts.

That is to say, if I want to understand and build an inanimate object, I may decompose it, try to understand what different pieces are for, replicate how they work, and figure out the rules underlying its behavior. On the other hand, if I want to understand a person's behavior, I am interested in such things as what motivates him or her, the reasons he or she engages in particular activity, and how his or her behavior reflects on his or her whole personality.

This contrast between narrative explanations that explore the meaning of living activity and atomistic explanations that allow for the understanding and construction of mechanical artifacts provides a theoretical basis for the criticisms of anti-psychiatry. Anti-psychiatrists, after all, complain that the difficulty with institutional psychiatry is that it reduces the patient to a pile of data, thereby making a machine of a living person. The anti-psychiatric solution of interpretation uses narrative understanding to "repersonalize" patients: structuring and relating the "data" of a patient's life into the semi-coherent story of a meaningful, though painful, existence; focusing on the patient not as an instance of a disease but as a particular individual and how that person feels about his or her life experience; and relating the doctor's narrative to its background conditions and the life context in which it is created and understood. It is only through this process of narrative interpretation that, according to anti-psychiatry, the psychiatrist can fully respect and understand the patient's subjective experience as a human being.

In AI, this distinction between mechanism and intentional being becomes problematic. AI agents should ideally be understandable both as well-specified physical objects and as sentient creatures. In order to understand intentional behavior, users attempt to construct narrative explanations of what the presumed intentional being is doing, but this approach conflicts with the mechanistic explanations that designers themselves need to use in order to identify, structure, and replicate behavior. The resulting abrupt behavioral breaks create the (often correct) impression that there is no relationship between the agent's behaviors; rather than focusing on understanding the agent as a whole, the user is left to wonder how individually recognizable behaviors are related to each other and the agent's personality. Behaviors are designed in isolation and interleaved according to opportunity, but users, like it or not, attempt to interpret behaviors in sequence and in relationship to each other. The result of this mismatch between agent design and agent interpretation is confusion and frustration on the part of the user and the destruction of apparent agent intentionality.

At this point, there seems to be a basic and unsolvable mismatch between fragmentation and intentionality. But narrative psychology suggests that the fundamental problem with current agent-building techniques is not simply recognizable fragmentation in and of itself, but rather that fragmented agents do not provide proper support for narrative interpretation. From this follows the major insight of this paper: If humans understand intentional behavior by organizing it into narrative, then our agents will be more"intentionally comprehensible" if they provide narrative cues. That is to say, rather than simply presenting intelligent actions, agents should give visible cues that support users in their ongoing mission to generate narrative explanation of an agent's activity. We can do this by organizing our agents so that their behavior provides the visible markers of narrative.

Narrative Agent Architecture

What does it mean for agents to support narrative comprehension? The properties of narrative are complex.[8] Elsewhere, I have discussed in detail how they can apply to AI.[25,26] For the sake of brevity, I will here limit discussion to the following properties:

Context-Sensitivity and Negotiability
In behavior-based systems, the "meaning" of a behavior is thought of as always the same: the name the designer gives the internally-defined behavior. But in narrative comprehension, meaning is not a matter of identifying already-given symbols, but comes out of a complex process of negotiation between the interpreter and the events being interpreted. The meaning of the same event can change radically based on the context in which it occurs, as well as on the background, assumptions, knowledge, and perspective of the interpreter. In order to design narratively expressive agents, designers must respect (rather than attempt to override) the context- and audience-dependency of narrative comprehension.

Intentional State Entailment
In most behavior-based systems, the reason a behavior is run is implicit in its action-selection mechanism. The behavior is then necessarily communicated to the user on a "just-the-facts-ma'am" basis: it is usually easy to see what an agent is doing, but hard to tell why. But in narrative, the reasons or motivations behind actions are just as important as (if not more important than) what is done. People do not want to know just the events that occur in the narrative. They also want to know the motivations, thoughts, and feelings behind them. Supporting narrative comprehension means communicating clearly not just what the agent does, but its reason for doing it.

Diachronicity
Behavior-based agents jump from behavior to behavior according to what is currently optimal. Each of these behaviors is designed independently, with minimal interaction. But a fundamental property of narrative is its diachronicity; it relates events over time. In a narrative, events do not happen randomly and independently; they are connected to and affect one another. Narrative support in a behavior-based agent requires normally independent behaviors to be able to influence each other, to present a coherent picture of narrative development to the user over time.

These properties are the motivation for the Expressivator, an agent architecture that focuses on the narrative expression of agent behavior. The Expressivator is an extension of Bryan Loyall's Hap,[15,16] a behavior-based language designed for believable agents. The Expressivator has been tested in the Industrial Graveyard, a virtual environment in which the Patient, a discarded lamp character implemented with the Expressivator, attempts to eke out a miserable existence while being bullied about by the Overseer, an agent implemented in Hap. Generally, the Expressivator supports narrative comprehension using the following heuristic:

Behaviors should be as simple as possible. The agent's life comes from thinking out the connections between behaviors and displaying them to the user.

Simpler behaviors are essential because complex processing is lost on the user. Most of the time, the user has a hard time picking up on the subtle differences in behavior that bring such pleasure to the heart of the computer programmer. But the properties of narrative interpretation mean that simpler behaviors are also enough. Because the user is very good at interpretation, minimal behavioral cues suffice.

More specifically, the Expressivator provides systematic support for narrative comprehensibility through the following mechanisms:

Context-Sensitivity and Negotiability
Rather than building an agent from conventional context- and communication-independent actions and behaviors, a designer builds agents from context-dependent signs and signifiers that are to be communicated to the user.

Intentional State Entailment
Transitions are added between signifiers to explain why the agent's observed behavior is changing.

Diachronicity
Signifiers can use meta-level controls to influence one another, presenting a coherent behavioral picture over time.

Signs, Signifiers, and Sign Management
Typical behavior-based agents are designed for correctness, not for user comprehensibility. The first step the Expressivator takes in creating narratively understandable agents is to open the architecture up for communication. Agent design is based, not on the functions the agent must fulfill, but on its intended, context-dependent interpretation by the user. In the Expressivator, signs and signifiers support the construction of clearly communicated behavior; sign management allows the agent itself to keep track of what has been communicated, so it can tailor subsequent behavioral communication to the user's current interpretation.

Signs and Signifiers
Current behavior-based approaches are based on an internal, problem-solving approach, and generally divide an agent into activities in which the agent likes to or needs to engage. Typical behavior-based systems divide an agent into three parts:

1. Physical actions in which the agent engages
2. Low-level behaviors, which are the agent's simple activities
3. High-level behaviors, which combine low-level behaviors into high-level activities using more complex reasoning.

Because these activities are implemented according to what makes sense from the agent's internal point of view, there is no necessary correlation between the agent's behaviors and the behaviors we would like the user to see in our agent. But if the agent is to be narratively comprehensible, it may make more sense to design the agent according to the desired user interpretation. We may want to make the internal behaviors exactly those behaviors we want to communicate to the user. Then, communicating what the agent does reduces to the problem of making sure that each of these behaviors is properly communicated. For this reason, the Expressivator structures an agent not

into physical actions and problem-solving behaviors, but into signs and signifiers, or units of action that are likely to be meaningful to the user. This structure involves three levels, roughly corresponding to those of generic behavior-based AI:

1. Signs, which are small sets of physical actions that are likely to be interpreted in a particular way by the user
2. Low-level signifiers, which combine signs, physical actions, and mental actions to communicate particular immediate physical activities to the user.
3. High-level signifiers, which combine low-level signifiers to communicate the agent's high-level activities.

There are several differences between these structural units and the default behavior-based ones. Unlike physical actions and behaviors, signs and signifiers focus on what the user is likely to interpret, rather than what the agent is "actually" (internally) doing. In addition, signs and signifiers are context-dependent; the same physical movements may lead to different signs or signifiers, depending on the context in which the actions are interpreted. Most importantly, signs and signifiers carry an explicit commitment to communication; they require the agent designer to think about how the agent should be interpreted and to provide visual cues to support that interpretation.

Signs and signifiers are not simply design constructs; they also have technical manifestations. Formally, a sign is a token the system produces after having engaged in physical behavior that is likely to be interpreted in a particular way. This token consists of an arbitrary label and an optional set of arguments. The label, such as "noticed possible insult," is meaningful to the designer and represents how the designer expects that physical behavior to be interpreted. The arguments (such as "would-be insulter is Wilma") give more information about the sign. This token is stored by the sign-management system described below, so that the agent can use it to influence its subsequent behavioral decisions. A low-level signifier is a behavior that is annotated with the special form "(with low_level_signifying...);" a high-level signifier is similarly annotated "(with high_level_signifying....)." Signifiers can also generate tokens for the sign-management system, as described below.

Sign Management

Once a designer has structured an agent according to what it needs to communicate, agents can reason about what has been communicated in order to fine-tune presentation of subsequent signs and signifiers. That is, by noting which signifiers have been communicated, agents can reason about the user's likely current interpretation of their actions and use this as a basis for deciding how to communicate subsequent activity. The most obvious way for the agent to keep track of what the user thinks is for it simply to notice which signs and signifiers are currently running. After all, signifiers represent what is being communicated to the user. But in practice, it turns out that this is not correct because the user's interpretation of signs and signifiers lags behind the agent's engagement in them. For example, if the agent is currently running a "head-banging" signifier, the user will need to see the agent smack its head a few times before realizing that the agent is doing it.

The sign-management system deals with this problem by having the agent post signs and signifiers when it believes the user must have seen them. A behavior can post a sign each time it has engaged in some physical actions that express that sign, using the "post_sign" language mechanism. Similarly, once signs have been posted that express a low-level signifier, behaviors use "post_low_level" to post that that low-level signifier has been successfully expressed. Once the right low-level signifiers have been posted to express a high-level signifier, "post_high_level" is used to post that high-level signifier.

Each of these commands causes a token to be stored in the agent's memory listing the current sign, low-level signifier, or high-level signifier, respectively, along with a time stamp. Once signs and signifiers have been posted, other behaviors can check to see what has been posted recently before they decide what to do. The result is that the signs and signifiers the agent has expressed can be used just like environmental stimuli and internal drives to affect subsequent behavioral presentation, tuning the agent's behavior to the user's interpretation.

Transitions

The second requirement of narrative comprehensibility is that the user should be able to tell why the agent is doing what it is doing. In behavior-based terms, every time an agent selects a particular behavior, it should express to the user the reason it is changing from the old behavior to the new one. This is difficult to do in most behavior-based systems because behaviors are designed and run independently; when a behavior is chosen, it has no idea who it succeeds, let alone why.

In the Expressivator, behavioral transitions are used to express the agent's reasoning. Transitions are special behaviors which act to "glue" two signifying behaviors together. When a transition notices that it is time to switch between two signifiers, it takes over from the old signifier. Instead of switching abruptly to the new signifier, it takes a moment to express to the user the reason for the behavioral change.

Transitions are implemented in two parts, each of which is a full-fledged behavior: transition triggers, which determine when it is appropriate to switch to another behavior for a particular reason, and transition demons, which implement the transition sequence that expresses that reason to the user. Transition triggers run in the background, generally checking which behaviors are running (e.g., exploring the world), and combining this information with sensory input about current conditions (e.g., the Overseer is approaching). When its conditions are fulfilled, the transition trigger adds a special token to memory, noting the behavior that should terminate, the behavior that should replace it, and a label that represents the reason for the replacement (e.g., "afraid_of_overseer"). Transition demons monitor memory, waiting for a transition for a particular reason to be triggered. They then choose an appropriate behavioral expression for the reason for change, according to the current likely user interpretation and conditions in the virtual environment. Expressing the reasoning behind behavioral change often requires changes to subsequent behaviors; for example, if the Patient starts doing some odious task because it is forced to by the Overseer, it should include some annoyed glances at the Overseer as part of the task-fulfilling behavior. Transitions are able to express these kinds of interbehavioral influences using the meta-level controls described below.

Meta-Level Controls

The third requirement of narrative comprehensibility is that behaviors should be structured into a coherent sequence. Instead of jumping around between apparently independent actions, the agent's activities should express some common threads. But these relationships between behaviors are difficult to express in most behavior-based systems because they treat individual behaviors as distinct entities that do not have access to each other. Conflicts and influences between behaviors are not handled by behaviors themselves but by underlying mechanisms within the architecture. Because the mechanisms that handle relationships between behaviors are part of the implicit architecture of the agent, they are not directly expressible to the user.

The Expressivator deals with this problem by giving behaviors meta-level controls, special powers to sense and influence each other. Because meta-level controls are explicitly intended for communication and coordination between behaviors, they are in some sense a violation of the behavior-based principle of minimal behavioral interaction. Nevertheless, meta-level controls are so useful for coordinating behavior that several have already found a home in behavior-based architectures. An example is Hamsterdam's meta-level commands, which allow non-active behaviors to suggest actions for the currently dominant behavior to do on the side.[3] In the Expressivator, behaviors can:

1. Query which other behaviors have recently happened or are currently active
2. Delete other behaviors.
3. Add new behaviors, not as subbehaviors, but at the top level of the agent.
4. Add new sub-behaviors to other behaviors.
5. Change the internal variables that affect the way in which other behaviorsare processed.
6. Turn off a behavior's ability to send motor commands.
7. Move running subbehaviors from one behavior to another.

The most important function for these meta-level controls in the Expressivator is to allow for implementation of transitions. Transitions, at a minimum, need to be able to find out when an old behavior needs to be terminated, delete the old behavior, engage in some action, and then start a new behavior. This means that transition behaviors need to have all the abilities of a regular behavior, and a few more:

- They need to be able to know what other behaviors are running.
- They need to be able to delete an old behavior.
- They need to be able to begin a new behavior.

Ideally, they should also be able to alter the new behavior's processing to reflect how it relates to what the agent was doing before. In the Expressivator, transitions can do all these things with meta-level controls. More generally, meta-level controls make the relationships between behaviors explicit, as much a part of the agent design as behaviors themselves. They allow behaviors to affect one another directly when necessary, rather than making interbehavioral effects subtle side-effects of the agent design. Meta-level controls give agent builders more power to expose the inner workings of agents by letting them access and then express aspects of behavior processing that other systems leave implicit.

Putting It All Together

Narrative psychology suggests that narrative comprehension is context-sensitive, focuses on agent motivation, and seeks connections between events over time. The Expressivator supports comprehensibility by expressing the agent's actions with signs and signifiers, the reasons for agent activity with transitions, and the coherent threads through activities with meta-level controls.

These architectural mechanisms are described separately but used together in the agent design process, changing the way in which agents are designed. In a typical behavior-based system, an agent is defined in three major steps:

1. Deciding on the high-level behaviors in which the agent will engage
2. Implementing each high-level behavior, generally in terms of a number of low-level behaviors and some miscellaneous behavior to knit them together.
3. Using environmental triggers, conflicts, and other design strategies to know when each behavior is appropriate for the creature to engage in.

With the Expressivator, the choice and expression of these structural "units" for the agent is not enough; in order to support the user's comprehension, the designer must also give careful consideration to expressing the reasons for and connections between those units. These connections are designed and implemented with transitions, which alter the signifiers they connect into a narrative sequence. In practice, transitions are the keystone of the architecture, combining signifiers in meaningful ways through the use of meta-level controls.

Results

The best way to see how the Expressivator changes the quality of agent behavior is to look at how its transitions work in detail. Here, I will go over one point where the agent switches behaviors and explain how transitions make this switch more narratively comprehensible. One example does not proof make, but it does take up a lot of space; the sceptical reader can find more my earlier work.[25]

As our excerpt begins, the Patient notices the schedule of daily activities that is posted on the fence and goes over to read the schedule. The Overseer, noticing that the Patient is at the schedule and that the user is watching the Patient, goes over to the schedule, changes the time to 10:00, and forces the Patient to engage in the activity for that hour: exercising.

The goal of this part of the plot is to communicate to the user the daily regime into which the Patient is strapped. The Patient does not have autonomy over its actions; it can be forced by the Overseer to engage in activities completely independently of its desires. The specific behavioral change from reading the schedule to exercising, then, should show the user that the agent changes its activity because:

- It notices the Overseer.
- The Overseer enforces the scheduled activities
- The activity that is currently scheduled is exercising.

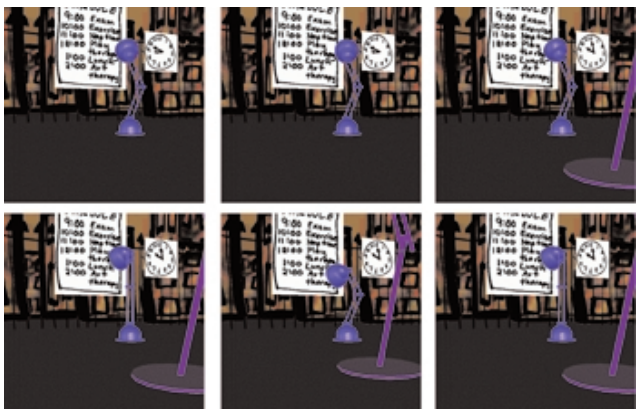


Figure 2. Response without transitions

Without transitions, the Patient's response to the Overseer is basically stimulus-response (Figure 2). The Patient starts out reading the schedule. As soon as the Patient senses the Overseer, it immediately starts exercising. This reaction is both correct and instantaneous; the Patient is doing an excellent job of problem-solving and rapidly selecting optimal behavior. But this behavioral sequence is also perplexing; the chain of logic that connects the Overseer's presence and the various environmental props to the Patient's actions is not displayed to the user. It is jumped over in the instantaneous change from one behavior to another.

Figure 3. Response with transitions

With transitions, attempts are made to make the reasons behind the behavioral change clearer (Figure 3). Again, the behavior starts with the Patient reading the schedule. This time, when the Overseer approaches, the Patient just glances at the Overseer and returns to reading. Since the Patient normally has a strongly fearful reaction to the Overseer (and by this time the Overseer's enthusiasm for punishing the Patient has already generally aroused sympathy in the user's mind), the user has a good chance of understanding that this simple glance without further reaction means that the Patient has not really processed that the Overseer is standing behind it.

Suddenly, the Patient becomes startled and quickly looks back at the Overseer again. Now, the user can get the impression that the Patient has registered the Overseer's presence. Whatever happens next must be a reaction to that presence. Next, the Patient checks the time and the schedule of activities to determine that it is time to exercise. Then the Patient whirls to face the Overseer and frantically and energetically begins exercising, tapering off in enthusiasm as the Overseer departs. This transition narrativizes the agent's behavior in the following ways:

- The agent design is predicated on the user's context-dependent interpretation (for example, that the user will interpret the agent's short glance at the Overseer differently now than earlier in the story.
- The transition communicates that the change in behavior is connected to several factors: the presence of the Overseer, the clock, and the schedule. This is in contrast with the transitionless sequence, in which there is no clear connection among any of the environmental factors and the Patient's behavioral change.
- The subsequent exercising behavior is altered to fit into a narrative sequence by making it more frantic in response to the agent's panic during the transition.

Evaluation

How good is the Expressivator? The kind of detailed transition analysis given here suggests that, with the Expressivator, the agent's behavior is designed for context, provides more information about the reasons for agent behavior, and makes for a smoother narrative sequence. This is certainly a basis for improved narrative understanding, but does not necessarily imply actual improvement. In particular, the quality of the animation is not up to snuff, which means users sometimes have trouble interpreting the simple movements of the agent. All the innovations the Expressivator introduces are worthless if individual signs are not clearly animated; everything rests on the substantial animation problem of getting a sigh to look like a sigh and not like a cough or a snort. This problem is exacerbated when, as in Hap, there is a mind-body split, with the mind generating actions that are implemented autonomously by the body. The resulting divide between command and execution makes accurate timing and therefore effective control of animation impossible. This problem of generating expressive animation, while not a straightforward "AI problem," must be addressed by any architecture that is going to implement graphically presented, comprehensible agents.

The Industrial Graveyard is an entertainment application, but the constructs of the Expressivator are not limited to believable agents. The concept of a narrative structure for behavior can be just as important for tele-autonomous robots, semi-autonomous avatars, or pedagogical agents. However, the Expressivator's focus on visible behavior and concrete action probably does not adequately support systems like automatic theorem provers that engage in complex, abstract reasoning.

The greatest conceptual problem with the Expressivator is the potential explosion of the number of transitions needed between signifiers; but this turned out not to be a problem in practice. For the Patient's eight high-level signifiers, there were only 15 transitions, and for the Patient's 16 low-level signifiers, there were only 25 transitions. There are several reasons for this. First of all, transitions are only needed between high-level signifiers, and between low-level signifiers that share the same high-level signifier – not between low-level signifiers in different high-level signifiers. This would be implemented, instead, with a transition between the respective high-level signifiers. I also cut out many transitions by writing several generic transitions, which could go from any behavior to a particular behavior. Most importantly, I found in practice that many of the possible transitions did not make practical sense because of the semantics of the behaviors involved.

The greatest advantage of the Expressivator for the behavior programmer is that it makes it much easier to handle interbehavioral effects. Coordination of multiple high-level behaviors is one of the major stumbling blocks of behavior-based architectures.[5] Since interbehavioral factors are implicit in the architecture, they are hard to control, leading to multiple behaviors battling it out over the agent's body, and hours of tweaking to get each behavior to happen when and only when it is supposed to. This is much easier to handle when behaviors can simply kill other behaviors that are not appropriate and when the trigger conditions for each behavior can be explicitly set.

Socially Situated AI

So far, I have argued that there is a fundamental lack in autonomous agents' behavior, which reduces their apparent intentionality. By being constructed in a fragmented manner, agents suffer a kind of schizophrenia, a schizophrenia that can be addressed, in analogy to anti-psychiatry, by making agents narratively understandable. In order to do this, I have built an agent architecture that combines:

- Redefinition of behaviors as signifiers and their reorganization in terms of audience interpretation
- The use of transitions to explain agent motivation, structuring user-recognized behaviors into narrative sequences.

- The use of meta-level controls to strategically undermine fragmentation of the agent's behaviors. Preliminary results are encouraging, but further work, preferably involving development of support for graphical presentation, will be necessary in order to fully evaluate the implications of and possibilities for the architecture.

More generally, if black-box behaviorism involves thinking of human life mechanically, reducing it to a matter of cause-effect, while narrative allows for full elucidation of meaningful intentional existence, then it seems likely that narrative, and by extension the humanities, for whom narrative is a modus operandi, can address meaningful human life in a way that an atomizing science simply cannot. If humans comprehend intentional behavior by structuring it into narrative, then AI must respect and address that way of knowing in order to create artifacts that stimulate interpretation as meaningful, living beings. This suggests that the schizophrenia we see in autonomous agents is the symptomatology of an overzealous commitment to mechanistic explanation in AI, a commitment that is not necessarily unhelpful (since it forms the foundation for building mechanical artifacts), but needs to be balanced by an equal commitment to narrative as the wellspring of intentionality.

In this final section, I will show that the focus on narrative communication to generate artificial beings that appear lifelike is part of a broader shift in view that comes about when AI is looked at from a cultural perspective. The resulting perspective I term socially situated AI, which shares close affinity with culturally oriented approaches taken by other AI researchers, notably Michael Mateas,[17] Simon Penny,[18] and Warren Sack.[24]

Introduction

To recap, the analysis in the first sections of this paper suggests that AI and institutionalization share properties that lead to schizophrenia. Both AI and institutionalization take objective views of living beings. By "objective," I mean that they are taken out of their sociocultural context and reduced to a set of data. Because these data are not related to one another or the context from which they spring, the result is the fragmentation of experience that cultural theorists term schizophrenia.

The conclusion of this argument is that, in order to address schizophrenia, we can take the opposite approach. Rather than seeing patients as objects to be manipulated or diagnosed, we could see them subjectively. This means turning objectivity as defined above on its head: studying people in their life context and relating the things we notice about them to their existence as a whole.

If you are a technical researcher, it is quite possible that the early sections of this paper left you with lingering doubts about the accuracy or validity of the cultural-theory argument. But however you feel about the understandability or truth-value of that argument, the perspective cultural theory brings can be understood as a kind of heuristic which could be tried out in AI. At this level, cultural theory suggests the following: If your agents are schizophrenic, perhaps you need to put them in their sociocultural context.

In this section, we'll explore what it means for an agent to be designed and built with respect to a sociocultural environment. This way of doing AI I term socially situated AI. I will differentiate socially situated AI from the approaches taken in classical and alternative AI, and then discuss the impact this methodological framework has on the way AI problems are defined and understood. This different way of approaching AI is, in retrospect, the key to solving schizophrenia by suggesting the redefinition of the problem of schizophrenia as a difficulty of agent communication rather than of internal agent structure.

AI in Context

The heuristic suggested by cultural theory – that agents should be considered with respect to their context – should have a familiar ring to technical researchers. The contextualization of agents (their definition and design with respect to their environment) is, after all, one of the major bones alternativists like to pick with classicists. Alternative AI argues that agents can or should only be understood with respect to the environment in which they operate. The complexity or "intelligence" of behavior is said to be a function of an agent within a particular environment, not the agent understood in isolation as a brain-in-a-box.

But the contextualization which is so promoted in alternative AI is actually limited, in particular by the following implicit caveat to its methodology: The agent is generally understood purely in terms of its physical environment, not in terms of the sociocultural environment in which it is embedded. Generally speaking, alternativists examine the dynamics of the agent's activity with respect to the objects with which the agent interacts, the forces placed upon it, and the opportunities its physical locale affords. Some alternativists have also done interesting work examining the dynamics of agent activity in social environments, where "social" is defined as interaction with other agents. They generally do not, however, consider the sociocultural aspects of that environment: the unconscious background of metaphors upon which researchers draw in order to try to understand agents, the social structures of funding and prestige that encourage particular avenues of agent construction, and the cultural expectations that users – as well as scientific peers – maintain about intentional beings and that influence the way in which the agent comes to be used and judged.

In fact, when such aspects of the agent's environment are considered at all, many alternativists abandon their previous championing of contextualization. They see these not-so-quantifiable aspects of agent existence not as part-and-parcel of what it means to be an agent in the world, but as mere sources of noise or confusion that obscure the actual agent. They may say things like this: "The term 'agent' is, of course, a favourite of the folk psychological ontology. It consequently carries with it notions of intentionality and purposefulness that we wish to avoid. Here we use the term divested of such associated baggage"[27] – as though the social and cultural environment of the agent, unlike its physical environment, is simply so much baggage to be discarded.

In this respect, the alternativist view of agents-in-context is not so different from the Taylorist view of worker-in-context or the institutional view of patient-in-context. After all, Taylorists certainly look at human workers in context; in the terminology of situated action, they analyze and optimize the ongoing dynamics of worker-and-equipment within the situation of a concrete task, rather than the action of the worker alone and in general. Similarly, institutional psychiatrists look at human patients in context; they are happy to observe and analyze the dynamics of patient interaction with other people and objects in the world, as long as in those observations and analyses they do not need to include themselves. In each of these cases, contextualization is stopping at the same point: where the social dynamics between the expert and the object of expertise, as well as its cultural foundation, would be examined.

I do not believe that the elision of sociocultural aspects from the environment as understood by alternative AI is due to any nefarious attempt to hide social relations, to push cultural issues under the rug, to intentionally mislead the public about the nature of agents, etc. Rather, I believe that because AI is part of the scientific and engineering traditions, most alternativists simply do not have the training to include these aspects in their work. Science values simplification through separation, and one of the key ways in which this is done is by separating the object of study from the complex and rich life background in which it exists. This strategy lets researchers focus on and hopefully solve the technical problems involved without getting bogged down in all kinds of interconnected and complex issues that may not have direct bearing on the task at hand.

The Return of the Repressed

The problem, though, is that even from a straightforward technical point of view, excluding the sociocultural context is sometimes unhelpful. At its most basic, ignoring this context does not make it go away. What ends up happening is that, by insisting that cultural influences are not at work, those influences often come back through the back door in ways that are harder to understand and utilize.

As an example, consider the use of programming through the use of symbols. Symbolic programming involves the use of tokens, often with names like "reason," "belief," or "feeling." which are loaded with cultural meaning to the agent designer. Critics point out that the meaningfulness of these terms to humans can obscure the vacuousness of their actual use in the program. So a programmer who writes a piece of code that manipulates tokens called "thoughts" may unintentionally believe that this program must be thinking.

Alternative AI, generally speaking, involves a rejection of these sorts of symbols as tokens in programs. This rejection is often based on a recognition that symbolic programming of the kind classical AI engages in is grounded in culture, and that symbols carry a load of cultural baggage that affects the way programs are understood. Some of them believe that by abandoning symbolic programming they, unlike classicists, have also abandoned the problem of cultural presuppositions creeping into their work. And, in fact, it is true that many alternative AI programs do use such symbols sparingly, if at all, in their internal representations.

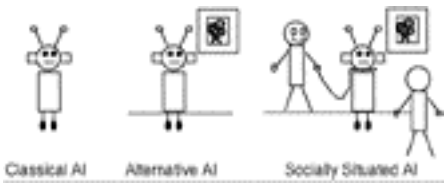
Nevertheless, it would be fair to say that the architecture of such agents involves symbols to the extent that the engineer of the agent must think of the world and agent in a symbolic way in order to build the creature. For example, the creature may have more or less continuous sensors of the world, but each of those sensors may be interpreted in a way that yields, once again, symbols, even when those symbols are not represented explicitly as a written token in an agent's program. For example, a visual image may be processed to output one of two control signals, one of which triggers a walking style appropriate on carpets, and one of which triggers a walking style appropriate for walking on uncarpeted surfaces. While a variable named "on-carpet" may not appear in the agent's code, it would be fair to predicate an "on-carpet' symbol in the designer's thinking as the agent is constructed – a symbol that is as informed by the designer's cultural background as the identifiable "on-carpet" symbol in a classical AI program.

The behaviors into which the agent is split are similarly fundamentally symbolic ("play fetch," "sleep," "beg," etc.) and are influenced by cultural notions of what behaviors can plausibly be. While alternative AI has gotten away from symbolic representations within the agent when seen in isolation, it has not gotten away from symbolic representations when the agent is seen in its full context. Once you look at the entire environment of the agent, including its creator, it is clear that despite the rhetoric that surrounds alternative AI, these symbols, and their accompanying sociocultural baggage, still play a large role.

Leaving out the social context, then, is both epistemologically inadequate and obfuscating. By not looking at the subjective aspects of agent design, the very nature of alternative AI programming, as well as the origin of various technical problems, becomes obscured. This is particularly problematic because not being able to see what causes technical problems may make them hard, if not impossible, to solve. This is exactly what happens with schizophrenia, and by taking the opposite tack a path to solution becomes much more straightforward.

Socially Situated AI

What should AI do instead? Alternativists believe that situating agents in their physical context often provides insight into otherwise obscure technical problems. I propose that we build on this line of thinking by taking seriously the idea that the social and cultural environment of the agent can also be not just a distracting factor in design and analysis of agents, but also a valuable resource for it (Figure 4). I coined the term "socially situated AI" for this method of agent research.



The increased context from classical through alternative to socially situated AI.

Here, I will first describe at a philosophical level the postulates of socially situated AI. This lays out the broad framework within which technical work can proceed. I'll then discuss at a more concrete level what it means to design and build agents with respect to their sociocultural context.

Postulates of Socially Situated AI

Like other methodological frameworks, including classical and alternative AI, socially situated AI involves, not just a kind of technology, but a way of understanding how to define problems and likely avenues of success. I represent this changed way of thinking here through an enumeration of postulates of socially situated AI. These are propositions that form the framework for how research is done and evaluated. Specifically, socially situated AI distinguishes itself from other forms of AI through explicit commitment to the following principles:

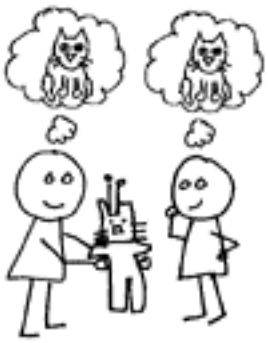
- An agent can only be evaluated with respect to its environment, which includes not only the objects with which it interacts, but also the creators and observers of the agent. Autonomous agents are not "intelligent" in and of themselves, but rather with reference to a particular system of constitution and evaluation, which includes the explicit and implicit goals of the project creating it, the group dynamics of that project, and the sources of funding, which both facilitate and circumscribe the directions in which the project can be taken. An agent's construction is not limited to the lines of code that form its program. It involves a whole social network, which must be analyzed in order to get a complete picture of what that agent is, without which agents cannot be meaningfully judged.

- An agent's design should focus not on the agent itself, but on the dynamics of that agent with respect to its physical and social environments. In classical AI, an agent is designed alone; in alternative AI, it is designed for a physical environment; in socially situated AI, an agent is designed for a physical, cultural, and social environment, which includes the designer of its architecture, the creator of the agent, and the audience that interacts with and judges the agent, including both the people who engage it and the intellectual peers who judge its epistemological status. The goals of all these people must be explicitly taken into account in deciding what kind of agent to build and how to build it.

- An agent is a representation. Artificial agents are a mirror of their creators' understanding of what it means to be at once mechanical and human, intelligent, and alive (what cultural theorists call a subject). Rather than being a pristine testing ground for theories of mind, agents come overcoded with cultural values, a rich crossroads where culture and technology intersect and reveal their co-articulation. This means in a fundamental sense that, in our agents, we are not creating life but representing it, in ways that make sense to us, given our specific cultural backgrounds.

Socially Situated AI as Technical Methodology

These philosophical principles do not necessarily give technical researchers much to go on in their day-to-day work. Concretely speaking, socially situated AI can be understood in the following way. Rather than seeing an agent as a being in a social vacuum, we can see it as represented in Figure 5, as a kind of communication between a human designer, who is using it to embody a conception of an agent. and a human audience that is trying to understand it.



Agents as communication.

After all, for many applications it is not enough for an agent to function correctly in a technical sense. Many times, the agent should also be understandable. For example, when an agent researcher designs an artificial cat, the researcher will have some ideas about the kinds of behaviors the cat should have and the kind of motivations behind the cat's selection of various behaviors – ideas which, optimally and sometimes crucially, the viewers of the agent should also pick up on. In this sense, the agent as program is a vehicle for a conception of a particular agent, which is communicated from the agent builder through the technical artifact to the observers of or interactors with the agent.

This way of understanding socially situated AI can be thought of as a change in metaphor. Many current approaches to AI are based on the metaphor of agent-as-autonomous: The fundamental property of such an agent is its basic independence from its creator or users. Lenny Foner, for example, defines autonomy as one of the most basic aspects of being an agent:

> Any agent should have a measure of autonomy from its user. Otherwise, it's just a glorified front-end, irrevocably fixed, lock-step, to the actions of its user. A more autonomous agent can pursue an agenda independently of its user. This requires aspects of periodic action, spontaneous execution, and initiative, in that the agent must be able to take preemptive or independent actions that will eventually benefit the user.[10]

This autonomy implies that the agent's fundamental being is as a thing for itself, rather than what it actually is: a human construction, usually a tool. AI researchers are far from believing that agents magically spring from nowhere, and autonomy can certainly be a useful notion. Nevertheless, the focus on autonomy (separation from designer and user) as a defining factor for agents can unwittingly hide the degree to which both designers and users are involved in the agent's construction and use.

As an alternative to this metaphor, socially situated AI suggests the metaphor of agent-as-communication. Socially situated AI sees agents not as beings in a vacuum, but as representations that are to be communicated from an agent builder to an audience. This point of view is deeply informed by recent work in believable agents,[20,15,29] that focuses more and more on the audience's perception of agents, rather than on an agent's correctness per se. This conception of agents is also very like contemporary conventional conceptions of artwork, as vehicles through which ideas can be transmitted from a designer to his or her audience.

But the concept of agent-as-communication is not limited to believability or other "artsy" applications. This is because proper perception of agents matters not only when we want to communicate a particular personality through our agents. It matters in any situation where the design of the agent (including its purpose, methods, functions, or limitations) should be understood by the people with which the agent interacts.

Thinking of agents as communication has several advantages. The notion of an agent as communication is clearly a more accurate description of how agents function culturally than the notion of an agent in an autonomous vacuum. It also brings advantages from a purely technical point of view. By making the commitment that "agentiness" is meant to be communicated, we can explicitly communicate to the audience what the agent is about, rather than assuming (often incorrectly) that this will happen as a side-effect of the agent "doing the right thing." And by building agents with an eye to their reception, builders can tailor their agents to maximize their effectiveness for their target audience. In this sense, agents built for social contexts can be not only more engaging but more correct than purely rational, problem-solving agents, in the following sense: they may actually get across the message for which they have been designed.

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Thick & Thin: "Direct Manipulation" & The Spatial Regimes Of Human-Computer Interaction

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Abstract

Consider a design trajectory, figured on one end by the screens of early command-line computer interfaces and ColecoVision's "Donkey Kong" (1981), and on the other, by the more complex and finely rendered spaces depicted in "Tomb Raider III: The Adventures of Lara Croft" (1999) and Apple's newly-released Mac OS X.

Lara Croft runs, jumps, tumbles, and blasts away at her opponents in visual fields that are more subtle and perspectivally sophisticated than those inhabited by Mario and "Donkey Kong." The responses of the screen images to the user's keyboard, gamepad, or joystick have been enormously enhanced, in both quickness and variety. But the fundamental spatial tropology – the tropology *of* space: abstract space, empty space, space that doesn't get in the way of players or their agents on the other side of the glass – remains consistent, from the earliest to the most recent examples of both desktop computing interfaces and computer gaming. The conceptual and psychological commonplace that grounds play in the domains inhabited by Mario and Lara, and the principles of "direct manipulation" in the graphical user interface, is the assumption of a permeable field of agency, essentially free of substance or resistance, or marked only by the sorts of resistance that a more efficient game pad, a faster processor, or a more "intuitive" visual metaphor, may eliminate.

In this paper, I propose that the "thin" spaces typical of the modern GUI and videogaming appear self-evident or "intuitive" to users and designers because they draw upon conventions of spatial thought that strategically foreclose traits of actual embodied encounters of human-computer interaction. It is desirable, I argue, to reconceive the forms of space commonly presupposed by the contemporary discourses of the GUI – to grasp these spaces materially, not as empty domains, open to the user's purposive manipulations of objects sited within them, but rather as persistently impermeable, resistant – "thick" – spaces, in which objects are only imperfectly manipulated and incompletely detachable from the lived moment of the interaction.

Knowledge on the Screen

This is Donald Norman, from his 1994 CD-ROM for Voyager, *Defending Human Attributes in the Age of the Machine:*

Donald Norman describes the advantages of the GUI in his *Defending Human Attributes in the Age of the Machine* (1994). the Voyager Company. Used by permission.

> In the early days of computers,when you turned it on, there wasn't anything there. There was no way of knowing what it is you could do. You had to have it memorized. You had to have all the knowledge in your head. [At this point in the CD-ROM, a black MS-DOS screen changes to a ca. 1994 Mac Finder] Today we've changed that. We've put a lot of knowledge on the screen to help you. You don't have to remember as much. You can just look. So we have menu bars above us. We have icons on the screen. We have a trash can. All of these are visual aids, putting knowledge there that lets you easily recollect what you must do.[17]

As Norman calls out the names of elements of the Mac OS's graphical user interface (GUI), a miniature Norman walks along the frame of a simplified computer screen, pointing to each element. This brief intervention in the mostly static pages of an "Expanded Book" (Voyager's name for the HyperCard-based CD-ROM series that includes Norman's text) underscores his claim for the self-evidentiary qualities of the Mac OS. It's a consciously cinematic gesture: recasting the on-screen field as an open, permeable domain, within which an agent (in this case, Norman) moves freely, and into which other objects are projected. "You can just look," Norman says, and the little Norman seems to prove the claim. The advantages of this new and better way of depicting knowledge on the screen are, well, obvious – so long, as nothing gets between between the eye and the things it regards.

Whatever non-pictorial or non-iconic signifiers they include, digital artifacts in the era of the GUI are understood chiefly by being seen. Users' and designers' understanding and expectations of them are informed by largely unacknowledged schemes of space, visuality, and agency, which nonetheless are crucial to their function. Designers tend to ignore the influence of these schemes, I suspect, for two reasons.

1. Many of them take these forms of spatial representation to be natural or self-evident. They are unaware of the extensive critical and philosophical literature that asserts that relations of embodied space and agency, and of seeing to knowing, are more complex, inconsistent, and contested than Norman's formula suggests.

2. Designing interfaces in this way appears to work, and work very well, for a specific task domain, though the fact that the domain is specific is rarely acknowledged. The forms of spatial thought encoded in Norman's praise of the GUI are, as I will observe later, typical of dominant spatial regimes of our time (see Martin Jay's analysis of the "scopic regimes" of modernity[10] and my discussion of Jay, below). What this means in practical terms is that users of a GUI are predisposed to expect human-computer interfaces to work in much the way they aim to work, even if they are unaware that this predisposition may be produced by the artifacts that seem to support it.

Critics and designers of new media should be wary of the epistemological sleight of hand that makes this seem easy or obvious. To say that the GUI puts knowledge "on the screen" – a version of Norman's signature distinction between "knowledge in the head" and "knowledge in the world" – may be appropriate for pragmatic analysis of the GUI's dominance of desktop computing.[n1] Nonetheless, it leaves little room for critical thinking about the spatiality of the digital field or the conditions of knowledge it presumes, because it too narrowly circumscribes the terms of investigation.

"You can just look," Norman promises of the GUI. But just looking is, strictly speaking, impossible for the intractably inconsistent consciousness we summarily describe as the "user." Looking will always be caught between moments of seeing and not seeing, bracketed and deformed by historical, cultural, and technical practices that determine the viewer's grasp of what it means to see anything at all. Before we can carefully discuss the siting of something called knowledge "on the screen," we need to investigate the assumption, widely held by designers of human-computer interfaces, that the spaces of the screen within which looking happens start off as empty, and empty in a particular way.

An important clue that this is all more complicated than it may at first appear is the frequent and explicit conflation in descriptions of the GUI of the attitude of seeing and the relation of knowing or understanding. Norman's praise of the "visual aids" of the GUI is one example of this. Another is a distinction made by Bruce Tognazzini between (merely) "graphical" and "visible" interfaces:

> A visible interface is a complete environment in which users can work comfortably, always aware of where they are, where they are going, and what objects are available to them along the way. To be labeled a graphical interface, an interface need only make use of objects that have a distinct graphical representation. Many aspects of the graphical interface may remain invisible.[n2,23]

The "visible" interface is a name for the ideal to which the GUI plainly aspires: it hides nothing that would be of interest or value to the user; nothing is missing; nothing is obscured; nothing gets in the way.[n3] The much-touted usability and "intuitiveness" of GUIs depend on this myth of perceptual and conceptual transparency.

If that transparency is impaired in any way, the interface will fail Tognazzini's benchmark: "When we set about to fool the senses through a very carefully constructed reality," he writes, "it becomes very important that we have no hidden rules that violate the user's sense of trust."[23]

In this context, the user's mastery of objects on the screen (the formal term is "direct manipulation" or "direct engagement")[9,20] is strictly determined by the GUI's substitution of visuality for other orders of relation. In 1982, David Canfield Smith described this substitution as the signal achievement of the new "desktop" interface of the Xerox STAR, the first commercial implementation of a GUI:

The Desktop of Xerox's Star Information System (1981). (From Smith, et al., *Designing the Star User Interface*, copyright 1981 Xerox Corp). Used by permission.

> A subtle thing happens when everything is visible: the display becomes reality. The user model becomes identical with what is on the screen. Objects can be understood purely in terms of their visible characteristics. Actions can be understood in terms of their effects on the screen. This lets users conduct experiments to test, verify, and expand their understanding – the essence of experimental science.[n4, 21]

Smith's enthusiasm for visual catachresis (the iconic, figurative ambiguities of the interface collapse into a way of simply naming what is seen on the screen) is echoed in Hutchins, Holland, and Norman's still broader claims for the transformative experience of direct manipulation:

> The point is that when an interface presents a world of action rather than a language of description, manipulating a representation can have the same effects and the same feel as manipulating the thing being represented. The members of the audience of a well-staged play will fully suspend their beliefs that the players are actors and become directly engaged in the content of the drama. In a similar way, the user of a well designed model world interface can willfully suspend belief that the objects depicted are artifacts of some program and can thereby directly engage the world of the objects.[9]

This alchemical metamophosis from a "language of description" to "a world of action" is not effected simply by a technical shift from a command-line interface to a GUI (as a common misreading of Norman's "you can just look" might suggest). A command-line interface easily can be, as Douglas Engelbart's NLS demonstrated as early as 1968,[4] constructed on design principles similar to those voiced by Tognazzinni, Hutchins, Holland, and Norman. The thread of conceptual continuity across all these interface strategies, and the basis of any claim that an interface approaches the idealized encounters of direct manipulation, is the consistency with which they address the fields in which looking, naming, and doing take place.

Thick and Thin Spaces

Personal computing has undergone innumerable changes in the last 20 years, but in this area, most of the effort seems to have gone into technical refinement rather than critical investigation of reigning scopic and spatial conventions. Aqua, the interface of Apple's recently-released OS X, may be the most programmatic encoding to date of these conventions.[n5]

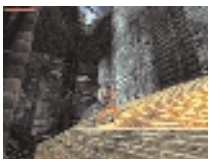
Aqua, the desktop interface for Apple Computer's OS X (2001). Used by permission.

Hard-core fans of the command line are likely to dismiss the extravagance and graphical nuances of the Mac OS X desktop as so much eye candy, a constrained computing environment masquerading as an interactive space by virtue of putting on an especially showy dress.[n6] But this complaint misses the real aim of Mac OS X's lush visual redesign, which is to bind cultural conventions of spatial complexity, depth, and transparency to practices of computing that don't fully conform to those conventions. The masquerade of visual depth is, in an important sense, precisely candy for the eye, a self-conscious artifice. No user would mistake the overlapping and translucent frames of this desktop for "real" (embodied) spatial fields, just as no viewer schooled in these matters would mistake pictoral or filmic spaces for those of the world off the canvas or the screen.[n7] Since the invention of linear perspectival method in Italy in the early 15th century, a lexicon of specific visual cues (projection lines, vanishing points, lengthening shadows, etc.) has informed the discourses of verisimilitude in traditions of scientific visualization and industrial and commercial graphic design that have most shaped the visual toolbox of the GUI.[n8] This reliance on perspectival technologies as the privileged measures of an image's "realism" was extended and solidified by practices of modern photography and cel animation, as the simple convex lens appeared to concretize and objectify scopic relations of linear perspective. The nearly direct line of descent from the *camera obscura* to the cathode ray tube has embedded these conventions in the visual and spatial logic of the computer display.

But our responses to these visual conventions are always – if not always consciously – adaptable. We take them to be markers of a reliable representation of the realms of the eye. Yet we also understand implicitly that they belong to a domesticated, geometrically sanitized version of those realms. In this way, the "visibility" of a GUI's spatial forms ("visible" as Tognazzini might use the word) is a function of both a tacit acceptance of visual conventions and a pragmatic willingness to suspend some of them, if circumstances require it.

Left: Microsoft's Bob interface for home computing. Used by permission.
Right: General Magic's Magic Cap interface for PDAs. Used by permission.

The history of the GUI suggests that overly-rigid implementations of screen-based interaction in "real-world" forms are destined to fail. Microsoft's Bob interface for desktop computers and General Magic's Magic Cap interface for handheld communicators are good examples of this fatal strategy. Mullet and Sano argue that these schemes must fail, not because they aren't "real" enough to fool the eye, but because their crude literalism works against the need for some kinds of digital data to be manipulated in ways not tied to visual depth.[15] The fictions of the "real-world" interactive spaces, for example, fracture as soon as users "open" their check registers or address books, where they are confronted by visual fields that (at best) relegate drop shadows, translucency, and the like to the margins. Successful GUIs, therefore, tend to apply strategies of frank spatial hybridity, mixing flat and deep visual fields. For example, a drop-down menu will cast a subtle shadow on the objects "behind" it, but the menu items are displayed on the plainest of fields, and the letterforms will have no dimensionality.[n9] These hybrid approaches do not, however, challenge the basic spatial production that acts as the conceptual and procedural support for the rest of the interface. Whatever inconsistencies appear in the visual framework of the desktop remain subject to an overarching representational logic that fuses spatial depth (more precisely, spatial emptiness) and the user's efficient manipulation of the desktop.



Left: "Tomb Raider III: The Adventures of Lara Croft" (1999). Used by permission.
Right: ColecoVision's release of the Nintendo classic, "Donkey Kong" (1981).

Visual conventions of spatial depth and manipulation have played a more conspicuous role in the evolution of video gaming during the period of the GUI's rise to dominance.[n10] Consider a design trajectory, figured on one end by the screens of ColecoVision's 1981 release of "Donkey Kong"; one of the first video games to move beyond the purely planar schema of early games, like "Pong"; "Space Invaders", or "Pac-Man"[n11]; and, on the other, by the more complex and finely rendered spaces of the 1999 release of "Tomb Raider III: The Adventures of Lara Croft". Lara runs, tumbles, and blasts away at her opponents within spaces more elaborate and subtle than those inhabited by Mario and Donkey Kong.[n12] The responsiveness of objects depict-

ed on the screen to the user's keyboard, gamepad, or joystick has increased enormously, in both quickness and variety. But the fundamental spatial tropology (that of *space*: abstract space, empty space, space that doesn't get in the way) is consistent from the earliest to the most recent examples of game play.

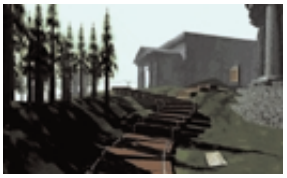
As is true of most GUIs, the visual fields of video games are typically hybridized in certain ways. The game's action ostensibly takes place in two- or three-dimensional domains in which objects, people, monsters, etc., look pretty much as they might in a "real" world (that is, they aren't emblazoned with titlebars, menus, buttons, and the like). But game designers, facing the need to communicate vital information that can't be gleaned from action on the screen (How many lives does a character have remaining? How many bullets are in her gun? What's the current score?), resort to the use of counters or controls displayed over the game play, in the margins, or called up with a special keystroke. These visual inconsistencies don't programmatically challenge the overall fiction of spatial openness.Their usual position in the foreground or periphery of the game window or screen reinforces the illusion that the events of gameplay somehow take place behind them. They are almost always a minor element in the game's graphic design, which is overwhelmingly dimensional, and designers will go to great lengths to give these violations of the space of the game a look and feel that evokes the game's visual sensibilities.[n13]

The principles of direct manipulation in the modern GUI, and play in the spaces peopled by Mario and Lara, are grounded by a single conceptual commonplace: the assumption of a prior permeable field of agency, free or nearly free of resistance, or marked only by the sorts of resistance that a more efficient keypad, a faster processor or video card, or a more "intuitive" or "natural" visual metaphor, might eliminate. I've been referring to this field of agency as "empty" or "transparent" space (its idealized instance), but a more accurate term would be "thin" space – a form of space that is very nearly emptied out beforehand, so that movement within it and mastery of the objects it contains are minimally challenging to users. In an important sense, users are constituted as users by their successful penetration into and traversal of this space. This is what the startup screen of the GUI signals. The desktop icon zooming out into a directory window; the expressly cinematic full-motion video sequence that "sets up" the story of the game; the constant running, tumbling, flying down corridors, tunnels, and narrow alleyways – the first effect of the graphic interface *cum* visible interface is to open up a space before you, already thinned out, ready for your purposive movement inside.

Thin space will take on different casts depending on the contexts of its production. It will be shaped and bounded by requirements of input devices, screen sizes, rendering speeds, and OS conventions and fashions. But its underlying structure is consistent and decisive. Putting "knowledge on the screen" (Norman really means "behind" the screen – the distinction is not inconsequential) is possible (conceivable) only if the shared domain of users' eyes and the objects they observe may be freely traversed by them or the avatars who act in their place. Norman misses something vital to understanding the spatial regimes of the human-computer interface when he observes that there was "nothing" in the black void of the C-prompt, until the GUI revealed its secrets. There was – there is – a very particular sort of nothing, a nothing that prepared the way for the expectation that something may come to be in its place.

The Spatial Regimes of Human-Computer Interaction

> The real world is the best user interface there is. And it's an invisible interface. Or at least it's something we've all learned. So we tried to make something that was as close to the real world as possible, and that meant the absence of any kind of computer interface, like buttons and things like that.
> – *Robyn Miller, The Making of Myst*



"Myst" (1993), Cyan Interactive. Used by permission.

Robyn Miller's claim that the "real world" is an "invisible" interface is not a contradiction of Tognazzini's praise of the "visible" interface. Both are versions of an epistemic scheme that also undergirds the exuberant rhetoric of direct manipulation: the ideal interface would be the thinnest of interfaces, the interface in which manipulation is *direct* manipulation because its field has been conceptually and procedurally emptied out before the interaction begins. This form of space is not, however, a given condition of interaction. It is produced and sustained by historically and culturally bracketed understandings of visuality and spatial form. Discursive practices of spatial emptying are among the most privileged methods of conceptual and political coercion of the post-Enlightenment period.[10, 13] They are also, as I have noted elsewhere, among the methods by which specifically cybercultural regimes of spatiality pattern themselves on pernicious traditions of scientific positivism, national-political identity, and social normativity.[6, 8]

An important step toward a critical-theoretical understanding of the peculiar spaces of human-computer interaction lies, I suggest, in learning to think carefully about the forms of space presupposed by the GUI and the fields of game play. These are not uncontested domains. As Martin Jay has observed of practices of visuality of the modern era, it is most accurate to say that there are multiple, overlapping, and inconsistent scopic regimes at work in the art and science of our time. This is true as well, I think, of the spatial regimes of the GUI. The history of contested spatiality in art, science, and politics off the computer screen can point the way toward a careful spatial design *of* the computer screen. Those debates may even provide strategies of design that break the epistemic confines of direct manipulation. The visual fields of contemporary GUIs are irreducibly hybrid; their inconsistencies demonstrate technical and conceptual limits of the common instances of this odd sort of place we call "cyberspace." Every space – and this includes the spaces of the human-computer interaction – will be at least a little thick: impermeable,

imperfectly or incompletely manipulable, stuck in historical, cultural, and psychic materiality that stops up efforts to empty it out. We need better ways of looking, where the space of looking and knowing thickens.

Endnotes

n1. That the icon- and window-laden fields of GUI screens are also called "desktops" demonstrates the remarkable efficacy of the GUI. As Ted Nelson pointed out more than a decade ago [16], these images don't look at all like the surfaces of desks. But the effect of a strong metaphor is such that it tends to eliminate from our awareness experience that doesn't fit that metaphor.

n2. Tognazzini's use of the term "visible" is evocative of Norman's use of that word in *The design of everyday things*: "The user needs help. Just the right things have to be visible: to indicate what parts operate and how, to indicate how the user is to interact with the device. Visibility indicates the mapping between intended actions and actual operations" [17].

n3. Neal Stephenson's criticism [22] of the pervasiveness of the GUI and the decline of the command-line interface – that the former oversimplifies what the latter reveals to be complicated – differs from Norman and Tognazzini's celebration of the GUI only in Stephenson's preference for text and syntagm over window and menu. All three critics begin with the assumption that human-computer interaction may be (or should be) exhaustively encoded in forms of the screen, that the secrets of the system's inner domains may be revealed to the user who is able to interpret the appropriate glyphs.

n4. For discussion in a similar vein, see [11].

n5. OS X is not unique among GUIs in using translucent widgets and antialiased shadows to suggest visual depth on the monitor screen – though Apple's new GUI may be the most complete and consistent implementation of these schemes. Recent releases of the K Desktop Environment for Linux (KDE), for example, have incorporated some translucent elements. Windows XP, Microsoft's recently-announced GUI for future versions of the Windows OS, also appears to incorporate similar elements. Given Apple's traditional role as a pathbreaker in the personal computing industry, it is probable that other OSes will adopt traits of OS X, and widget translucency is likely to be among them. On the use of transparent and translucent interface widgets in general, see [1].

n6. This is, in a somewhat caricatured form , Stephenson's complaint [22].

n7. Contrary to often-repeated claims that early cinema goers naively confused images on the screen with "real" objects and events, this was clearly not the case [5].

n8. See Mullett and Sano [15]. On the larger historical question of the role of perspectivalist technique in Western spatial thought, Damisch and Panofsky [2, 18] are valuable sources. But see also Elkins [3] for a more subtle imbrication of spatial thinking and artistic practice. He argues (convincingly) that the Renaissance inventors of linear perspective never mistook it for a unifying optical practice (as Enlightenment critics would have it, and as perspective is now widely understood), but accepted it as only one of the tools available to the painter. Jay [10] emphasizes that the varieties of scopic and spatial technique in Western art and science have been far more varied and inconsistent than claimed by historians of what he terms "Cartesian perspectivalism."

n9. The use of anti-aliased screen fonts in menus and window titles aims at improving their readability, not creating an illusion of depth.

n10. For the purposes of simplifying this (very schematic) historical overview, I won't distinguish between spatial discourses specific to coin-operated arcade, television console, and desktop computer games. I follow Poole's lead in labelling all of these forms, "videogames" [19].

n11. See Le Diberder and Le Diberder, and Wolf [12, 24] for differing taxonomies of spatial representations in these early video games. See also Poole's discussion [19] of the early history of videogaming, and the evolution of three-dimensional gameplay.

n12. Though that distinction may not be true of "SuperMario 64" (1996), which discarded the platform architecture of the classic Mario games in favor of more complex spatial representations – in many ways, resembling those of "serious" action games, like the Tomb Raider series. Many Mario purists have complained that the newer, more spatially "realistic" variation of the game has sacrificed much of the charm and conceptual simplicity of the original.

n13. The cognitive significance of these interruptions in the game's visual orders – they are signals to the user that the events on the screen are embedded in a larger psychic and cultural dynamic – has been, I think, underestimated. See [7].

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Towards Computer Game Studies

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Part 1: Narratology and Ludology

It is relatively stress-free to write about computer games as nothing too much has been said yet, and almost anything goes. The situation is pretty much the same in what comes to writing about games and gaming in general. The sad fact with alarming cumulative consequences is that they are under-theorized; there are Huizinga, Caillois and Ehrmann of course,[1] and libraries full of board game studies,[2] in addition to game theory and bits and pieces of philosophy — most notably those of Wittgenstein's – but they won't get us very far with computer games. So if there already is or soon will be a legitimate field for computer game studies, this field is also very open to intrusions and colonisations from the already organized scholarly tribes. Resisting and beating them is the goal of our first survival game in this paper, as what these emerging studies need is independence, or at least relative independence.

It should be self-evident that we can't apply print narratology, hypertext theory, film, or theatre and drama studies directly to computer games, but it isn't. Therefore the majority of the random notes and power-ups that follow will be spent modifying the presuppositions firmly based on the academic denial of helplessness. Obviously I need a strategy, and fortunately I have one: to use the theories of those would-be-colonisers against themselves. For example, as we shall soon see, if you actually know your narrative theory (instead of resorting to outdated notions of Aristotle, Propp, or Victorian novels) you won't argue that games are (interactive or procedural) narratives or anything even remotely similar. Luckily, outside theory, people are usually excellent at distinguishing between narrative situations and gaming situations: if I'll throw a ball at you, I don't expect you to drop it and wait until it starts telling stories.

It's good we don't have to start from scratch, as there have been attempts to locate, describe, and analyse the basic components and aspects of the gaming situation, essentially different from the basic constituents of narrative and dramatic situations. I'm thinking here of Chris Crawford's early classic *The Art of Computer Game Design,* Gonzalo Frasca's and Jesper Juul's papers on ludology, and most of all Espen Aarseth's articles on computer games and cybertext theory.[3]

First of all, I would like to demonstrate or test a safe and painless passage from narratives to games by trying to exhaust classic narratology.[4] Most naïve comparisons between narratives and games usually result from too narrow, broad, or feeble definitions of the former: usually it comes down to discovering "plots" and "characters" in both modes – games and narratives. However, we should know that is not good enough because we can find those events and existents in drama as well – clearly its own mode. The minimal definition of narrative derived from Gerald Prince and Gerard Genette states basically that there must be two things or components to constitute a narrative: a temporal sequence of events (a plot if you want to water down the concept); and a narrative situation (with both narrators and narratees for starters). I think we can safely say we cannot find narrative situations within games. (Or if and when we sometimes do, most probably in "Myst" or "The Last Express," the narrative components are then at the service of an ergodic dominant).

To be brief: a story, a back-story, or a plot is not enough. A sequence of events enacted constitutes a drama or a performance, a sequence of events recounted constitutes a narrative, and perhaps a sequence of events produced or played out under certain circumstances and following formal rules constitutes a game. This is quite trivial but crucial; there are sequences of events that do not become or form stories (like in "Tetris" for example). The reason for this is equally simple. In games, the dominant temporal relation is the one between user time and event time, not the narrative one between story time and discourse time.

Regarding the fallacy of recognizing similar characters or existents in games, drama, and narratives, the situation is similar. In computer games you can operate your character if there is any in the first place, perhaps also discuss with other characters or voices, and the characters can be dynamic and developing, or they can change themselves with level points and power-ups. These entities are definitely not acting or behaving like traditional narrators, characters, directors, and actors, their supposed counterparts in literature, film, and on stage.

To sum up: different existents, different event structures, and different situations. On the other hand narratology is not completely useless, if its key concepts and distinctions are not taken for granted but traced back to their roots. In the following that is exactly what we try to do. The elementary categories of classic narratology are transformed into an open series of ludological components, if not for any other reason than to further specify the features inherent to games.

Before going into the finer points of ludology, the more or less peaceful co-existence of local traditions and global technologies should also be acknowledged. There is no guarantee whatsoever that the aesthetic traditions of the West are relevant to game studies in general and computer game studies in particular. It is tempting to assume that one reason for the never-ending series of unsuccessful game definitions is the need or urge to make clear-cut distinctions and compartmentalize aesthetics. To take an obvious counterexample: according to the Natyasastra, every art contains parts of other arts.[5] It would be almost equally sensible to speculate on Japanese aesthetics and claim that a tradition that emphasizes the values of perishability, suggestion, irregularity, incompleteness, and simplicity[6] is perhaps better suited to approach computer games than its Western counterpart.

2. The Gaming Situation

Jacques Ehrhmann understood games as economy, articulation and communication, and the player as both the subject and the object of the game.[7] The levels of articulation as specified by Warren Motte – the relations of player to game, player to player and game to world[8] – give important clues concerning the elementary differences between games and narratives. To take only one example: in multi-player games the positions of players constantly affect each other. Such an arrangement would be very unusual but not impossible to execute in narrative fiction. The

way I read The Idiot would then change other people's Idiots or their readers' possibilities to read them and vice versa. That wouldn't make much sense but in games such a practice has always already been in existence. Accordingly, we can distinguish between the static user positions of literature, film, and average drama from the dynamic ones of games and certain installations and performances. We should also mention mobile positions in the wake of mobile gaming and games like the recent "Nokiagame"[9] that contacts the player through multiple channels (text messages, television, the Web, etc.) and demands action.

As we all know, games have other than mere interpretative goals. These goals can be reached by traversing, negotiating, or otherwise overcoming a series of obstacles and gaps. When studying narratives as systems of gaps Meir Sternberg made three heuristic distinctions: gaps are either permanent or temporary, focused or diffused, and either flaunted or suppressed.[10] I think computer games can also be described that way with the all important exception that these gaps are not static and interpretative but ergodic[11] and dynamic: they need action to be encountered, closed, and dealt with. Aarseth's four user functions — interpretative, explorative, configurative, and textonic[12] — are useful in specifying what kind of action is required from the player. In practical terms this means options like finding paths, completing prefabricated relations, or adding new game elements for the other players to struggle with. The resulting typology of 32 possibilities could then be used to map out both qualitative and quantitative differences in the information given to the player in different stages and phases and levels of the game.

Focalization is one of the key elements of the narrative situation in classic narratology. In its most abstract sense it is a channel for narrative information and ultimately based on the assumption of the uneven distribution of knowledge. Focalization is accompanied by the category of distance that regulates the amount (too much or too little) of information distributed through the channel, or two channels (audio and visual) as in film. This is exactly the level where I would like to draw a few parallels between this ludology-in-progress and narratology. One could argue that information is distributed and regulated very differently in games than in narratives as in the former it's also invested in formal rules. In some cases the knowledge of these rules is all that is needed to succeed in the game (in "Tetris" for example). It is important to understand that rules are not conventions One can by all means change conventions while reading a narrative, but one cannot change the rules of the game while playing. The situation is more complex however, since it is common that the player has all the information needed but lacks skills.

In Genette's narratology there are three main categories – narrative level, person, and time of the narrating – that specify the narrator's position or the co-ordinates of narrative acts.[13] Parallels are pretty obvious. It would be only sensible to note the arrangement of levels in a game, and whether or not the player is represented by a character in a game as well as the player's abilities to time the action.

3. Aspects of Time in Computer Games

The dominant temporal relation in (computer) games is the one between user time (the actions of the player) and event time (the happenings of the game), whereas in narratives it is situated between story time (the time of the events told) and discourse time (the time of the telling). The key concept here is the dominant. As we all know, narratives like Stuart Moulthrop's "Hegirascope" and "Reagan Library"[14] can utilize both user and event times for narrative purposes, and games like "The Last Express"[15] can use story and discourse times for gaming purposes. Despite these hybrids the underlying restriction remains the same: there is no narrative without story and discourse times, and no game without user and event times; everything else is optional.

In the course of a game the player encounters temporal phenomena or events with different durations, speeds, orders, and frequencies – and some of these must be manipulated or configured to move from the beginning to the winning situation. Even though game time doesn't have much in common with narrative time, this does not prevent us from observing similar temporal categories in both modes, as order, repetition or speed are not narrative or game-like in themselves.

Traditionally, events are divided into actions and happenings based on their agency, and into kernels and satellites based on their relative importance. There is also a difference between punctual acts and more durational actions.[16] Events can of course be more or less separate or connected and we can borrow the three elementary possibilities of combination from Claude Bremond: embedding, enchaining, and joining.[17] In our case, games can be differentiated from each other on the basis of which events can or cannot be manipulated, which parts and dimensions of events can be manipulated, and for how long and how deeply. An almost ready-made set of temporal relations can be derived from print and film narratologies – this act gives us six categories to study: order, speed, duration, frequency, simultaneity, and the time of action. It is very probable that there exist other noteworthy temporal relations, but I begin with these.

Let me note in passing that the manipulation or completion of multiple relations takes place in time – a kind of general economy of games – but here we are dealing only with the restricted economy of manipulating temporal relations. The importance of mutable temporalities varies from game to game, and there are games that are more dependent on other kinds of variables. For example, turn-based strategy games like "Civilization" seem to

favour causal relations over temporal ones to create event structures that have remarkable similarities to complex board games. We are talking here about quantitative differences: at one extreme there are multiple and highly interdependent chains of events with a complex tactical and strategic calculus, and at the other end looser chains of completed action episodes or stimulus-response cycles with no or minimal cumulative consequences. Taking into account the demands of gameplay (a well-balanced combination of tempo and cognitive tasks) it makes sense that the former types of games utilize intransient time and the latter transient time.

Order
In computer games this is the relation between user events and system events, or the actions of the player and their interaction with the event structure (happenings) of the game. In some cases there is only one sequence of events and the player has to act accordingly in the sense of keeping up with it for as long as is humanly possible. "Tetris" best exemplifies this type of game. In other cases, commonly in exploration games like "Doom," order is a tripartite combination of events, negotiation and progression;[18] in these cases the player must find and test possible event sequences until the right one is found and the game can continue. So you either follow the order or spend your time finding it. In cases where the player can't affect the order of events there's still the difference between variable and invariable sequences of events. In "Tetris" where those objects just keep falling the player can't know in what exact order they'll follow each other. This is also one of the simplest ways to limit or prevent anticipation.

Frequency
This factor concerns the repetitive capacities of the game. Basically, both events and actions (or to be precise the player's chances for taking action) may happen only once or unlimited number of times. There may also be a limit to these recurrences, a kind of a middle ground between those two extremes. In some computer games, especially in role-playing games like "Ultima Online," at least some actions are irreversible and one cannot go back to a previous situation and undo the changes. In other kinds of games this is not the case, and the player can by all means keep banging his head against the wall until there occurs a break somewhere. Sometimes it is even advisable.

Speed
This aspect concerns pace. As we know, one of the great gifts computers brought to gaming is their superb ability to keep pace. To once again borrow a concept or two from Espen Aarseth, we can say that the main difference here is between transient and intransient games. In the former, the computer controls the pace and in the latter the player. On the other hand, this concerns only the agent of speed. There are at least two other relevant dimensions of speed: its steadiness (for some reason the obvious alternative to this is almost always the accelerating and not the decelerating speed), and its importance as a goal in itself.

Duration
This variable contains at least three aspects. Firstly, Richard Schechner distinguishes between event time and set time.[19] In the former case the game is over after all the events are properly traversed, and in the latter there's a temporal limit to all this and the winner is the one who is in the better position when the set time is up. Secondly, temporal limitations can either affect the whole game in its entirety, or only some parts of it that should be traversed within the set time. "The Last Express" is an intriguing combination of these possibilities. In games like "Doom" the players should usually try to reduce the time span or duration allotted to any odd monster. If such an entity is allowed to live its life to the full extent, the game is over. Thirdly, the reverse options may be equally valid depending on the situation – to reduce the duration of an event by cheating or getting out of the situation, or to prolong the duration of an event (letting it happen) by avoiding any confrontation, as in "Thief."

The time of action concerns the player's possibilities to act. Basically, the player can act before, after, during, or in between events. Not all games allow all these possibilities, and not all of these possibilities are equally important in any one game or in any one situation in a game. This is just one aspect of the type or the modality of action. It also corresponds in some degree to the difference between turn-based and real-time strategy games.

Simultaneity
The player may have to increase or decrease the number of simultaneous or parallel events, generate, or initiate such events. A typical example would be "Command and Conquer" and its multiple pieces. Events may have to be alternated, embedded, or linked to each other, or such prefabricated connections and arrangements may have to be reversed and dismantled.

We could easily go into greater detail here by introducing various subdivisions to the temporal categories discussed above; or by taking more rigorously into account temporal requirements (in terms of speed, order, duration etc.) set for the player's possible and necessary actions, and mapping them onto the temporal dimensions of game events. So, after all, there is still much work to be done.

4. Summary

Ludology is not about story and discourse at all but about actions and events, the relations of which are not completely fixed.[20]

From Stuart Moulthrop's Hegirascope

From Stuart Moulthrop's Hegirascope

Notes

1. Caillois, R. (1979 [1958]). *Man, play, games*. Translated by Meyer Barash. New York: Schocken Books; Ehrmann, J. (1969). Homo ludens revisited. In *Yale french studies* 41: 38-57.
2. For instance, Parlett, D. (1999). *The Oxford history of board games*. Oxford and New York: Oxford University Press.
3. Aarseth, E. (1997). *Cybertext perspectives on ergodic literature*. Baltimore: The Johns Hopkins University Press; Aarseth, E. (1998 [1995]). Dataspillets diskurs. In *Espen Aarseth, Digitalkultur og nettverkskommunikasjon*, 75-98. Bergen: Espen Aarseth; Aarseth, E. (1998). Aporia and epiphany in Doom and The Speaking Clock: Temporality in ergodic art. In Marie-Laure Ryan (ed.) *Cyberspace Textuality*, 1-14. Bloomington and Indianapolis: University of Indiana Press; Crawford, C. (1982). The Art of Computer Game Design. URL: www.vancouver.wsu.edu/fac/peabody/game-book/Coverpage.html; Frasca, G. (1998). Ludology meets narratology. URL: www.jacaranda.org/frasca/ludology.html; Juul, J. (2000). What computer games can and can't do. Paper presented at the Digital Arts and Culture conference in Bergen.
4. Chatman, S. (1978). *Story and discourse*. Ithaca: Cornell University Press; Chatman, S. (1990). *Coming to terms*. Ithaca: Cornell University Press; Genette, G. (1980 [1972]). *Narrative discourse*. Ithaca: Cornell University Press; Genette, G. (1988 [1983]). *Narrative discourse revisited*. Ithaca: Cornell University Press; Prince, G. (1981). *Narratology*. Berlin: Walter de Gruyter; Prince, G. (1987). *The Dictionary of Narratology*. Lincoln and London: University of Nebraska Press.
5. Vatsyayan, K. (1996). *Bharata: The Natyasastra*. Delhi: Sahitya Akademi.
6. Keene, D. (1995). Japanese aesthetics. In Nancy G. Hume (ed.) *Japanese aesthetics and culture*, 27-41. Albany: State University of New York.
7. Ehrmann, J. (1969). Homo ludens revisited. In *Yale French studies* 41: 55-57.
8. Motte, W. (1995). *Playtexts*. Lincoln & London: University of Nebraska Press, 25.
9. "Nokia Game" (www.nokiagame.com) is interesting in how it makes use of the immediate media environment of the player as the following excerpt from its rules makes clear: "The player must complete various kind of challenges and puzzles based on the given clues in order to proceed to the next stage of "Nokia Game." A time period for completing a task in question may be limited for some tasks (e.g. for couple of hours or the clue might be given at an exact time). This time limit will be notified to the player with the task or clue in question. The player may find the clues via received short messages to his or her mobile phone or via other various kinds of media, such as Internet, TV, radio, magazines or newspapers. At most stages of "Nokia Game" the player has only one chance to complete the task in question. At each stage part of the players will be excluded from "Nokia Game" based on a wrong answer or action, or not being among the announced number of best players that has performed the task in question." The game continues for a month (for the winner and a little less for others).
10. Sternberg, M. (1978). *Expositional modes and temporal ordering in fiction*. Baltimore: Johns Hopkins University Press.
11. Aarseth, E. (1997). *Cybertext perspectives on ergodic literature*. Baltimore: The Johns Hopkins University Press, 1.

From Stuart Moulthrop's Reagan Library

12. Aarseth, E. (1997). *Cybertext perspectives on ergodic literature.* Baltimore: The Johns Hopkins University Press, 60-62.
13. Genette, G. (1980 [1972]). *Narrative discourse*. Ithaca: Cornell University Press, 215.
14. "Hegiracope," a web fiction by Stuart Moulthrop, limits the reaction time of its readers to 30 seconds per node. Within that period of time the reader must decide which narrative thread to follow and choose a link; otherwise the program makes that decision for the player. In "Reagan Library," also by Moulthrop, the content of the nodes change when they are revisited for the first three times (there is more text available for the persistent reader). This affects or at least has the capacity to affect and alter the temporal relations between story time and discourse time. See Moulthrop, S. (1995). Hegirascope. URL: raven.ubalt.edu/staff/Moulthrop/HGS; Moulthrop, S. (1999). Reagan Library. URL: raven.ubalt.edu/staff/Moulthrop/rl.
15. "The Last Express" (CD-ROM, Broderbund 1997, see also http://www.lastexpress.com) is an adventure game (a murder mystery) happening in the real-time of the game world. The player must find the culprit in time, that is, he may run out of time to solve the crime, as there's a temporal limit to the duration of the exploration. In other words the wasted time also counts, and the player has to manipulate discourse time and condense it to contain the relevant story events.
16. Chatman, S. (1978). *Story and discourse*. Ithaca: Cornell University Press, 32-56.
17. Bremond, C. (1980). The logic of narrative possibilities. New Literary History 11:398-411.
18. Aarseth, E. (1998). Aporia and epiphany in Doom and The Speaking Clock: Temporality in ergodic art, 9.
19. Schechner, R. (1988). *Performance theory*. London: Routledge, 6-7.
20. Here's a preliminary example of how to apply some of the key concepts utilized in this paper to "Tetris," probably the most successful abstract computer game ever.

	story time < narratives	> discourse time/event time < games	> user time
order	——		X (random)
speed	——		X (accelerating)
frequency (repetition)	——		0
duration	——		0
simultaneity	——		X (no simultaneity)
time of narration/action	——		X (during and after)

Explanation: dotted line = non-existent relation, X= non-manipulatable relation, 0 = manipulatable relation. Discourse time in narratology is somewhat similar to event time in ludology. The former could be seen as a series or a combination of individual event times, either fixed (or semi-fixed) as in print or hypertext narratives or variable as in games. Still, as differences in the time needed to complete a game usually vary considerably from player to player I prefer event time to discourse time. One should also note that in computer games there's always a conceptual difference between events as they exist in the game and as they are presented to or generated for the player (very much like textons and scriptons in cybertext theory, see Aarseth 1997, 62).

What Does A Very Large-Scale Conversation Look Like?

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Introduction

The new electronic spaces that I am interested in have the following characteristics in common:

- They are large. Many server sites now support interchanges between hundreds and thousands of people. Usenet newsgroups and large listservs are the most common such sites. I call these usually text-based, usually asynchronous interchanges very large-scale conversations.[21]

- They are network-based. More specifically, they support network-based communities. The boundaries of these spaces and the communities they support are not geographic boundaries. Communities of artists, writers, and scientists are examples of pre-Internet, network-based communities (communities based upon a social network and some shared interests or needs). Network-based communities are of a different kind than geographically based communities like neighborhoods, cities, and nations. Network-based communities (for example, the scientific community) have continued to grow with the help of new network technologies, but contemporary technologies have also engendered a variety of new communities (for example, the open source community).

- They are public. As more and more people gain access to the Internet from their homes or schools rather than from their workplaces, the Internet increasingly becomes a space for public discussion and exchange. Very large-scale conversations are a common event within the confines of large industry (for example, the huge number of communications among thousands of people required to design and build an airplane or coordinate production of a film). However, these have a distinctly different character than the very large-scale conversations in which people are participating as individuals rather than as employees. The Internet is engendering the production of new public spaces that may offer the means to reinvigorate public discourse.[11,26]

From the perspective of the history of media, very large-scale conversation (VLSC) is a new and mostly unexplored phenomenon. At no other point in history have we had a medium that supports many-to-many communications among hundreds or thousands of people. VLSC takes place across international borders, often on a daily or hourly basis. Unlike in older media (for example, telephones) participants in these very large-scale conversations usually do not know the addresses of the others before the start of a conversation. Current social-scientific theories and tools we have for understanding and investigating conversations and discourse include those of discourse analysis[24] and conversation analysis.[13] These existing theories and techniques can handle analysis of small-scale conversations (for example, interactions among 30 or fewer people). But it is not obvious how the existing methods can be scaled up to handle the huge, many-to-many interactions that have now become commonplace on the Internet. So the challenge is this: What software can be designed to help us navigate the new public spaces of VLSC?

Navigation

Michel Foucault has pointed out that "the comparison between medicine and navigation is a very traditional one.[8] Medicine, navigation, and government have to do with self-guidance, control, and governance. Etymologically, the verb "navigate" comes from the combination of words navis [ship] and agere [to guide]. Thus, in the case of navigation of a large, public information space, the "ship" has been replaced by the self, and so the point of navigation is self-guidance or self-governance. From this perspective, the right way to evaluate or critique a browser (or any other piece of navigation software) is with respect to how well it supports self-governance. In the particular case of a VLSC browser, it should help us better understand where we are located (and where we might go) in a wider network of social and semantic relations. It should also help us consider the existence of a collective self-organization constructed through the text and talk of a VLSC. I am interested in the larger ethical and aesthetic implications of this understanding of navigation.

To better understand the issues of designing software for navigation, I've borrowed a conceptual framework from Paul Dourish and Matthew Chalmers. In 1994,[5] they asserted that there are at least three ways in which large bodies of information can be navigated:

1. Social Navigation

Dourish and Chalmers claim that software can be designed to support the social navigation of information.[16] By social navigation I understand them to mean people helping other people to find information. Examples of social navigation software include the mechanisms employed in recommender systems and collaborative filtering.[17] Work done in organizing texts through citation analysis, as is done in the field of science studies, can also be counted as support for social navigation.[9]

2. Semantic Navigation

Semantic navigation requires, for instance, the sorts of computation we have available to us when we use a search engine on the Web. Using techniques from information retrieval and computational linguistics, semantic navigation can be supported through calculation of some approximation to the meaning of a set of documents.

3. Spatial Navigation

Spatial navigation entails the kind of manipulations often performed in the area of information visualization to convert a large body of data into a two- or three-dimensional image. The image then can function as an interface to the information that it incorporates.[2]

To support all three of these types of information navigation, I use some techniques and tools from sociology to support social navigation, some ideas from linguistics to support semantic navigation, and, some aspects of graphical interface design to support spatial navigation of VLSCs. A more complete description of my approach can be found elsewhere.[22] I have designed and implemented a prototype VLSC browser system to embody this approach: the Conversation Map.

Conversation Map

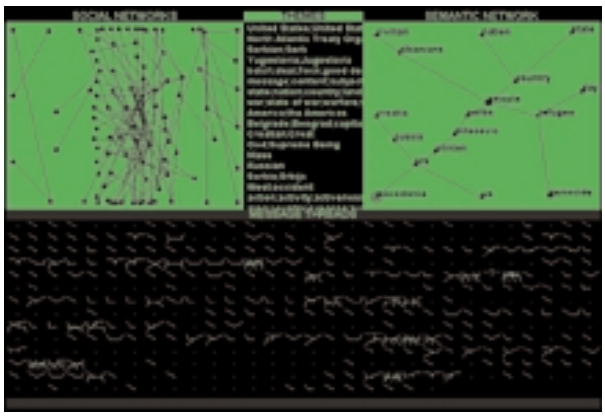
The Conversation Map system can analyze several thousand messages at a time. It employs a set of computational linguistics and sociology techniques in order to generate a graphical summary of the messages. The graphical summary includes:

- A set of social networks that illustrates who is corresponding with whom.
- A menu of themes of discussion that are important to the conversation embodied in the messages.
- A semantic network that articulates some of the emergent synonyms or metaphors of the discussion.

One can use the Conversation Map like Netscape Messenger, Outlook, Eudora, or any other conventional news or mail reader. However, right now, the text analysis procedures are too slow. An analysis of several thousand messages currently takes the system several hours. I am re-engineering the system (and redesigning the interface) to allow one to use the Conversation Map as an everyday email reader or news browser.

Social Networks

The upper left quadrant of the interface depicts a set of social networks that record who is corresponding with whom. By "corresponding" I mean who is mutually responding to and/or quoting from whom. According to my definition, two participants (say "Sally" and "Spot") correspond with one another if Sally posts to the newsgroup, Spot responds to (or cites) Sally's message. and then, later in the discussion, Spot posts to the group and Sally responds to (or quotes from) Spot's message. In the social network, Sally and Spot will be represented as two nodes with a line connecting them. If they correspond frequently, then the line between them will be short. In contrast, those pairs of participants who correspond only once will be plotted relatively far apart. Note that posters who spam the group with many messages, but who receive no replies, do not even show up on the graph. Those participants who show up closely connected are pushed to the middle of the graph and can be understood as virtual mediators of the newsgroup. They are virtual moderators because most of the analyses I have done have been of unmoderated, public discussion spaces on the Net. To end up in such a position one needs not only to post many messages, but also to have others in the group reply to or quote from many of one's messages. So the social-network display acts both as a filter for spammers and a means to identify some of the main players in a discussion.



The Conversation Map interface.

Themes

The menu in the upper middle of the interface lists the themes of the conversation. Imagine that Sally posts a message about football, and then Spot responds with a message that includes some reference to baseball. Then, perhaps later in the discussion, Spot posts a message about skiing, and Sally responds with one concerning skating. This correspondence will be represented in the social network, but some approximation to the theme of their exchange will also be listed in the middle menu. In this case, since football, baseball, skiing, and skating are all sports, the term "sports" might be listed on the menu of themes. Calculating that these four terms are all sports requires, of course, a machine-readable thesaurus. The thesaurus employed in the Conversation Map system is WordNet, a lexical resource created by George Miller, his colleagues, and students at Princeton University.[7] Th ealgorithm for calculating the multi-authored themes is akin to (but not exactly the same as) a set of procedures from computational linguistics designed to analyze the lexical cohesion of single-authored texts.[12]

Semantic Network

The calculations performed to create the semantic network shown in the upper right-hand corner do not use a thesaurus, but, rather, automatically generate a rough-draft thesaurus. Creating a rough-draft thesaurus the Conversation Map system does the following:

First, the content of all of the messages exchanged during the conversation is parsed. In other words, the subjects, verbs, objects, and some of the other modifying relations are identified between the words of each sentence in the texts of the messages. Next, for each unique noun mentioned in the corpus of messages a profile is built. By "profile" I mean that, for each noun a vector is created that records all of the verbs for which the noun functioned as a subject, all of the verbs for which the noun functioned as an object, all of the adjectives which modified the noun, etc. Once a profile has been calculated for each noun, the nouns' profiles are compared to one another and each noun's nearest neighbor is identified. An algorithm[10] is used to calculate and compare the noun profiles. If two nouns have similar profiles, then they can be said to have been "talked about" in similar ways by the participants in the discussion. Therefore, they may be considered synonyms or possibly metaphors for one another. In the semantic network, if two nouns are nearest neighbors, then they are plotted as two nodes connected to one another.

Why is this sort of analysis of interest for the navigation of very large-scale conversations? To answer this question, I compare this sort of analysis with some work done by the cognitive scientists George Lakoff and Mark Johnson. Lakoff and Johnson wrote a book entitled Metaphors We Live By.[14] The book is filled with a set of metaphors that Lakoff and Johnson claim are central to our (presumably North American, English-speaking) culture. In their book, for instance, they claim that one emergent metaphor of our culture is that arguments are buildings. As part of their argument for the validity of insights like this, they show how two nouns, which might a priori be considered to be completely unlike one another, show up in very similar contexts. For example, one can say "The building is shaky," but one can also say "The argument is shaky." One can say "The building collapsed," but also "The argument collapsed." Similarly, both buildings and arguments can be said to have "foundations," "to stand," and "to fall," "to be constructed," "to be supported," "to be buttressed," etc. A set of similar sentences of this sort provides an empirical means for thinking about and discovering how synonyms and metaphors are produced over the course of a large amount of discussion.

Thus, this tool for automatic, rough-draft thesaurus generation gives one the means to begin to generate the sorts of hypotheses that Lakoff and Johnson explore in their book. Alternatively, one can understand the noun profiles and semantic networks in Michel Foucault's terms, as "statements" and "diagrams," respectively. Gilles Deleuze explains Foucault's terms.[3] So the Conversation Map gives one some data exploration/navigation tools to start to understand how conversations differ from one another according to the metaphors, synonyms, and "statements" that are produced by the collective efforts of their participants.

Message Archive

The lower half of the interface is a graphical representation of all of the messages that have been analyzed by the Conversation Map system. Messages are organized into threads. A thread is defined as an initial post, all of the responses to the initial post, all of the responses to responses, etc. The threads are plotted like spider webs. The first message posted is represented as a large node, and the responses, responses to responses, etc. are plotted as radi ating out from the center. Double-clicking on a message thread in the lower half of the interface will cause a larger picture of the thread to be displayed.

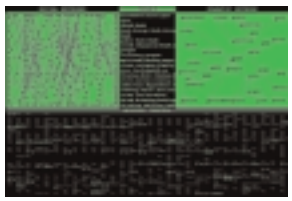
An example message thread.

The lower half of the screen is divided into a grid, and the threads are organized in chronological order from upper left to lower right. If a thread contains many messages, it shows up as an almost completely green square on this display. If a thread contains few messages, then it shows up as an almost completely black square. So, scanning across from upper-left to lower-right, the lower-half of the screen can be seen as a rough guide to the posting activity in the newsgroup.

Examples

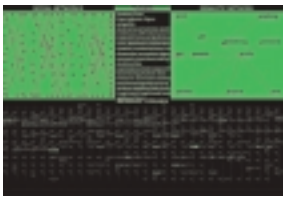
In the following section, I show 12 example Conversation Maps that were generated from a wide variety of online, public discussions. With these examples, I hope the semiotics of how to read these maps will become understandable. Also I hope that these one-page, graphical summaries of hundreds or thousands of email messages will be seen to be a useful thing for gaining a quick glimpse into a very large-scale conversation.

Politics

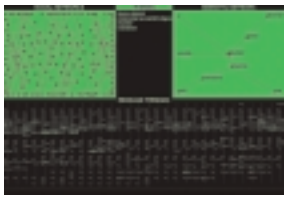


The map on the left and the map on the right were created about a week apart using messages from the newsgroup alt.politics elections. The one on the left was generated immediately before the presidential election. Notice how the main themes of discussion center around the candidates: Gore, Bush, and Nader. A week after the election the conversation has moved away from a discussion of the candidates. Now it is a discussion of the technicalities of elections: votes, counts, ballots, laws, and courts are the newly prominent themes of discussion. This can be seen in the themes and semantic network of the map on the right.

Media



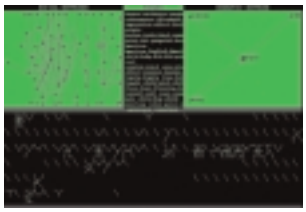
Talking to one another.



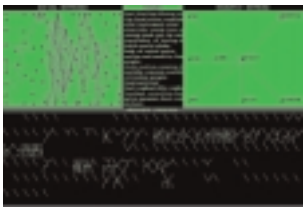
Talking at one another.

This pair of maps shows the same newsgroup (a discussion about the television show "X-Files") at two different times. Notice how many themes of discussion there are in the map on the left. Now notice how very few themes of discussion are listed in the map on the right. Because the Conversation Map uses a very generous means of counting the themes of discussion, it usually lists too many, not too few. What the map on the right tells us is that no one is following up on what other people are saying. The two snapshots in time represented by these two maps demonstrate how an online discussion can change from being one where people talk to one another into one where they just talk at one another. This fact is also represented in the very scattered appearance of the social network.[20]

Environment



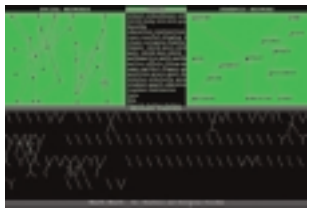
People as problems.



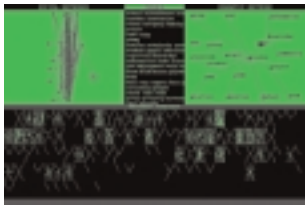
And problems as people.

The map on the left represents about a month's worth of messages posted to the group sci.environment. The map on the right represents the same newsgroup one month later. By comparing the two maps, you can get some idea of how the group has changed over time. One thing that has remained stable between the two maps is the connection in the semantic networks between the terms "people" and "problem." This is a clue that perhaps, in this newsgroup, people are seen to be one of the causes of environmental problems. But a hypothesis like this that one can come up with by looking at the maps needs further investigation to be confirmed or discarded.

Education



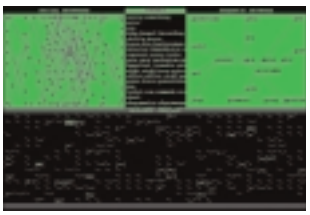
A shallow discussion.



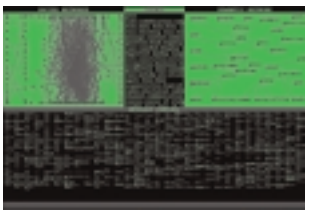
A deep conversation.

On the left is a map of about 300 messages from the Usenet newsgroup misc.education. Note the themes of discussion and compare them to the map on the right. Both maps summarize discussions about education and learning. The map on the right summarizes a semester's worth of messages posted by a distance-learning course taught by Linda Polin of Pepperdine University. In comparison with the first map, note how much more tightly knit the social network is here: people are responding to one another. Note also the elaborate threads containing many messages as compared to the sparse threads in the first map. These elaborate thread structures show that the participants are repeatedly elaborating on one another's postings. This sort of an exchange is perhaps much deeper than, for example, the quick question-and-answer format of the technology discussions depicted below and the curt exchanges that one can note in the threads of the political discussions above.

Technology



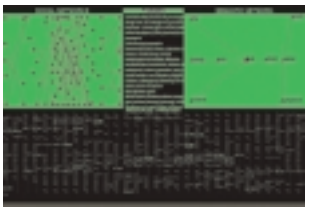
Experts as hubs in social network.



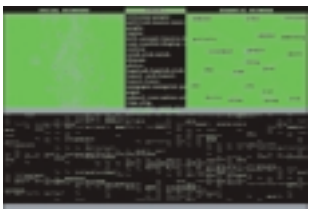
A patter of question-and-answer pairs.

The conversation map on the left was created from about a month's worth of messages posted to a public listserv devoted to the construction of Lego robots. Note how the social network shows that there are multiple hubs: these correspond to an expert in mechanical systems, an expert in programming, and an expert in electronics. The second map is an analysis of about 2,500 messages from the newsgroup devoted to the Perl programming language: comp.lang.perl.misc. Note the dense social network and also compare the thread pattern here with the deep discussion of education analyzed above. The pattern here is indicative of a series of brief question-answer clusters. In contrast, the elaborate threads in the deep education conversation indicate that participants are repeatedly elaborating on one another's responses.

Health



Illness and family relatives.



Illness and citizens.

The conversation depicted here, on the left, took place in a public newsgroup devoted to attention deficit disorder. However, one can see from the map that the discussion was not just about the illness, but about family members as well. The map on the right is a summary of several hundred messages sent to a newsgroup on chronic fatigue syndrome. As can be seen here, too, the discussion focuses not just on the illness but on a more general discussion of people and citizenry. The anthropologist of science, Joseph Dumit of MIT, argues that illnesses like these (ADD and CFS) are illnesses one has to "fight to get" because they are often not recognized by doctors and insurance companies. Consequently, online discussions can become places where sufferers can meet and illness-based social movements can emerge.[23]

Conclusions

Mapping Common Ground

In a recent essay, the writer and frequent contributor to Artforum Frances Richard discusses the Conversation Map in juxtaposition with other work on mapping conversations, specifically the work of artists Janet Cohen, Keith Frank, Jon Ippolito, and Mark Lombardi:

Sack's project unfolds a tiered grid on which this collective polemic can be tracked. Electronic communication is often theorized in terms of a return to epistolary or conversational consciousness, and the opportunity of discussing, say, the Kosovo situation with political scientists, Balkan historians, NATO-watchers, Albanian teachers, and Serb journalists represents a previously unimaginable crucible for spontaneous intercultural and interdisciplinary debate. The existence of such a collective is so fascinating that the interface seems transparently beneficial, a labor-saving device without which important knowledge would smear into static. Sack's high-tech browser and Mark Lombardi's painstaking low-tech works on paper thus perform similar procedures on the information glut, but their interventions point to opposite feelings about that information. The group Lombardi examines is a suspect elite, and conversations are presumed to be exploitative and self-serving, ripe for the whistle blower. Newsgroup and chat-room speech, in contrast, is imagined as vox populi in action. The VLSC map does not expose a closed coterie; it expands an egalitarian fellowship.[18]

The specific conversation map Richard considers is the one that appears at the beginning of this paper. This image was produced by the Conversation Map system from an analysis of over 1,200 messages from the Usenet newsgroup soc.culture.albanian, a group devoted to discussion of Albanian culture in general, but at this period in time (16 April 1999 - 4 May 1999) especially the war in Kosovo. One can see from the social network that the discussion was rather cohesive and dominated by a few central voices. But, it is the automatically generated semantic network that illustrates the optimistic politics that motivates this project: the hope for a truly global conversation.[27]

The upper right-hand corner of the semantic network connects the terms "nation," "state," and "country." These are associations that one might find in a conventional thesaurus and simply show that the empirical procedure for automatically compiling a rough-draft thesaurus from a corpus of messages is working. A closer examination of the automatically compiled thesaurus reveals many of these conventional associations.

The lower left-hand corner of the semantic network contains a cluster of entities that all represent a category one might label as "political or military entity." These include the KLA, the US, Macedonia, Russia, and Croatia. Closely connected to these is an association that is at first surprising but, upon reflection, not so surprising: Clinton is connected to Milosevic. Why? Because, as described in the contents of the messages, both Clinton and Milosevic are acting as (and thus associated with the verbs and adjectives descriptive of) a president of a country.

But, it is neither the upper right-hand corner's reproduction of conventional associations nor the lower left-hand corner cluster of political actors that is of especial interest here. Rather it is the central portion of the semantic network, which connects "Albanians" to "Serbs" through "people," that instantiates what might be seen as an implicit hope or goal of the conversation: namely, to understand Albanians and Serbs as comparable and equal. One optimistic way of reading the semantic network computed by the Conversation Map system for the soc.culture.albanian group is this: "people" is a neutral term: Serbs, Albanians, refugees, countries, and governments are all "talked about" like people. This is, perhaps, a sort of thin humanism: "after all we are all people."

However, it must be kept in mind that no one in the newsgroup necessarily wrote "we're all people." In fact, the comparison is much more subtle. The neutral term is not necessarily "people" per se, but rather attributes (adjectives and verbs) that may be applicable to everyone (Serbs, Albanians, or people in general) on all sides of the argument. These overlaps, these neutral attributes, can be seen by examining the profiles for the terms in the semantic network. This is done using a part of the Conversation Map interface not discussed in this paper.

If we focus on only those verbs for which both "people" and "Serbs" appeared as a subject of the verb, then the resultant overlapping list looks like this: SERBS ARE PEOPLE (terms appear as subject for each of the verbs one or more times) allow, be, destroy, die, do, drive, exist, flee, get, give, have, keep, know, lay, leave, live, make, need, pay, remember, tell, think, turn.

In other words, by looking at the archive of messages one can find many places where, for instance, both "people" and "Serbs" appear as subjects of the same verb. From the intersected lists of verbs one can see that, in the archive of soc.culture.albanian messages, "Serbs" and "people" are discussed in similar terms because there exist one or more statements in the archive for both "Serbs" and "people" where they are described separately as agents that allow, destroy, die, do, drive, exist, etc.

The verb "to need" is one of these shared verbs found in the intersection of the "Serbs" and "people" profiles. Clicking on a verb in the intersected profiles (not shown here, but displayed by the Conversation Map interface when two terms in the semantic network are selected) reveals the following two example sentences that partially underpin the link between "Serbs" and "people" in the semantic network: "You have to realize that Greeks and Serbs need a just solution, and not just Serbia has a solution." "It is not enough to be alive, people need normal life."

Similar word association lists are computed on demand by the Conversation Map system for any other pair of terms in the semantic network and, if desired, example sentences of the terms in use can also be viewed.

ALBANIANS ARE PEOPLE (terms appear as subject for each of the verbs one or more times) cross, displace, do, flee, have, hate, hide, leave, lose, say, suffer, think, walk.

SERBS ARE ALBANIANS (terms appear as subject for each of the verbs one or more times) do, flee, found, have, insist, leave, shoot, think, want

These sorts of verbal overlaps designate possible common ground and thus potential insights into where and how to start a discussion that all sides of the argument might listen to or participate in. In other words, the associations shown in the semantic network do not document an accomplished humanism, but rather empirically point back into the discussion to show places in the conversation where one might return to build a common ground because Serbs and Albanians are all actants who flee, think, and want. Thus, we can see these associations as both an empirical fact documented in the archive of the conversation and, simultaneously, as a set of potential goals for future discussion.

Closer examination of this particular conversation reveals that the participants used a variety of languages (English, but also the languages of the region) and pursued the discussion in a highly combative, argumentative style. From a philosophical perspective, it is extremely hard to understand this exchange as a dialectic in which the many sides might eventually reach a compromise or synthesis (for example, the classical pro + con ==> compromise; or hypothesis + antithesis ==> synthesis).

This conversation illustrates a non-dialectical exchange in which, potentially, no common ground might ever be accomplished. In the words of the philosopher Jean-Francois Lyotard, this conversation may very well illustrate a differend, a difference so vast between participants that it can never be bridged.[15] But, the machinery of the Conversation Map (those functions that automatically compile a rough-draft thesaurus for a set of messages) works in a strictly mechanical manner that sums and then averages together the language of the group. The Conversation Map is doggedly dialectical.

Because of the way it is built, it cannot not find a common ground. Consequently, even for an argument so vicious or incoherent that a skilled, human negotiator might find no place to start building common ground, the Conversation Map will diagram (through its mechanical operations) a potential synthesis. In a recent interview, I explain how this role of the software (to articulate the synthesis and limits of common ground or common sense) is akin to the role played by performance artists and philosophers of a Socratic persuasion.[23] Also, in an entry written for the Oxford Encyclopedia of Aesthetics, I explain how this constitutes a new sort of artistic, software design aesthetic.[19]

The Conversation Map is unlike other electronic art and software design work that has been done to map out the written exchanges of email and online chat. Previous work in this area1,4 has tended to concentrate on how messages are threaded and/or how social networks of response patterns are constructed without building any sophisticated linguistic analysis into the software. Finding the limits and dialectical syntheses of contentious language from an email archive of an argument is thus difficult, if not impossible, using the work of these other artists and designers.

There is a sort of (perhaps ridiculous) optimism built into the machinery of the Conversation Map. The output of the Conversation Map is therefore not simply a description of the status quo. Rather, the output can be interpreted as a set of possible goals, a set of landmarks that can be used to navigate, to steer, the conversation forward into the future. This is quite unlike much recent artistic mapping work. For example, Laura Kurgan, in a piece for the show "World Views: Maps & Art,"[25] used the images from French SPOT satellites to map out the burning villages, the mass graves, and hidden refugees ("seen" in forests and hills with heat sensors) of the Drenica valley of Kosovo for approximately the same time as the Conversation Map image discussed above. Kurgan's images are invaluable as memorials to horrific events that must neither be forgotten nor trivialized. However, they lead us out of discussion, conversation, and dialectics and into an aporia: What can possibly follow these events? In contrast, the images of the Conversation Map are naive and ridiculous: they are invented, hopeful landmarks with which to navigate through the conversation. They play the role of the Socratic jester who voices the unthinkable: perhaps compromise and common ground is possible, perhaps healing can be accomplished after these unforgivable acts have taken place?

www.sims.berkeley.edu/~sack/SIGGRAPH01

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Erasing Boundaries: Intermedia Art in the Digital Age

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Panel Abstract

"Intermedia" is a term coined by the Fluxus artist and theorist Dick Higgins which refers to works of art that include structural elements not usually associated with the medium being performed. Although intermedia can be "multimedia" it certainly does not have to be. In this panel we would like to make the distinction between the two terms.

In intermedia, the compositional process works across the boundaries between media or even fuses media.Thus intermedia implies structures that are shared by or translated from one medium to another: in this respect it is a more specifically defined term than multimedia. While it is sometimes called "synesthetic art," intermedia does not seek to imitate the physiological phenomenon of synesthesia, but approaches it metaphorically. It extends the creation of form across sensory modalities without necessarily promoting a tight coupling of multisensory events. Synesthetic coupling is just one potential contrapuntal technique for intermedia, a kind of parallel movement. Other possibilities abound, and intermedia is just getting started as an artform.

With the advent of digital multimedia and real time interaction and performance with computers, intermedia can now achieve a precision and synchronicity of events that were not possible until the last two decades. Moreover, digital media enable compositional structures to operate at all levels of granularity and with a degree of abstraction that places all media on the same plane. One could argue that digital intermedia is the high-level process that corresponds to the low-level truism: all media is data, a single substance. Intermedia suggests that we explore that substance with all available senses.

This panel will examine the historical concept of intermedia, compositional methods and processes for creating intermedia, issues of sense perception and sensory coupling in the reception of intermedia, and the implications of digital multimedia, real time performance and interaction for the future development of intermedia. We also expect to open the discussion to the metaphoric and even magical qualities associated with synesthesia, and to the relation of multisensory stimuli to memory, but by grounding the panel in compositional practices and structures we hope to avoid some of the pitfalls of interpretation that the mystique of synesthesia often inspires.

While we cannot predict the trajectory of intermedia across the imaginary of the 21st century, it holds out the possibility of new forms and experiences. At a time when we have begun to suspect that formal invention had collapsed along with the historical avant-garde, this may even permit us a brief moment of euphoria. We would do well to remember how, at the beginning of the 20th century, the cult of synesthesia promised a mystical revelation that did not transpire. At the beginning of the 21st century, intermedia points to a perceptual revelation that may well transpire. The instruments are in our hands and it seems we have only to learn to play them. To what end and for whom? As much as with the formal and technical issues of digital intermedia, we must also grapple with this question.

Opening Statement

Brief thematic presentation by co-chairs (five minutes): Intermedia and structure; synesthesia as method and metaphor; cross-modal structure, interactivity, and immersion as forms of revelation.

Yvonne Spielmann

Forms and Structures of Intermedia

Abstract

Starting from the phenomena of convergence in recent media development, the paper opens the question how we may consider the interrelationship between different media in the digital age. Conceptually, the term intermedia implies an interrelationship between different media that merge with each other where the couplings of different media elements result in a third, a new form of media. This can be characterized as the transformative quality of intermedia. The forms and the structures effected through an intermedial relation and transformation may shift, nevertheless intermedia structurally differs from related concepts such as multimedia and mixed media. The paper discusses the history and theory of the concept of intermedia in relation to other forms of interrelationship and in comparison to intertextuality and the notion of dialog. The aim is to point out similarities and differences in the history of synaesthesia that shape the understanding of the specific concept of intermedia and also help to define the limits of intermedia when confronted with hypermedia and hybridization. Furthermore, the convergence of media in intermedia that is based on the transformation is different from hypermedia where the issue is no longer transformation but access and multidimensional connectivity. I will argue that intermedia is conceptual term and encompasses: a model of transformation; a structural shift in the organization and positioning of media elements to build a form; and finally, an aesthetic strategy differently performed in analog and in digital images. In particular with regard to the interrelation of aesthetic features referring to image, text, and music, I will show that intermedia practices in the arts cause the revelation of the medium through the representation of the difference between form and medium. As the history of the concept shows, the emergence of intermedia is based on the difference between media and it reveals media specific elements, because intermedia is a self-reflexive and transformative device. As theories point out, the concept implies a dialectical relationship between "old" and "new," "analog" and "digital" media, and the relationship between (historically) separate media is dynamic. In short; I will consider intermedia as a conceptual term and a category of transformation in media arts. As such, intermedia preshapes and prefigures issues in digital imaging and virtual reality.

Key Words

Intermedia, multimedia, hybridization, intertextuality, transformation, digital images.

Yvonne Spielmann
Yvonne Spielmann teaches Media Studies at the University of Siegen, Department of Art. She received her PhD in 1989, and the postdoctoral degree (habilitation) in 1997. She was awarded a post-doctoral fellowship at the Getty Center in 1989/90 and a fellowship at the Society for the Humanities at Cornell University for the year 2000/2001. Her published essays include those in German and English on experiment and avant-garde; history and theory of visual media; aesthetic theory in 20th-century media theories, intermediality and visual culture. Books in German include: *Art and Politics of the Avant-Garde* (editor), Frankfurt/Main 1989; *The Concept of Avant-Garde,* Frankfurt/Main 1991; *Intermediality: The Systems of Peter Greenaway*, Munich 1998; *Image - Media - Art* (editor together with Gundolf Winter), German/English, Munich 1999. She is currently writing a book on video arts.

Ina Blom
The Touch Through Time - Raoul Hausmann, Nam June Paik and the Optophon

Abstract
The paper discusses the interchange between technology and historiography in Berlin Dadaist Raoul Hausmann's Optophon (1920) — a synaesthetic instrument designed to transform sound signals into light signals and vice versa. Hausmann's invention was part of his attempt to formulate a new mode of perceptual presence, which involved both a particular notion of tele-visuality and a new "interruptive" form of tactility which could perhaps be described as the construction of a transactional synthesis beyond the realm of the corporeal. Hausmann's renewed focus on electronics in the 1960s highlights the historiographic implications of this construction. The Optophon could on the one hand be seen as a rudimentary piece of groundwork that supported the technological consciousness from which new electronic-related art, such as Nam June Paik's new television art, was emerging. This was, notably, and art predicated in the telematic and the immersive. On the other hand, Hausmann's 1960s elaboration on the theme made it increasingly clear that his investment in the telematic was destined to produce an interruption at the site where such art-historical legacies were constituted.

Ina Blom
Ina Blom is a writer, art critic and art historian based in Oslo, Norway. After a short period as a senior curator at the Museum of Contemporary Art, in Oslo, she is now an associate professor at the Institute of Art History, University of Oslo, where she submitted her doctoral dissertation "The Cut Through Time, A Version of The Dada/Neo-Dada Repetition" (1999). A former radio DJ and music critic, she is an editor of the art journal NU and the cultural journal Samtiden, and a regular contributor to Frieze and Flash Art. Her writing has appeared in numerous other books and publications. Her most recent publication is a book-length essay on the ambivalence of Joseph Beuys.

Jack Ox
A Complex System for the Visualization of Music, including the journey from 2D to Virtual Reality

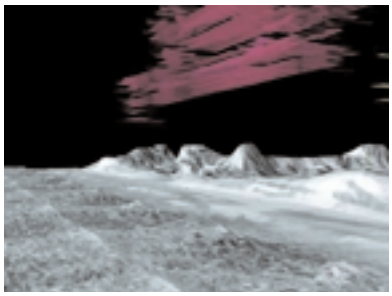
Abstract
Jack Ox will give a description of the algorithmic, music visualization system she developed over a period of twenty years outside of cyberspace. She will then describe the transformation of this system into a virtual reality 3D immersive world utilizing supercomputing technology.

Ox makes detailed analyses of musical data from either the written score and/or an electronic score known as MIDI. This information might include any or all of the following: pitch, harmonics, phonemes and/or formants, time, timbre, and dynamics. Each of these is translated into a visual data system created by the artist. The environment through which the data is experienced or seen has always been landscape and/or architectural images that are connected to the visualized music in metaphorical and structural ways.

She has also developed several complex color systems for the carrying of information including harmonic movement and quality, vowels, timbre, and dynamics. These color systems occupy an important place in the complex of systems needed to translate music into visual images with a satisfactory level of detail.

The latest version of this group of systems has become an actual visualization instrument, the 21st-century Virtual Color Organ because it is the most recent incarnation of an ongoing number of interesting precedents like the 1730 Ocular Harpsichord by Louis B. The Virtual Color Organ is an interactive virtual reality instrument – a stereoscopic, immersive sound and visual environment.

Ox will describe the project currently being realized in the Organ, "Im Januar am Nil," by the internationally known computer composer, Clarence Barlow. The melodic structure of this piece takes its mathematical components from a spiral, while the harmonic structure comes from the formants of vowel sounds.



Jack Ox, Still Frame from 21st Century Color Organ

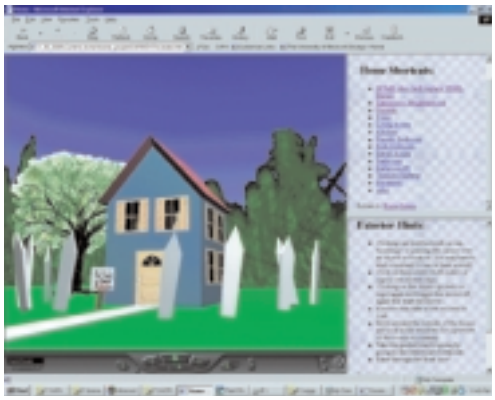
The Virtual Color Organ is supported by the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign, with additional support from Silicon and EAI. Ars Electronica provided the initial research and development money; Robert Putnam from the Scientific Computing and Visualization Group at Boston University is doing the interactive, kinetic sound placement and 3D localization. David Britton is the programming architect, and Art and Science Collaboration, Inc. is supporting the project as the umbrella organization to receive non-profit funds.

Jack Ox (co-chair)
Jack Ox has been working on the visualization of music for over 20 years, including studies and research in musicology and phonetics. While working on her 800 square foot visualization of Kurt Schwitters' "Ursonate," the 41-minute long sound poem in a four movement sonata form, she came upon and caused to be published on WERGO (Mainz, Germany) an original, unknown performance by Kurt Schwitters himself. The complete "Ursonate" will be shown in the Contemporary Museum of Lodz, Poland in 2002. Ox was included in "Vom Klang der Bilder" at the Staatsgalerie Stuttgart in 1985, made an "Ursonate" presentation at the Centre Georges Pompidou during the Kurt Schwitters retrospective in Paris in 1994, and exhibited the complete cycle of 12 paintings based on Anton Bruckner's "Eighth Symphony" in 1996 at the Neue Galerie der Stadt Linz, Austria. She has shown parts of her "Ursonate" installation at SoundCulture'96 in San Francisco and at the Podewil, Berlin in 1998. The electronic version of the "Ursonate," created by the graphics department is the current exhibition online at the University of Illinois, Urban-Champaign's curated site "@art" (www.art.uiuc.edu/@art/main.html). Ox has been on the editorial board of Leonardo for over 10 years and is presently guest editor, along with Jacques Mandelbroijt, of a special section called "Synesthesia and Intersense." She is also on the Board of Directors of ASCI. Her collaborative project, the 21st century Virtual Reality Color Organ, has received support from NCSA, BU, SGI, EAI. Ox was a visiting fellow in the department of Computer Science, Lutchi Research Centre, Loughborough University, UK, in 2000.
www.bway.net/~jackox/

Paul Hertz
Form, Substance, Correspondance

Abstract
Cross-modal form is an attempt to "make sense" of the world. There are two primary approaches to intersensory composition: a poetics that operates on symbols through language and a constructivist methodology that formalizes media. Computational technology enables new forms and disciplines for the formal approach, while the poetics of intermedia provide the setting for these formal experiments – a way to construct their meaning and cosmological viewpoint. Intermedia structures within interactive environments can have both cognitive and emotional aspects; they expand the field of information and intensify the experience of immersion. We will view some examples of artists working with multi-modal visualization and emergent behavior of complex systems, within the scientific and the artistic domains. These include the author's own generative/a-life system, the "ignoverse," an interactive environment for cross-modal composition.

Paul Hertz (co-chair)
Paul Hertz teaches and develops interactive multimedia projects at Northwestern University in Evanston, Illinois, USA. From 1971 to 1983 he lived in Spain, where he exhibited his drawings, paintings, and musical and theatrical compositions, notably in the XVIII International Theater Festival of Sitges, the Universitat Nova in Barcelona, and in various editions of the Joan Miro International Drawing Competition. He also worked as a jazz musician in local nightclubs. In 1985 he was awarded a research grant from the Mellon Foundation as a Fellow of the Center for Advanced Studies in Art and Technology at the School of the Art Institute of Chicago, where he was working towards his MFA degree. In 1994, with a host of other artists and engineers, he collaborated with Muntadas in creating the "Fileroom," one of the first on-line artworks. As a visiting artist at the Polytechnic University of Valencia, Spain, in 1996, he exhibited his suite of digital images "Deadpan, or the Holy Toast" and chaired a panel on "The Colonization of Cyberspace," a topic explored by seven artists in "The Homestead/La Finca," a WWW installation he designed and curated. He has exhibited his work in Artemisia Gallery, Chicago, the Chicago Cultural Center, ISEA95, ISEA97, and SIGGRAPH99, where he was also a panelist for "Algorithmics and Patterns from Life." For Chicago's Project Millennium he curated a show of new media art, "Second Nature," at the Ukrainian Museum of Modern Art. Hertz is a reviewer for Leonardo Electronic Almanac. His essay on the poetics of intermedia, "Synesthetic Art, an Imaginary Number?" was published in the "Synesthesia and Intersense" section of Leonardo, v32-5, 1999. Currently he is working on a CAVE-based virtual reality project, "Fool's Paradise," a collaborative effort funded by a grant from the Center for Interdisciplinary Research in the Arts at Northwestern University.
www.nwu.edu/people/paul-hertz



Annette Barbier, Screen Shot from HOME
www.unreal-estates.com

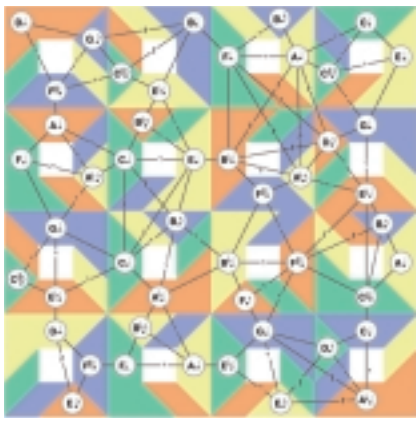
Andrea Polli
Rapid Fire: Performative Experiences in Scanning the Visual and Auditory Scene

Abstract
The author discusses her work in building and performing with eye tracking musical instruments and other inter-sensory instruments. Issues involved in the translation of different modalities, or "digital synesthesia" are central to the instrument design, informed by processes used in musical improvisation. Improvisational systems in these cases serve as a temporal document of the decision making process, infusing computer-based interactivity with the potential for deep structural interaction between the different sensory modes of human perception.

Andrea Polli
Andrea Polli is a digital media installation and performance artist living in Chicago, Illinois. She is currently an Assistant Professor of Digital Media at Columbia College Chicago and an adjunct faculty member of Art and Technology at the School of the Art Institute of Chicago. Polli has presented her performance work with eye and motion tracking devices throughout Europe, in Brazil, and across the United States. Her recent Audio CD, "Active Vision," was produced at the iEAR Institute at Rensellaer Polytechnic and at Harvestworks in New York City. Her recent performance work is documented in the article "Active Vision" in the October 1999 issue of the journall Leonardo; and a retrospective article about her work from 1991-1998, "Virtual Space and the Construction of Memory," is published in the Spring 1998 issue of Leonardo.
homepage.interaccess.com/~apolli

Annette Barbier
Annette Barbier is a media artist whose roots are in sculpture and video and who is currently exploring the expressive possibilities of new media. An attempt to integrate life and art leads her to make commentaries on the domestic environment. A recent work, "Home Invasion," concentrates on dealing with pesky telemarketers. Other ongoing projects involve an exploration of American expatriates and why they left home, as well as ongoing revisions to "Home," an interactive VRML environment which includes the work of several other artists. This can be found at: www.unrealestates.com. Barbier is Director of the Center for Art and Technology and an Associate Professor at Northwestern University, where she teaches computer animation, video installation, and experimental video. Selected video work is distributed by the Video Data Bank.
www.rtvf.nwu.edu/people/barbier/

Andrea Polli, Eye-tracking Performance Interface



Paul Hertz, Parametric Space for "Pond"
(digital intermedia installation, 1997-2001)

The Pixel/The Line: Approaches to Interactive Text

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Camille Utterback
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The Web is a major topic at SIGGRAPH 2001, as it has been for several years. But there has not yet been a substantial discussion at a SIGGRAPH conference of the Web's primary and foundational media: text. This panel brings together five experts who span a range of approaches to responsive text through computer graphics and interactive techniques. The presentations are both theoretical and applied, demonstrating techniques ranging from direct manipulation through artificial intelligence, and drawing on the insights of various fields, from visual art through literature.

Camille Utterback
In three recent installations by Camille Utterback ("Text Rain," "Composition," and "Written Forms"), participants are given an opportunity to literally "play with words." In "Text Rain," (created with Romy Achituv and displayed at SIGGRAPH 2000), participants use their video images to catch and play with virtual letters, sometimes collecting enough letters to read lines of a poem. In "Composition" and "Written Forms," a live video image of the participants is composed entirely of characters or texts. In order to read the texts in "Composition" or "Written Forms," participants must maneuver their bodies to different areas of the screen. Utterback is not alone in her exploration of the visceral possibilities for interacting with language. In "Legible City" by Jeffrey Shaw, a participant rides a real bicycle to control a virtual journey through city streets made from giant letters. Each letter forms part of a famous text written or spoken in that city. In David Small and Tom White's "Interactive Poetic Garden," people push their hands on a squishy liquid pad to alter the course and content of projected words swirling down a waterfall. By creating a physical interface to text, each of these installations raises questions about our relationship to language. What does it mean to "read" a text by catching it, bicycling through it, or pushing it around in a waterfall? Like a calligraphic scroll, a concrete poem, or a written "play on words," each of these installations resonates and intrigues by allowing participants to engage with a series of words on multiple levels.

Camille Utterback is an artist working at the intersection of computation and representation. She holds a BA in art from Williams College and a masters degree from The Interactive Telecommunications Program at New York University's Tisch School of the Arts. She is currently an adjunct professor at the Interactive Telecommunications Program and recently finished a two-year Interval Research Fellowship in the department. The conceptual aspects of her interactive installations have earned her a 1999 Silver NewMedia Invision Award, and she has been selected by *Res Magazine* as artist pick of the year for their Annual Res 10 - "Ten people who are making a difference in their field." On the technical side, NYU has filed for a patent on an interactive system that she developed. She has developed installations for Herman Miller and Shiseido, and her "Text Rain" installation, developed with Romy Achituv, has been purchased by two collectors. Before her digital work, she created art in a variety of traditional media and exhibited widely in the Boston area. Her work has been featured in the *Boston Globe*, the *San Francisco Chronicle, USA Today, Vogue Nippon, V-Magazine,* and *ArtByte*. She has received a scholarship from the New York Type Directors Club (1997) and grants from the Mellon Foundation (1991) and the Massachusetts Cultural Council (1992). She was one of six artists representing New York in the New York, New Faces, New Media exhibit at the NTT InterCommunication Center in Tokyo in the spring of 2000. Recent exhibits of Utterback's work include Game_Over at the Netherlands Institute for Media Art in Amsterdam (2001), and Print on Screen at the Ars Electronica Center in Linz, Austria (2000 - 2001)

Stephanie Strickland
Vannevar Bush wanted his Memex to intercept and capture the neural circuits of the stenographer, who could reduce his words to a phonetic code on the fly, whose encoding practice was encompassed by her body. As an electronic poet, Strickland wants to do the same thing, not from the position of Bush, outside the device, but from the position of the stenographer, inside the new electronic device. In her body, words moved through her as she moved, a fluent circuit of meaning that she hosted, instigated, permitted, understood, explored, and enjoyed; hers is a somatic practice that deflects not only the threat of analytic dispersal, into "simplified language…nascent form…intelligible only to the initiated," as Bush characterizes her code, but also the threat of obsessive recombination and confusion, the multiple overlapping streams of speech she is asked to transcribe. Resituating this fluent knowledge into digital electronic or Web-specific work is an active area of inquiry. Jim Rosenberg and MEZ (Mary-Anne Breeze) are poets who approach this task by working at a granular level of language, each constantly testing for the fertile and provocative even as they host and instigate prolific recombination. Strickland's work and work she has done in collaboration with M.D. Coverley explore several approaches that specifically incorporate the visual. In "True North," a long poem in Storyspace concerned with navigation and various representations of embeddedness, including pregnancy, the most important orienting elements are six emblematic maps and the use of colored words, not to signify computational links (these are signaled by outline boxes in Storyspace) but rather links that can only be traced by human memory. In the Web-specific poem "To Be Here as Stone Is," Coverley and Strickland attempted to inflect the usual Web scan by incorporating pages of minimal text paired with moving images (Java applets) as well as pages where longer segments of text are overlaid on densely suggestive but non-illustrative visual backgrounds. In the Flash poem "Errand Upon Which We Came," Coverley and Strickland choreographed movement for the text itself as well as for accompanying images. Readers of this text can attempt to read it on the fly or press the silver butterfly to the screen if they wish to stop motion, which they must do to "read" rather than "view" it.

Various categories for combining word and image have been proposed by Scott McCloud, with regard to the medium of comics, and many of these apply to online media as well. By his schema, Rosenberg uses "interdependent" combinations, "True North" uses an "additive" combination; MEZ's work "To Be Here as Stone Is," "montage" and "interdependent" combinations; "Errand Upon Which We Came," "additive," "montage," and "interdependent" combinations. In the case of the "Ballad of Sand and Harry Soot," Strickland relies on what he calls a "parallel" combination, where words and pictures seem to follow very different courses. Images from Jean-Pierre Hébert's *Sisyphus* (shown at SIGGRAPH 99), a device that inscribes algorithmic patterns in actual sand, as well as other images suggestive of digital or mathematical culture accompany the text of a love poem, a ballad of love gone wrong or at least not entirely right, between two characters called Sand and Soot. The seeming disjunction of image and text, however, will be bridged by any reader who can read an avatar of biochemical man in Harry Soot and one of silicon liveliness in Sand.

Stephanie Strickland is distinguished visiting writer in the MFA Program at Boise State University, where she teaches Form and Theory: Reading and Writing New Media Literature. Her book, *V*, forthcoming from Penguin, won the 2000 Alice Fay Di Castagnola Award from the Poetry Society of America. Her "Ballad of Sand and Harry Soot" won the 1999 Boston Review prize, and its Web version (www.wordcircuits.com/gallery/sandsoot/) was chosen for an About.com Best of the Net award. "True North," her full-length hypertext poem from Eastgate Systems, won a *Salt Hill* Hypertext Prize. Her other hypertext poems on the Web include collaborations with M.D. Coverley, "To Be Here as Stone Is," published in Riding the Meridian, and "Errand Upon Which We Came," in Cauldron & Net. She has published several essays on electro-poetics, including "Dalí Clocks: Time Dimensions of Hypermedia," *ebr*11, Winter 00/01 (presented at DAC 2000), and the hypertext essay "Seven League Boots: Poetry, Science, and Hypertext." She is the author of the print poetry volumes *True North, The Red Virgin: A Poem of Simone Weil,* and *Give the Body Back*.

Bill Seaman

Seaman's research examines a specific transdisciplinary realm of Recombinant Poetics (coined by him in 1995) as brought about through advanced, generative, interactive art works. Recombinant Poetic works enable a vuser (viewer/user, pronounced viewser) to act upon and explore varying juxtapositions of computer-based media-elements, behaviors, and processes, to examine in an experiential manner computer-mediated environmental meaning production. The generative component is essential to Recombinant Poetics and differentiates it from other fixed virtual environments. A set of poetic potentials is made operative within these generative Recombinant Poetic spaces. A number of foci inform authorship and inter-authorship within such environments: inclusion of particular media elements and processes, the manipulation of media-elements as vehicles of communication and/or poetic exploration the ability to network the environments and to work and explore in a distributed manner, the conceptual position of considering the space as a continuum between physical and virtual environment, the potential for developing new forms of interfaces (layering and parsing different physical and "sensing" mechanisms), the potential to use Recombinant Poetic systems as generic tools for non-art purposes – all will be discussed. In particular, new approaches to meaning production in computer-based space is empowered, where each media element can be seen as a field of meaning having a particular meaning force. Participants bring their mind sets (or historical embodied field of past meaning relation) and participate in an ongoing summing of the meaning fields. Alternate configurations of media elements and processes can be observed, using the generative environment as a discourse mechanism to explore how meaning arises in such a space. This approach to meaning conflates the logocentric with the non-logocentric, and places text in dynamic relation to image and sound (all functioning as language vehicles) in a non-hierarchical environmental approach to computer-mediated meaning production.

Seaman discusses examples from his work, including collaboration with the Dutch programmer Gideon May, entitled "The World Generator/The Engine of Desire" (an interactive system that enables "vusers" to generate poetic worlds in real time in virtual space, based on a rotating template of potential choices). The piece presents a construction and navigation environment displayed through a series of pre-generated 3D computer graphic models, real-time behaviors related to chosen objects, a set of video loops projected onto selected objects (to function as texture maps), still-image texture maps, a selection of text modules, a set of location-sensitive audio/musical objects, and specific graphic variables. Errki Huhtamo has coined the term "world processing" to describe engagement with this environment. The system is facilitated through a new interface metaphor. A series of connected wheels is presented at the bottom of the screen. Each wheel presents a rotating set of potential choices. From the front, the viewer sees a set of curved shelving wheels of variables that can easily be explored. Each wheel is actually a rotating belt so that, potentially, huge amounts of information can be contained and accessed. Seaman also discusses his new work funded by Intel entitled "The Hybrid Invention Generator." This work explores an operative, Recombinant Poetic machinic genetics.

Bill Seaman received a master of science in visual studies from the Massachusetts Institute of Technology in 1985. He has a PhD from the Centre for Advanced Inquiry In The Interactive Arts, University of Wales, Newport. His work explores text, image, and sound relationships through virtual reality, video, compute-controlled videodisc, CD-ROM, photography, and studio-based audio compositions. He is self-taught as a composer and musician. His works have been in numerous international festivals where he has been awarded prizes such as the Prix Ars Electronica in Interactive Art (1992 and 1995); International Video Art Prize, ZKM; Bonn Videonale prize; First Prize, Berlin Film/Video Festival, for Multimedia in 1995; and the Awards in the Visual Arts Prize. Selected exhibitions include 1996, MEDIASCAPE GUGGENHEIM, New York; the premiere exhibition in 1997 of the ZKM; 1997, Barbican Centre (London); 1997, C3 (Center for Culture & Communication),

Budapest; in 1998, Portable Sacred Grounds, NTT-ICC Tokyo; Body Mechanique, The Wexner Center, 1999. He is currently professor in the Department of Design Media Arts, UCL.

Nick Montfort
The form known as "interactive fiction" (typified by the text adventure) uses natural-language input to direct interaction in a narrative world, which is also rendered in text. After a period of commercial success lasting through the late 1980s, the form has been preserved and advanced by hobbyists. Free and open development systems exist and are being improved, and interesting literary experiments have been among the hundreds of free works recently released. The interactive fiction form has been ignored or slighted by academics, however, since it is usually associated with commercial home-computer software, non-literary puzzles and logic games, and genre writing. The techniques and technologies of interactive fiction can provide insight into using language meaningfully as input and output in all sorts of creatively driven systems. A look at some recent interactive fiction reveals how the interactor's text is woven into large-scale works of
literary art.

Nick Montfort has earned masters degrees from Boston University's creative writing program and from the Massachusetts Institute of Technology Media Lab, and undergraduate degrees in liberal arts and computer science from the University of Texas-Austin. He wrote and programmed "Winchester's Nightmare," the first interactive fiction work to come with its own computer in a "hardback" edition, winner of the 2000 Best Puzzles XYZZY Award, and "Ad Verbum," the first-place pick of interactive fiction authors in the 2000 IF Competition. He also created, with William Gillespie and Dylan Meissner, the hoax and Web novel "The Ed Report" (honorable mention, 2000 trAce/Att-X New Media Writing Competition). He is co-editor, with Noah Wardrip-Fruin, of *The New Media Reader*, coming in 2001 from MIT Press. In 2002, *Twisty Little Passages*, his critical survey of interactive fiction, will be published by MIT Press.

John Cayley
The "andor" of Pixel/Line, an implicit contrast/linkage, immediately suggests critical issues for the theory and practice of so-called interactive text. Pixel is unambiguously associated with digital graphics. However (necessarily, on screen), pixels are used to build up the graphic images of letters. The "atoms" of one system of digital transcription (graphics) build the atoms of another (writing), although, perhaps, without any great significance or effect accruing from this process of programmatological generation. Do constraints, which are imposed on the manipulation of pixels in order to produce the drawings of letters, tell us anything about those letters or the words they, in turn, compose? Contrast/link the circumstances pertaining to the Line. Lines may also be graphic elements, yet here, I assume, we prefer the reading of "line" as "line of text" as an accepted, scriptable unit of writing. A line is composed of letters, which are the "atoms" of textual materiality.

Letters build words and then lines in a manner that allows far greater significance and affect to emerge from the process of programmatological generation. And yet, paradoxically, the programmatolgical and, specifically, algorithmic manipulation of pixels – to generate or modulate images "per se" (including the images of letters) – is undertaken with a far better grasp of the potential meaning of such manipulation (for example, we all know what to think about algorithmic "blurring" as applied to an image, including the image of a word). With text, there is as yet no accepted repertoire of algorithmic manipulations from, for example, letter to line. An important task for writing in programmable media is to address these difficulties and disjunctures. Interaction with text must be founded on its specific materiality, on "literal" art.

John Cayley is a London-based poet, translator, sinologist, and publisher born in Ottawa. He is the founding editor of Wellsweep, a small press that has specialized in literary translation from Chinese, and he is inernationally known for his writing in networked and programmable media (www.shadoof.net/in). His last book of poems, adaptations and translations is *Ink Bamboo* (London: Agenda & Belew, 1997). He has lectured on the writing programme at the University of California, San Diego, where he was also a research associate of the Center for Research in Computing and the Arts. He is now an honorary research associate in the Department of English, Royal Holloway College, University of London, and an honorary fellow of Dartington College of Arts, in close association with their degree-level course on Performance Writing.

Noah Wardrip-Fruin
Noah Wardrip-Fruin is a writer, text artist, and research scientist at the New York University Media Research Lab. He is currently the Art and Performance Chair for DAC 2001, an organizer of the art program for SIGGRAPH 2001, and editor of The New Media Reader (forthcoming from MIT Press) with Nick Montfort and Michael Crumpton. His current fiction projects include a collaboration with a.c. chapman, Brion Moss, and Duane Whitehurst on The Impermanence Agent, a storytelling Web agent that customizes its story of impermanence for each user. This project was featured at SIGGRAPH 2000 and will appear this year in The Iowa Review Web, at a show curated by Harvestworks at The New Museum of Contemporary Art, and at the Brave New Word event at the Guggenheim Museum, New York. At SIGGRAPH 2000, he moderated two special sessions, a panel, and the gallery talks. He has also spoken at SIGGRAPH 99, SIGGRAPH 97, and SIGGRAPH 96.

Boite Noire

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This is a clip about a crash test dummy who works in a copy center and is subject to ubiquity. He photocopies documents and repeats gestures rhythmically, surrounded by clones that do the same as he does. Then he has a fantasy about total reproduction.

Boite Noire is about the mechanisms of life and their micro variations (daily repetitions of gestures, rhythmic beats of a body driven by a large number of internal and external stimuli, the pleasure of repetition in musical trances) both corporal and sexual, up to and including the principle of life itself with the reproduction of DNA sequences to generate a clone that beats to the rhythm. In this project, digital technology allows the artist to model his own reality so that it might become real in the eyes of others.

After years as a professional cinematographer and a masters in multimedia at CNBDI, Eric Augier finished his education at l'Ecole Nationale Supérieure des Arts Décoratifs by specializing in digital effects technology. He has worked on a game called "La Planete des Singes" for Fox Interactive. More recently, he has worked on the special effects for a video clip called The Sound of Music for Bertrand Burgala on the Tricastel label. He has also made a video for l'Institut Francais de la Mode and was responsible for the special effects for the "Ca Cartoon" TV show. An image manipulator and short feature director, he is currently working on a hybrid clip on the theme of misadaptation.

City Block

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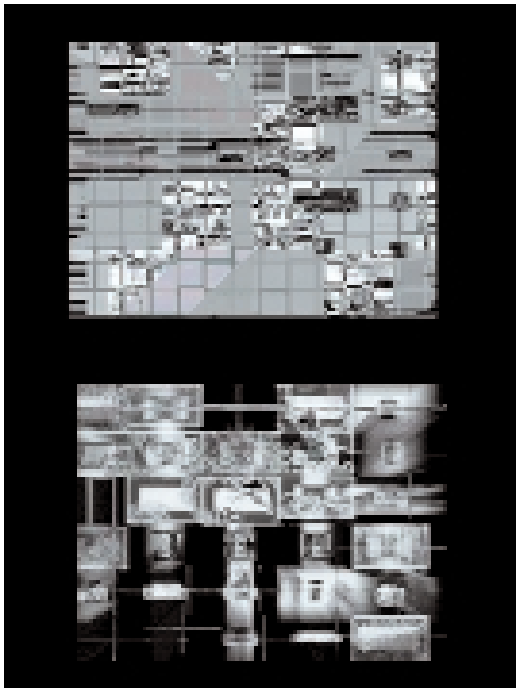
"City Block," an experimental animation, emulates the bustling, crowded, busy, chaotic feeling of a city. Timing and rhythm of the city comes together in moments of synchronicity like the choreography of chaos.



Disconnected

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In this image, the character is heading toward the mirror to find his alter ego inside. An image of Russian sculpture in the background enchances the environmental atmosphere and emphasizes what kind of society he lives in.

Early Light

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Producer and Director
John S. Banks

Original Soundtrack
Fritz Heede

"Early Light" is part two of a three part series dealing with times of day and the seasons. The idea is to create a living manuscript of the impressions and memories of different seasons and how they unfold. Set in the morning hours, the work progresses from the end of winter through spring. The work is inspired by experiences of landscape as sensed internally and spiritually. These are interpretations of nature as emerging from consciousness and shifting in character. The source scenes are constructed from multiple photographs and video footage. The stills are animated through mattes of generated light, wind, and noise.

Explosion

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"Explosion" is a funny little bit of my imagination. It took birth on a morning when I decided that utopia ends and freaks explode...or was it the lousy breakfast that inspired me? My idea led me into a small exploration of video, and later, processed video. What more can I say? After all, a video is worth a thousand words.

Futurity

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An experimental work depicting a dark, surreal vision of a child's world. A set of wooden sliding doors is the portal of an aged and decaying facade. Beyond these doors the viewer is allowed a voyeuristic glimpse of the interior space of a traumatic experience.

This work incorporates live action film footage with computer graphics and stop motion animation. The visual interface of sliding doors was modeled and rendered using Maya software. The live action, stop motion, and still imagery were digitally altered and composited using both Softimage DS and Adobe After Effects.

Hungboga

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1. Binary

Binary is a principle of separation by two and this separation already carries process of unification. Each binary opposition penetrated into the other side through membrane between them and transformed into their opponent. Becoming through interpenetration....Here & There, You & Me, East & West, Good & Bad, Reality & Virtuality, and Performer & Audience.

2. Interpenetration

I recognize numerous "interactive sounds" in Korean traditional performances: "Eolssigu!", "Ulssu!", "Eoi", "Jouta"... we call it "Chuimsae", which reflects Korean life philosophy from ancient times. These words do not have clear meanings, but instead, act in the confirming of existence: You & Me. It blows energy into the performer and simultaneously, substantiates the performer, like our act witnessed in front of mirror. We confirm our existence from our opposition.

I feel some transcendence of language and social boundary in "Chuimsae". It is not "yes" or "no". It is instinctive reflection towards the other self, arising from our sub-consciousness. It shows our desire for interaction. Interaction is a unique pathway to become one thing through our binary opposition. Paradoxically, binary systems exist to erase themselves, with tremendous potentiality for transformation and metamorphosis, rather than immovable separation.

In English, I also observe similar kinds of interactive sounds such as "U-hm!" In fact, these sounds exist in every language in different forms. I call them "Chuimsae", quoting from Korean traditional terminology. However, people are hardly aware of "Chuimsae" in their usage, since it is so natural, like the air surrounding them.

3. Hybrid

I have recounted to many Americans the traditional Korean story, "Hungboga." I tell them this story while carrying a Korean traditional fan. As they listen, they interact with me, using lots of "Chuimsae." When the story is complete, I ask my interviewers to re-tell it back to me by memory. My audience becomes the performer, using a Korean traditional fan. My audience and I exchange roles and the story is moved, changed, evolved and distorted. Therefore, it is kept alive.

This work is about the whole process of interpretation and hybridization, between every binary pair: Here & There, You & Me, East & West, Good & Bad, and Performer & Audience. This process blurs the distinction line between these dichotomies and allows them to become one element with its own potential energy of movements. Shamanic relationships are created between the audience and the animation on the screen, through continuous interaction by "Chuimsae."

Hardware: Compaq workstation SP 750, Del precision 420, Macintosh G3

Software: Maya 3.0 unlimited, Adobe Premiere, Adobe Photoshop, Protools

Images and sounds produced by Semi Ryu, 16 March, 2001

ICKY FLIX: The Residents

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Artists/Musicians
The Residents

Producers
Starr Sutherland/Cryptic Corporation

Interface Design
Jim Ludkte

Surround Producer
Ron MacLeod

"For the past 30 years, the Residents have always been among the first to take advantage of new technologies – reel-to-reel video in the early '70s, MIDI in the '80s, CD-ROM in the '90s, with a half-dozen others in between. And in many of these experiments, the Residents have used the advent of these new technologies as an opportunity to reinvent themselves – and rarely so clearly than in the case of their new DVD, 'ICKY FLIX.'" - *NY PRESS*

The idea for "ICKY FLIX" began as a simple "best of" compilation and evolved into that and 35 minutes of new visuals by six new artists, plus 100 minutes of newly recorded Residents' music mixed in 5.1 Surround Sound – all neatly packaged in a complex, animated interface. The work ranges from the early '70s to 2000 – a history of the changes in computer graphics and video technology.

With unblinking enthusiasm, The Residents are delighted that DVD technology makes it possible to deliver high-quality visuals and audio on a standardized, interactive platform.

Additional collaborative artists were David Blum, Bill Domomkos, Doug Carney/H-Gun, and Rand Wetherwax. The DVD was authored at bitsweet/Video Arts in San Francisco. The DVD authoring team: David O. Weissman, Simon Pargeter, Michael Endlich, Bob Johns, Jesse Spencer, Don Stone, and Richard Winter. Additional Digital Mastering was done at Superior Street Post in Chicago.

Indefinable Moods

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The direct physical expression of drawing and painting is still the most pure form for conveying the subconscious or dream world. I started to animate my images because I wanted to affect the senses of the viewer more strongly with the combination of image, movement, and sound.

In this work, I am exploring symbols and landscapes in nature and linking these to the psychological hopes, fears, and desires that exist in every culture. My approach to 3D work is greatly influenced by Renaissance and French Romantic painting. Artists of these periods created magnificent oil paintings that alluded to the 3D world through light, perspective, the study of the physical world of nature, and a desire for movement (animation).

Working with 3D software has allowed me to collapse, reconstruct, and journey through a landscape of symbolic narrative. This is similar to painting, where symbolic narrative is not represented in a linear cause and effect mode. The images are seen, passed by, and arrived at. It is the thought process that creates a static work, yet it incorporates the additional sense of sound with image movement and metamorphosis.

The advent of digital technology has generated the "Renaissance" of animation internationally, and the information technology age greatly parallels what happened during the earlier Renaissance: the sense of discovery and perception of our world via new exciting media and science.

Indefinable Moods was created using 2D oil-painted sequences mapped onto multiple planes and 3D forms. These were then further animated using Alias|Wavefront Maya. Additional software included Adobe Photoshop, Composer, and Chalice. Computer hardware was donated by Intel. Facilities and software generously provided by the Division of Animation & Digital Arts, School of Cinema-Television, University of Southern California. Musical sound FX composed and performed by Chris D. Halliwell. Soundtrack edited and mixed by Counterpoint Sound Sydney. Production Supervisor at USC: Mar Elepano.

Produced in association with the Australian Film Commission.

Oceanbells: Multiple 2D ocean planes animated amongst 3D forms within an oil-painted environment cube.

Field: 3D hand sculpted and animated in Maya. Landscape combines 2D painted images with 3D Maya paint effects.

INFECTION

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Adrift in the modern world, the new millenial citizen is held captive by technology whose slightest whim can fell empires (or inspire fits). Set upon by the digital hegemony, s/he finds the bit-wise facility of Turing's and Babbage's enfant terrible far too persuasive. This short piece arose out of an exercise to create a non-traditional countdown for a video reel. The actual countdown takes place sonically, descending from an octave interval to a major 2nd, while the digital video provides the title's analog – humanity turning to noise.

Faisons Les Zigopattes!
(Let's do the Zigopattes!)

Completed in Valenciennes (in the north of France) from the 22nd to the 24th of November during the 2000 European Gathering of Yound Digital Creation, and produced and conceived by…WAVE, "Let's do the Zigopattes!" is the video of the chain animation made by 34 students from an original picture created by the French artist Bériou. Fourteen student teams made ten seconds of computer graphics animations beginning and ending with this same imposed image, which made it possible to link them all at the end in a four minute creation with an animated introduction and conclusion offered by Bériou. A musical soundtrack was composed and produced by the "S.i.n." group to bring rhythm and life to this experimental collective computer graphics video work.

A chained animation by Bériou and: Olivier Duprez (Lycée Charles Deulin, Condé-sur-Escaut), Agnès Jouglet and Romain Vacher (Ecole Supérieure des Arts Appliqués et du Textile, Roubaix), Christine Dauvier, Bérangère Dominguez, Jérémie Basset and Franck Isabel (Ecole Nationale Supérieure Louis Lumière, Paris), Thibaut Deloof, Lucas Vallerie and Baptiste Van Opstal (Supinfocom, Valenciennes), Aude Lépere, Christian Hanquet, Pierrick Limousin, David Lobel and Frédéric Loubert (Maîtrise de Sciences et Techniques d'Art et Communication, Université de Valenciennes et du Hainaut Cambraisis), Hélène Dubois and Anne-Laure Totaro (E.S.A.A.T., Roubaix), Frédérique Bertrand and Laurent Leccia (Ecole d'Architecture de Marseille-Luminy), Hélène Ansel and Rémi Kozyra (C.F.T. Gobelins, Paris), Chloé Bocktaels and G.Rom Caron (E.S.A.A.T., Roubaix), Amélie Villeneuve and Nicola Liguori (E.S.A.A.T., Roubaix), Florent Jarry and Kévin Lene (Institut Supérieur de Design, Valenciennes), Nathalie Bailleul and Sébastien Billoue (Supinfocom, Valenciennes), Gael Cobert and Kévin Fleury (Ecole d'Arts du Havre), Olivier Lerouge, Fabrice Guevel, Fabrice Nzinzi (E.S.A.A.T., Roubaix).

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Basis picture, introduction, and conclusion animations: Bériou
Chained animation concept: Marie Anne Fontenier
Production, conception, and direction: Bruno Follet
Assistance: Frédéric Dujardin
Final cut pro editing: Sébastien Wibaut
Music: S.i.n. (Wave Productions)

Thanks to: Chambre de Commerce et d'Industrie du Valenciennois, Rencontres Européennes de la Jeune Création Numérique, Beriou, Philippe Meis, Thierry Pochet, Eric Ledune, Nedry and Ju, Free*d and No, Hugo, Jimmy and Nicolas, Nicola, Léo, and Tom.

Loading Animated Version

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Not being paid for endless project revisions is an international affliction. "Loading Animated Version" documents the email correspondence between an American office specializing in streaming media and the design studio they hired in Hungary. To illustrate the contrast of management and labor, screen captures of American Flash animations are juxtaposed with found footage scenes of Eastern Europe typically presented on American television. This satirical dramatization of the exchange across the ether reveals the vast inequality between bottom-line managers and their dispensable labor force. "Loading Animated Version" demonstrates that dot-coms could potentially be no different from infamous manufacturing companies and their unethical disregard of good labor practice.

Ojo Por Ojo

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This video was made for the opening show of a national festival of fine art painting in Mexico and is a tribute to the eye. We used several kinds and forms of eyes, or in its particular name that you find in the Spanish language like the huracans eye, or the eye of a needle, but no human eyes. We created motion graphics and effects with Adobe Photoshop, Adobe Illustrator, and Media 100 on a Macintosh G4.

Director
Alejandro Meludis

Producer
Lenin Leon

Production House
Arte y Parte

Contributors
Paco Zepeda, Tito Ramirez, Carlos Mendez, Lorena Rossete, David Valdez, Jesus Gonzalez

Second Thoughts

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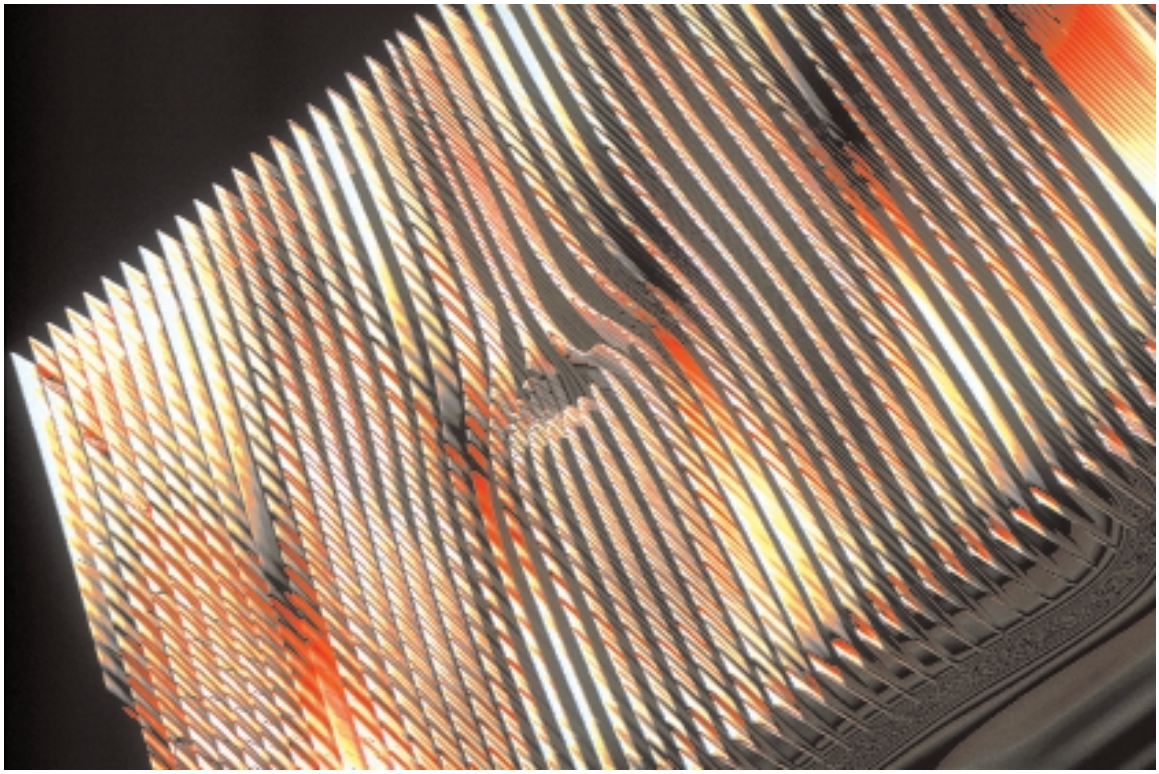
"Second Thoughts" was composed in 2000 and is intended for performance on videotape. The work is in three sections, the first two of which dominate the form. The opening section explores the inside of a virtual object and depicts many of the surfaces and textures found therein. The second section moves into 3D space and presents different perspectives of the initial object, as well as adding a number of new elements that derive their form from the elements in the opening. The short, third section is a recap of the first and adds several minor variations to it. The music, also composed by this author, contributes an emotive element as well as an added layer of continuity to the piece.

Like previous works by this author, all visual elements were scripted using the POV-ray scene description language; no special effects or plug-ins of any type were used. The musical material derives from both synthetic and acoustic sound sources.



Sunagimo

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"Sunagimo" means the liver of the bird in Japanese. This work is not created to be an aesthetically pleasing 3D computer graphics piece, but is designed to convey the dirtiness and mud-like smells that the title implies. This film is conceived to be the complete opposite from recent computer graphics works that focus on beauty. Similar to food preferences, "Sunagimo" is subjectively judged by the person witnessesing it. The theme of the piece incorporates "the thing spent in large quantities and the thing to spend."

Yuki-The Spirit of the Snow

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Modeling and Animation
Akiko Tohma

Composer
Shoji Yamashiro

Musician
Geinoh Yamashirogumi

Advisors
Jun Kurumisawa,
Michishige Udaka,
Ogamo Rebecca Teele

Software
Alias|wavefront Maya,
Adobe After Effects

Hardware
SGI Onyx2, Mac G3

To examine how computers can attain the expression of Yugen (profound beauty) found in Japanese traditional Noh drama, a computer animation based on the Noh drama "Yuki" was created.[1] The concept behind the creation was: the entire design should rely on the story; the movements of the Noh mask should be similar to the movements on an actual stage; and the animation sequences should be harmonized to bring out the most appropriate expressions from the Noh mask. By making these considerations, audiences could be expected to have diverse imaginative experiences even at a very subtle level, as in Noh drama.

"Yuki" is a short story about an encounter one night with "The Spirit of the Snow" by a traveling priest. For "The Spirit of the Snow," the Noh mask called Ko-omote was created as described in "What Noh Masks Whisper to Us." As the modeling was done with reference only to a carved wooden mask, the mask's shape retained the 3D-controlled asymmetry of the real mask, as well as a fluent carved surface and detailed edges. These shape characteristics were responsible for generating subtle changes in the mask's expression.

To move the Ko-omote mask, a head part and a skeleton of a body were created. Key frames were added to control all of the movements, which are in well-timed combinations with music and sound effects. In the dance part, the 3D models of a fan, a dance robe, and a wig band were bound to the skeleton. The character simulates basic movements of a Noh dance, and at the end, leaves towards the left side of the stage, in the same manner as in a real Noh play.

In some situations, parts of the character's body become invisible. However, this seems to succeed in creating a more effective expression than a full appearance of details. Such visual effects are inspired by Noh drama, where the effects depend not on the direct representation of objects but on the audience's imagination.

References

1. Tohma, A., Shimohara, K., and Tohkura, Y. (2000). Insight into reality through the creation of computer animation based on the Noh drama "Yuki." *Journal of Three Dimensional Images*, 14(4): 188-193.

Altzero 3

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"altzero" aims to create musical pieces that can be explored in an intuitive, non linear way, where the composer's original musical direction is developed and augmented by those visiting the interactive space.

By navigating through these virtual environments, visitors can explore the sounds and create an infinite array of different soundscapes, defining their own musical experience.

The project was initiated in 1999, and consists of a series of experiments (online and offline) exploring the possibilities of interaction, communication, and multi-user collaboration based on sound and space.

As well as the online format, "altzero" has also been shown as an installation in a number of venues.

"altzero1"
First shown in June 2000, this is a 3D space where visitors can place specially composed sound loops, creating different soundscapes. The music you hear depends on where you enter the environment, the route you take, the time spent in specific areas, who you encounter along the way, and how you and others select and affect the sounds.

Your presence within the space is defined by the interaction you have with the soundscape.

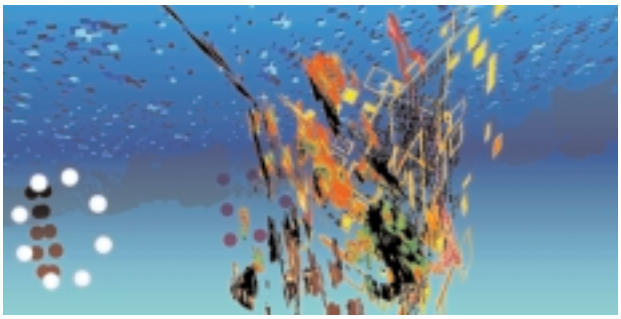
Installed at the Futuresonic festival in Manchester, United Kingdom, June 2000; and Transcinema, New York, November 2000.

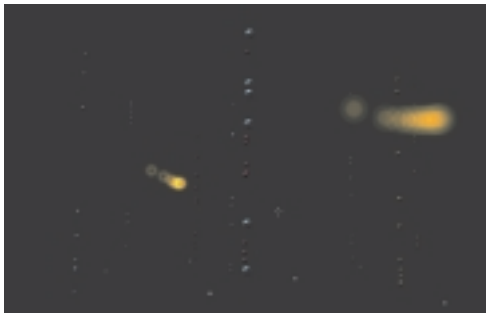
"altzero2"
An abstract deep ocean space where vertical lines of bubbles rise towards the surface, each line representing one sound. There are 50 distinct sounds placed in the environment, tuned to create rich, complex chords that change smoothly over time. The aim is to motivate people to explore the environment at their own pace, guided by the sounds they hear and enjoy.

Installed at the Institute of Contemporary Arts (ICA), London, in February 2001.

squid s o u p
squid s o u p is a group of interactive artists, designers and musicians based in London, UK. They have been experimenting with sound based interaction since 1997, and their work has been shown at international festivals such as Milia, Doors of Perception, Ars Electronica, Sonar FutureSonic, Micro Wave and Transcinema.

"altzero" won the Art Online category of the EMMA Award 2000 and was Macromedia Site of the Day in January 2001.





Altzero 3
2000, Web Site

Just below the surface, the sounds are warm and inviting. (left)

Deeper into an ocean of sound... (right)

CollageMachine: A Streaming Collage Browser Learns While You Surf

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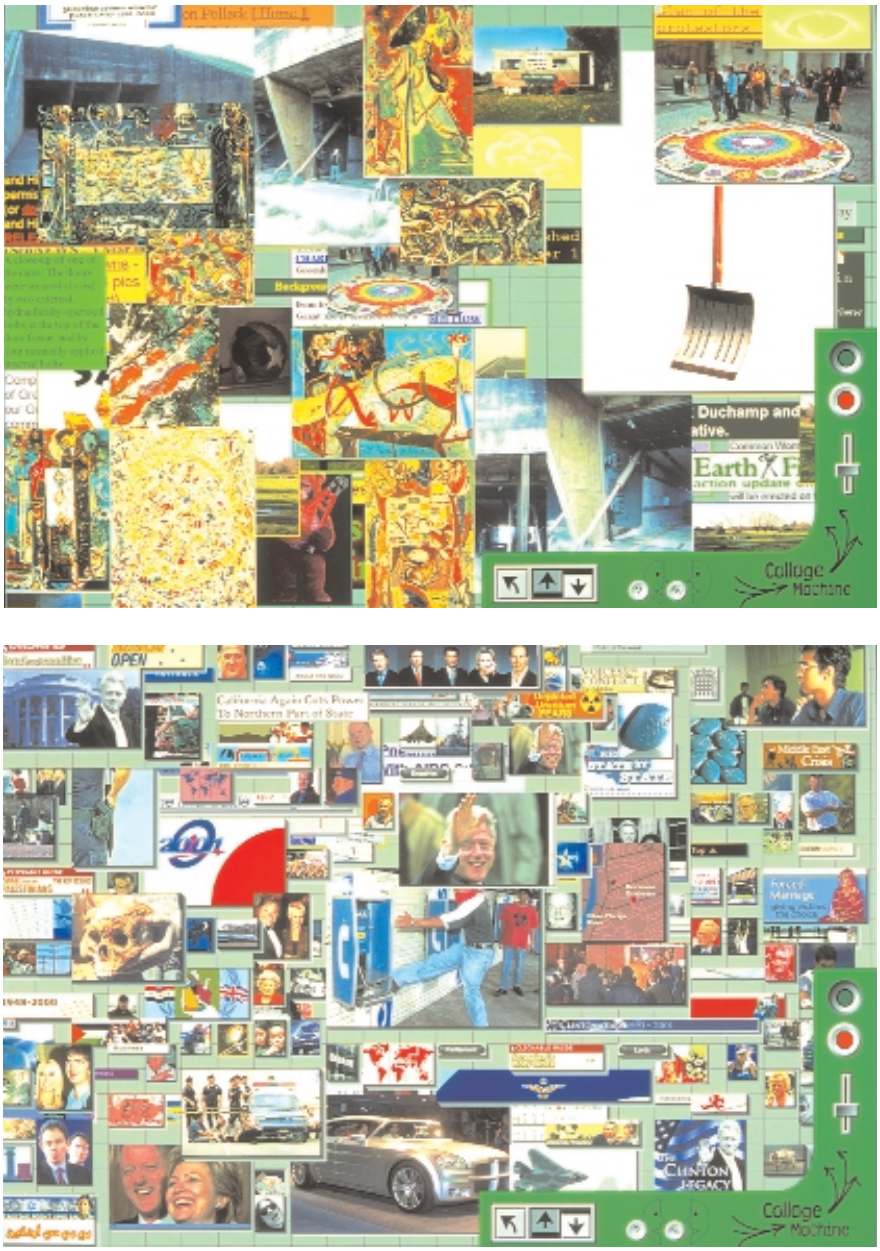
"CollageMachine" is an information visualization browser. It proactively pulls interesting content. "CollageMachine" alters the granularity of browsing. It downloads documents and decomposes them into media elements – images and chunks of text – which stream into a collage. The user can rearrange the collage interactively. An agent models her interests.



CollageMachine: A Streaming Collage Browser Learns While You Surf
mrl.nyu.edu/andruid, 2000, Web site

HaikuTree

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Poetry is a subjective medium – it is designed to create contexts for emotions and epiphanies. It is impossible to teach a computer to appreciate poetry for its own sake. However, computers may analyze patterns of poetry that have been identified by people as good. Given feedback and analysis, computers may teach themselves to generate better poetry.

HaikuTree.org is a system designed to help computers write better poetry. The system employs a poetry generator, ranking, a weathering algorithm, and a community of people to reveal the most popular poems. HaikuTree.org then analyzes the structure behind the poems and modifies its generative methods to write poems similar to those promoted by the community.

The idea of a Haiku Tree is taken from a real tree I saw at Reed College in the late 70s. Somebody had calligraphed several little poems about trees, rain, and wind, and tied them to a tree north of the library. These lovely poems were melting away in Portland's fall drizzle. The paper was handmade, a coarse collection of cotton fibers. They were knotted with ribbon and could not be removed without destroying them. These poems could only be read in this brief context and they provided a clear representation of the transience of all things. These poems were small masterpieces of immaterialism.

I learned later that these poems were known as WeatherGrams, and that they had probably been created by Lloyd Reynolds. Lloyd is known as the father of American calligraphy. He taught several famous font designers and Beat poets in his tenure at Reed. The inspiration of his work has stayed with me all these years.

The primary interface for HaikuTree.org may be found at the Web site (HaikuTree.org). I have been experimenting with other interfaces including email, screensavers, and voice menu systems. Interaction will be the same in each medium. There are three main activities: generate, judge, and top ten. To generate, the computer creates a new poem based on patterns that have evolved over the life of the system. The user is then asked if s/he likes this poem and would like to place it on the (virtual) tree. If not, a new poem is presented until the user finds one that s/he prefers. In the judging activity, a poem is randomly selected from existing poems and the user is asked if it should be promoted or demoted.

Each poem on the tree is given a starting life of 50 days. The poem's life is shortened by one day, every day (weathering). Poems are also subject to judgment by the community. Judgment is the sum of all promotions and demotions performed by the community. Promotion increments the life of a poem by one rank; demotion decrements the life by one rank. Poems are removed from the system when life reaches zero, and rank is determined by comparing the poem's life to its age. The "top ten" is the collection of the highest ranked poems, those whose life most exceeds the statistical mean.

Dedicated to Lloyd Reynolds.

MY LANGUAGE

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"my language" is a group of Web-based flash animations of densely layered, colorful words plus audio of the same words, with buttons allowing the person playing the animation to control the layers of words and corresponding audio.

What makes "my language" a language is that it uses words and offers people the ability to control its flow while they experience it. They cannot contribute words or sounds directly over the Web so the language remains mine; "my language" is a projective device providing virtual conversation.

All artworks may be understood as projective devices: objects and experiences in which audiences find themselves mirrored more or less specifically. Projective devices invoke peoples' histories with color, human faces, or words, for example. The power of a projective device for art, learning, entertainment, or therapy is in its feeling real enough to its audience that members relate to and interact with it emotionally, intellectually, and/or spiritually. The Web, in addition to carrying rich media and allowing user interactions, holds projective power in its availability – whenever people choose to connect, wherever they may be, with an Internet-connected browser. "my language" takes advantage of the Web and other projective expedients – common words used without confining narratives, and a recorded voice. With the ability to interrupt, select, and interpret my words, audience members are empowered to treat "my language" as their instrument. I hope you will experience a connection to and even ownership of the words, which become visible and are spoken in response to your actions. The sense of relationship to an author/creator may not disappear, but I hope you will experience the authorial presence as amorphous, unstable, or dissolved in your own presence.

Myriad virtual communications over the Web and elsewhere lay claim to us, from advertisements and political messages of all kinds, to interchanges with family members, friends, associates, and various strangers. "my language" has qualities in common with these, in addition to its own unique qualities and one important difference. Its title announces ownership, and no matter how enticing "my language" proves to be or how intently audience members project themselves into it, my voice resumes and rambles, in sound and image, often insistently. Working within and revealing limits of virtual communication (on the Web), "my language" provides a framework for interaction between the absent author and authorial audience. It is a massage with the message that shared language remains strictly personal.

my language
www.clayd.com/mm/mylanguage.html, 2000, Web Project

Network Communicate Kaleidoscope

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This is a virtual space system to chat. Participants can talk each other anytime, anywhere as particles. Yet, after disconnecting, particles leave and move independently based on their behavior. Finally, they will make kaleidoscope images like "clustering fireflies." This is a project to explore "beauty."

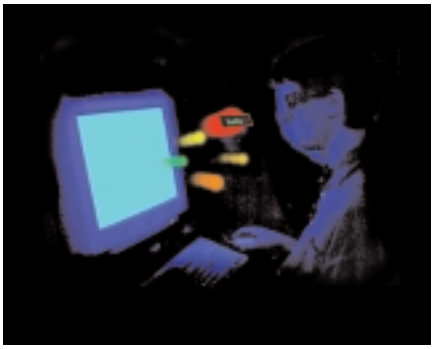
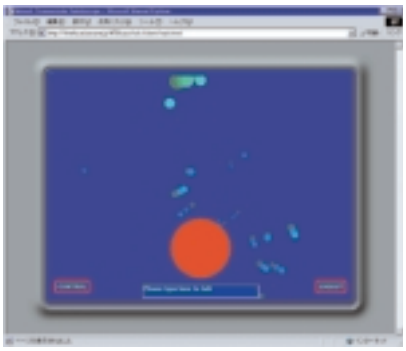
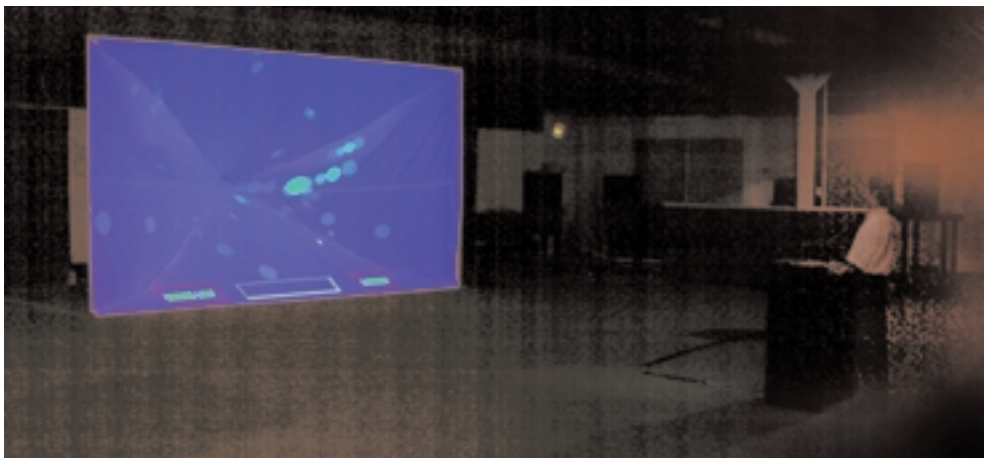


Image using with Chromatek's HoloPlay glass



Navigating scene with bird-view mode
2000, Web site

Chatting scene



Exhibition at CRCA, University of California, San Diego

Visual Chaos

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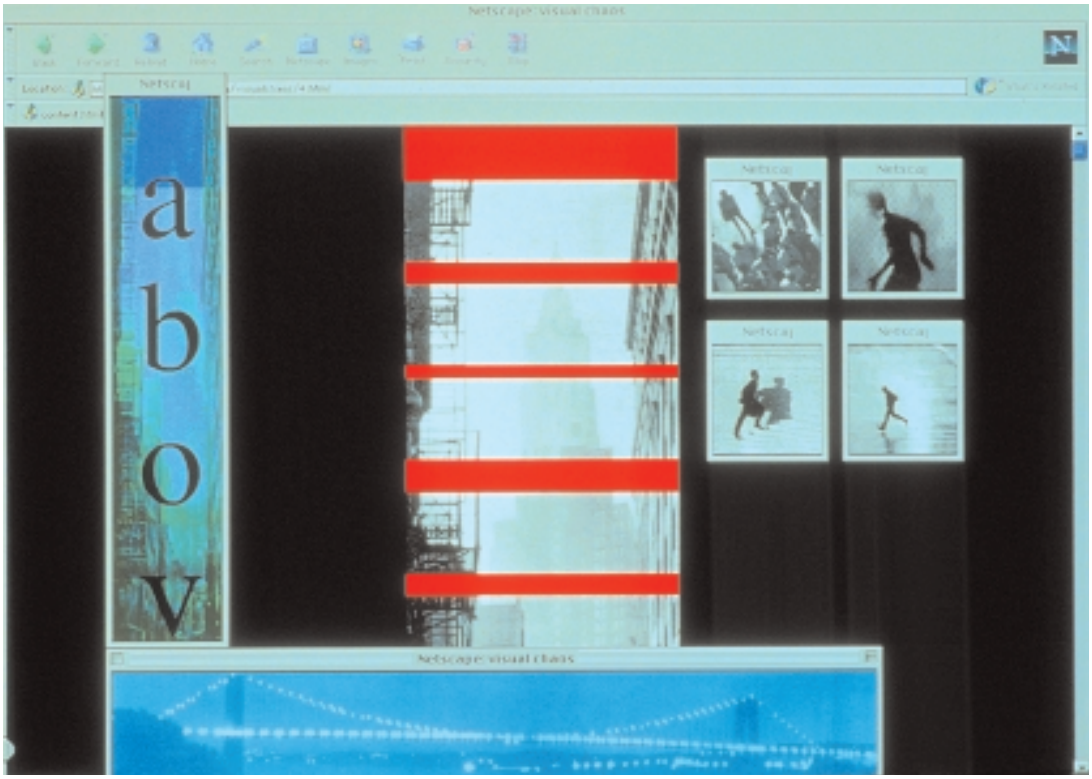
"Visual Chaos" is a short Web work that explores the idea of chaos on the Web. In "Visual Chaos" I created a number of moving windows, as well as windows that appeared in specific places on the screen. I wanted there to be a screen filled with little windows, all doing their own thing. I also used a clickable list to create a poem. Each word is a link that opens a new window. You can read the poem a number of ways. Contained within "Visual Chaos" are a number of flash movies that use historical images of Los Angeles as source material, adding current images and texts as animations to explore the relationship between the past and the present, as well as the ancient, the modern, and the future city.

"Visual Chaos" uses the space of the Web as a sculptural space, allowing viewers to interact with animated graphics to delve deeper and deeper into an imaginary city. The images are culled from various print media sources. The texts are either found passages from urban theory or specifically written poetic musings on the city. The site explores ideas relating to an abstracted idea of the city. The images depict shadows and bodies. It explores the ideas of being swallowed by the city. In "Visual Chaos" I explore grids as a metaphor for the many different paths one can journey down in the modern metropolis. One of the things I am interested in is to counter the use of the Web solely as a source of information.



Visual Chaos
www.visualchaos.org, 2001, Web site

Beyond Manzanar

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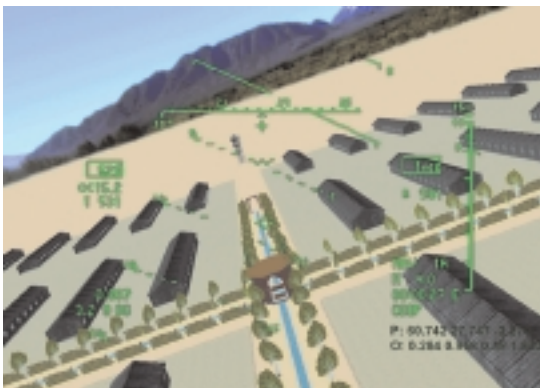
Zara Houshmand

Manzanar, an oasis in the high desert of Eastern California, was the first of over ten internment camps erected during World War II to incarcerate Japanese American families solely on the basis of their ancestry. Though this specific instance was ruled unconstitutional in 1988, mass internment of an entire group "in cases of military necessity" is still legal. Ethnic groups whose countries of origin are considered "rogue states" by the American government can legally be interned without trial if tensions between the countries escalate into violence.

In 1979 during the Iranian hostage crisis, there were physical attacks on Iranian Americans and calls to intern them "like we interned the Japanese." For an Iranian American, it would be irony indeed to be imprisoned at Manzanar for the "sin" of Iranian ancestry: The site itself is hauntingly reminiscent of the landscapes of Iran. The grid of roads drawn in the desert by the military echoes the geometric order of an Iranian paradise garden – a further irony, for the Japanese Americans did indeed create gardens, their own "virtual reality," within the barbed wire fences of Manzanar.

"Beyond Manzanar," an interactive virtual reality installation, uses the medium's unique spatial characteristics to "physically" locate you inside the Manzanar Internment Camp. As you explore the camp, visually bounded by three mountain ranges and physically constrained by the barracks and barbed wire fence, your kinesthetic sense is engaged to underscore the emotional impact of confinement. Your eyes see the passes that lead out of the valley, but you stand at the fence and can go no further. Confined within the camp, you have nowhere to go but inwards, into the refuge of memory and fantasy.

http://mission.base.com/manzanar/



Beyond Manzanar
2000, Interactive Virtual Reality Installation, 10 feet x 20 feet x 17 feet

CASE STUDY 5510/CASE STUDY 5510-B

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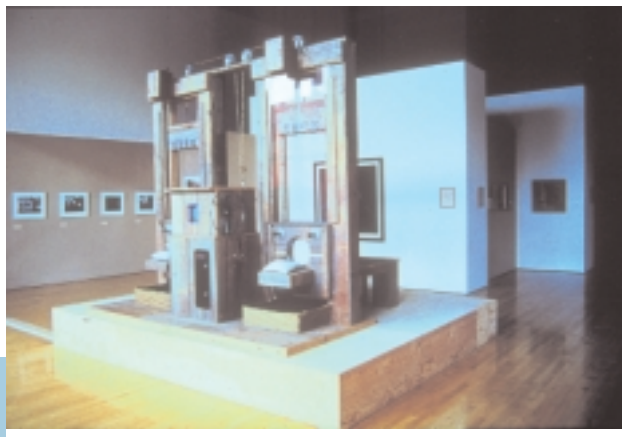
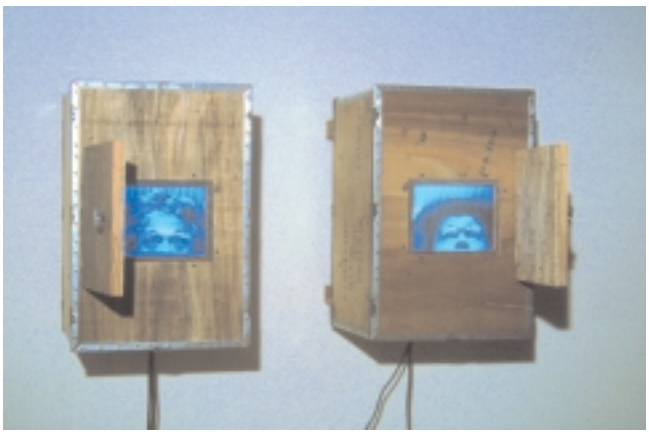
"CASE STUDY 5510" is a contemporary version of a dual-activated guillotine, offering participants a heightened virtual experience (psychophysiology). A supplement to this piece is "CASE STUDY 5510-B" – live video imagery of the subject's facial expression. Participants and viewers become subjects from an observational perspective, providing a simulated clinical "case study."





CASE STUDY 5510/CASE STUDY 5510-B
2000, Interactive installation, 12 feet x 8 feet

Contact Water

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Overview

My work is an installation made with MR technology. "MR" means "Mixed Reality." This technology can mix physical space and computer graphics on HMD. I created a new medium for face to face communication. Co-developed with technical collaboration with Mixed Reality Systems Laboratory.

Concept

Communication from human to human includes nuance, gesture as well as spoken language. Over time, numerous inventions of mass communication were developed which step by step took away the necessity of face to face contact. Today, communication technology via telephone, radio, TV, cellular phone, and the Internet is continuing to expand the human experience and the ability communicate globally, lessening in-person contact.

A troubling aspect of these new technologies is that they eliminate in-person communication. In the "virtual" world, there is less and less need for physical presence when interacting with one another. Surrounded by various media, we are losing some of our humanistic communication skills. There are some feelings and information that can only be expressed by physically interacting with another human face to face.

"Contact Water," is the name of my work, and hopefully will become a tool to enable people to communicate face to face.

When using this new medium, players at first sight will discover the importance of face to face communication, which is usually lacking in current media.

They will also realize that in-person nonverbal communication through facial expressions and gestures are precious to us, and essential to communication.

Contact Water
2000, Interactive installation, 3000mm x 6000mm

The Floating Words

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Shinji Sasada
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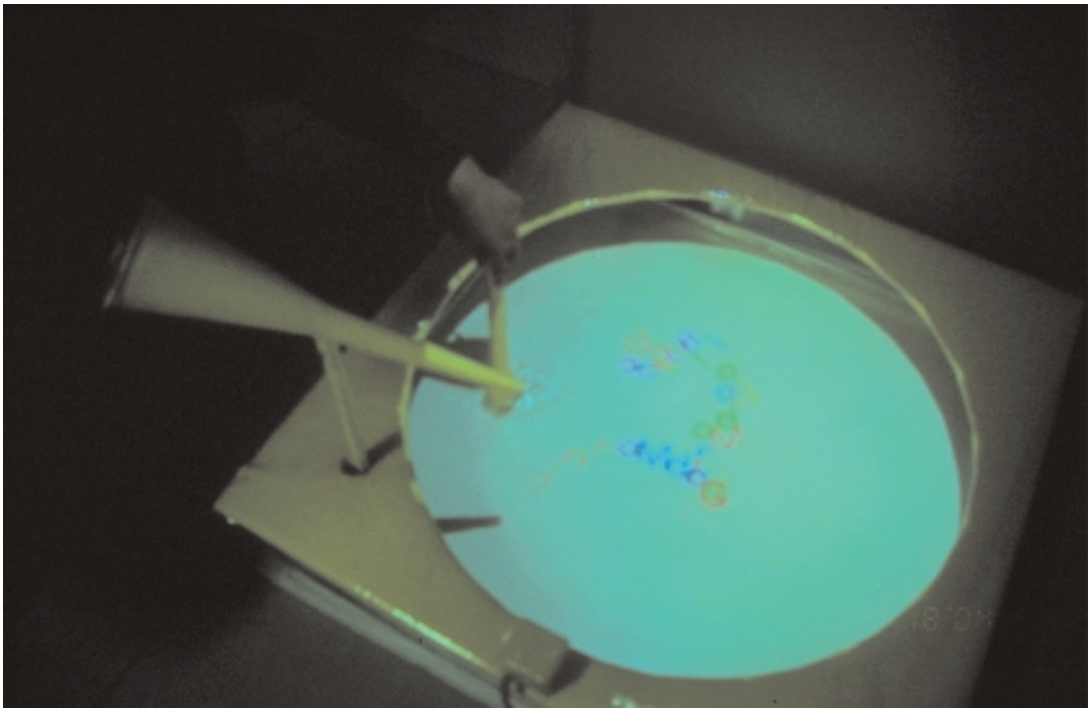
"The Floating Words" provides the viewer with a new feeling: if you speak to a microphone, your voice drips into a water pool as water drops, and will begin to float. You can stir the "letters" with a stick.

Speech recognition systems are completely different from other input systems, because we can input, without touching anything within the system.

When one keys letter on a computer keyboard, the letters do not have substance, yet we know the letters are inscribed on a monitor. However, when inputting letters through speech recognition, it is a feeling just like magic.

When your voice drips as water drops, when letters float in the pool, and can be stirred with a stick, you forget the everyday world, remembering instead the feeling from childhood when life was pleasant and time passed very slowly.

This small pool is not the last form in this work. I hope to be able to correspond this concept to various and different places and situations; for instance, a fountain where people relax.



The Floating Words
2000, Interactive installation

Gemotion

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Collaborators
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Hiroo Iwata
Shinji Sasada
Seiji Hori
Koji Abe
Naohiro Shichijo

We tried to represent growing emotion by computer for mixed reality. Audiences affect the feelings of the virtual creature in "Gemotion" by touching the screen. Three movies projected on the wall screens also represent the state of feelings of "Gemotion." (Gemotion = Growth, Gene + Emotion)

Gemotion
2000, Interactive Installation for Mixed Reality, 12 feet x 12 feet

Invisible Places

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M. Michelle Illuminato
Phuong Nguyen

Next Question is a group of three artists who have been collaborating since 1994: Emily Blair, Michelle Illuminato, and Phuong Nguyen. Next Question is committed to involving the audience directly in the art – both in its development and, through interactivity, in the piece itself. Summaries of our work can be found on our Web site (nextquestion.org).

"Invisible Places," our installation for SIGGRAPH's N-Space, is part of a conceptual mapping project that took place in Buffalo, New York. Working in collaboration with women and girls in Buffalo, we examined the diverse ways in which women perceive and navigate urban space. Entitled "Two Degrees of Separation," this project and accompanying installation were part of CEPA Gallery's Unlimited Partnerships Series. "Two Degrees of Separation" included material from our earlier mapping project, the "South Side Atlas," which took place in the South Side neighborhood of Pittsburgh. In symmetry with this previous work, we concentrated on the area of South Buffalo. Attention to these specific urban spaces allowed stories of women's interactions with the city to emerge, yielding a mingling of narratives rather than essentializing generalizations. However, the project continually flowed beyond the borders of South Buffalo, as indeed had been the case in Pittsburgh.

For we strive to keep our approach as flexible as possible. The question of how women navigate space is admittedly a broad one; its ambiguity allowed many points of entry for collaboration. In Buffalo, we worked with the Urban Girls, a group of middle school and high school poets who conducted their own interviews and composed new poetry about urban space, which they read on opening night at CEPA Gallery. Three of the girls also created an audio tour of places important to them, which is included in Invisible Places.

The title "Two Degrees of Separation" reflects both the proximity between participants as well as that between Buffalo and Pittsburgh. It also describes the structure of the interactive installation, where specific stories were placed side by side. For the "Invisible Places" part of the project, we asked women and girls to talk about where they were most and least comfortable. By plugging headphones into jacks in a chalkboard, visitors can hear portions of the interviews and then add their own observations using chalk. For SIGGRAPH, we have added a computer component that allows visitors to share their thoughts regarding digital or online space. The narratives enhance, redirect, and contradict one another, yielding a variety of stories about how women experience space.

The Urban Girls who participated in "Two Degrees of Separation" are Aquila Alexander, Vanessa Blaylock, Moira Carman, Regina Ernst, Leslie Feldballe, Michelle Ferri, Dominique Gadley, Faith Houston, Shalona Hogue, Gretchen Kamke, Dominique Montgomery, Shari Rosario, Rebecca Sipos, Lydia Thornton, and Ashley Watkins. Their teacher is Suzanne Diffine. CEPA's Unlimited Partnerships was supported by the Andy Warhol Foundation for theVisual Arts, Communication Workers of America, The John R. Oishei Foundation, Mid Atlantic Arts Foundation, The National Endowment for the Arts, and The New York State Council on the Arts.

Invisible Places
2000, Interactive Installation, 12 feet X 12 feet

Music Creatures

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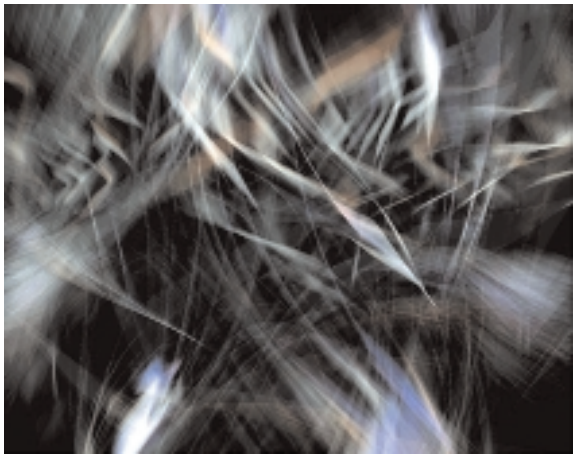
This interactive installation consists of musical creatures – autonomous, virtually embodied characters living within a sonic environment. The movement of their graphical bodies produces music and reflects their understanding of the sounds that they hear. In this installation, computer animation and music are synthesized through the creatures' animal-inspired artificial intelligences.



Music Creatures
2000, Interactive Installation, 10 feet x 8 feet

A music creature dancing to the sound that it hears.

NAFTA Stock Puppets

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The "NAFTA Stock Puppets" are an Internet-driven kinetic installation that tracks the movements of global stock markets with seven larger-than-life marionette puppets. Using a real-time data stream, a network of PC laptops, and a complex electro-mechanical control system, the installation reanimates the abstract machinations of global financial markets as an absurdist carnival puppet show.

Unfortunately, the script for this puppet show remains a bit hazy. One moment, we might find the NASDAQ puppet soaring 20 feet into the air, consumed with the latest IPO elation. The next moment, without apparent reason or warning, the Nikkei puppet might fall to the ground, crumpling into a fetal posture of weakness and desperation. From the opening to the closing bell, the puppets continue to rise and fall in serendipitous synchronicity with the "arbitrary" movements of the G-7 market indices.

In front of the puppet towers you will find a "Blackjack-style" trading table, staffed by a tuxedo-clad dealer. Feeling bullish on Germany? Step up to the trading table and place your "bet" on the Germany circle. No money please, just the random ephemera you happen to have with you – keys to unknown locks, photos of ex-lovers, business cards from clients you'd rather forget, or other random ephemera you've collected around SIGGRAPH. If the corresponding puppet goes up, choose your prize from the pile of profit in the trading pit. If the puppet goes down, you lose your "bet" and build the pile of profit for the next day trader.

The Puppet installation is a gentle commentary on our society's near pathological infatuation with global stock markets in this era of the "new economy." At the same time, it is also a serious experiment to map the complex information stream of financial data onto dynamic objects in the physical world. Our intention is to re-embody this information ecology in a manner that reveals some of the character and patterning encoded in the fragments of the data stream. And during the process, we hope to also laugh a bit at the arbitrary control this data stream holds over many of our emotional lives and reckonings of self-worth.

NAFTA Stock Puppets
2001, Interactive Installation

Netizens, net-fringers and outsiders

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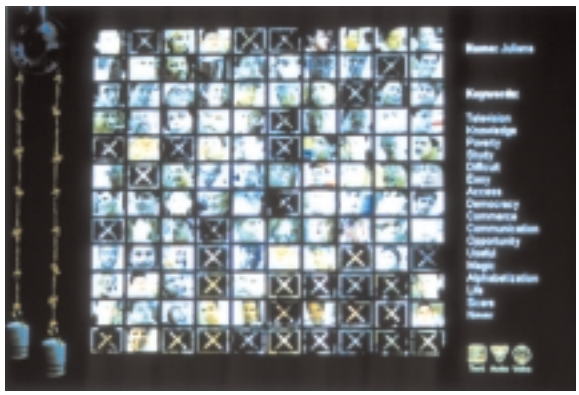
In recent years, the Internet has often been associated with the notions of progress, improved quality of life, and greater democracy. The media has been increasingly conveying a globalizing image of the Internet, along with a discourse that would lead one to believe in the possibility that – in a short term – it will include many, if not all of us.

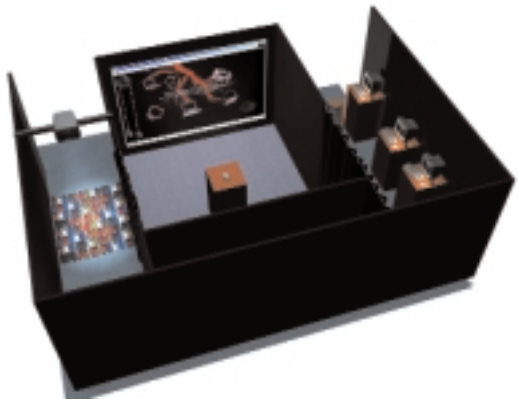
Nonetheless, research shows that – with rare exceptions – only the apex of the social pyramid in each community is connected to the Internet, totaling a paltry 7% of the population of our planet. "Unless we ensure proper capillary penetration and are creative in introducing alternative forms of universal access, we shall be helping perpetuate inequality and violating the essential right to communicate" (Afonso, 1999). While the industrialized countries are seeking ways to bring their citizens into the computer network through investments and political action, the gap seems vast – and in many cases probably unbridgeable – to those on the technologically less-favored side of the Third World.

This installation shows how people living in dramatically different socio-economic circumstances perceive and understand the Internet, how it affects their lives, and its implications for their future. We interviewed 120 persons in Rio de Janeiro (Brazil) – those who live in shanty towns and those who live in exclusive neighborhoods; people from urban and rural areas, those who earn 100 or more minimum wages a month; and others who would be happy to earn just one minimum wage (approximately US$60). We collected declarations regarding the Internet from all these peoples, and we wove a network of identities, creating a rich, interactive patchwork of images, sounds, and ideas. Our aim is to discuss the diversity of existent opinions – how the "haves" and "have-nots" understand the connected society – and the dangers and prospects of the Internet boom.

Those who visit the installation will be encouraged – in a very dynamic and intriguing way – to give their opinions and to add their images to the project's data bank, so that they themselves become part of the work too. This is a space where every person counts, and has a chance to speak. No matter who you are. Just the way we hope the Internet itself will be, one day.



Netizens, net-fringers and outsiders
2001, Interactive Installation, 16.5 feet x 23 feet



New York Mural: #2, for SIGGRAPH

Artist
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This mural is derived from a design originally developed as a proposal for the City of New York. It was modified and adjusted specifically for the SIGGRAPH site.

The imagery of the mural tries to capture the energy, diversity, and vitality of humanity, specifically as seen and experienced in New York City. Images of people rushing about their daily business, people at rest, people of different races, different ages, different social strata. Images of our buildings, the environments we create, our monuments. Images of our laughter, our socializing, our solitary quite moments. Images of nature's – and our – ephemeral beauty. Images of the vastness and smallness of our universe, and of us.

The rectangles of the mural echo both the historically rectangular canvases of painting and the more recent rectangles of video and film. The overlapping of the rectangles echoes the floating windows of our computer screens.

Combined with the photographic images are hand-drawn drawings. These different styles of imagery, and the images themselves, mix and intermingle to form a new whole. With digital imaging, the borders between categories of imagery, between image-making techniques, collapse.

In addition to the static imagery, there are also electronic elements embedded within the mural. A video screen displays images of pedestrians passing by the mural. Their imagery becomes part of the mural imagery. The mural is about them and about us. At another location, sound emanates softly from behind the mural wall. If we listen closely, we hear the sound of different people reading poetry, each in their own native language.

The mural is constructed as a grid of printed tiles. These tiles echo both the thousands of years of mosaic tiled imagery across cultures, and the pixels of today's digital image-making techniques.

Not You, Not Here

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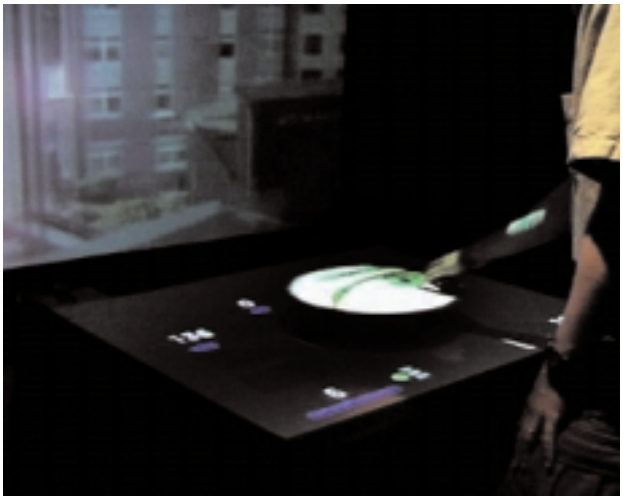
Sound Design
Chris Peck
University of Michigan

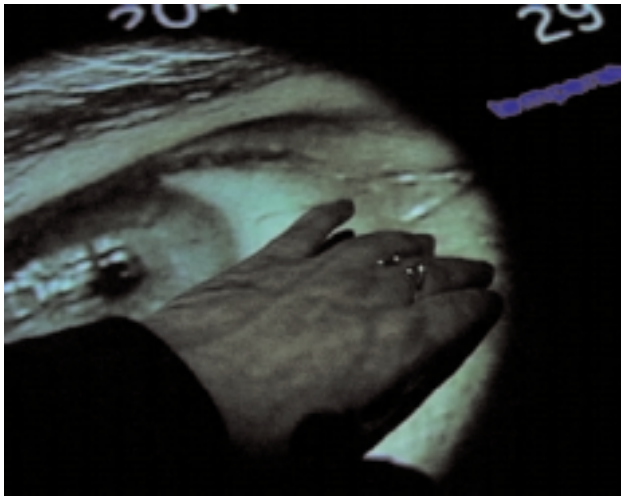
"Not you, Not Here" connects the present locus of the viewer with a remote, simultaneously co-existing place, enabling various modes of experiencing its otherness.

In the present instantiation of the artwork, the SIGGRAPH gallery and an outdoor location in Ann Arbor, Michigan are linked via the Internet, providing a video, audio, and data connection that makes some aspects of the faraway place present to viewers.

In addition to the computers which communicate live moving images and sound, others link to an EZ I/O interface board to read environmental sensors (for wind, rain, temperature, light) and transfer that information to the SIGGRAPH site, where it drives kinetic sculptures and a computer-orchestrated natural sound environment. The sculptures and sound translate aspects of the remote space into subjective correlatives that can be experienced directly, while projected numbers display a quantification of the changing features of the remote place.

The sonic aspect of "Not You, Not Here" consists of several independent layers controlled by MAX. Synthesized sounds representing the wind in Michigan are generated by an algorithm that takes actual wind data from Ann Arbor via the Internet as one of its parameters. A recorded reading of a short poem by Rodemer is played back with the turning of the camera control disc in Los Angeles. As the wheel is turned, MAX receives data through an EZ-I/O interface board and scrubs through the digital recording using Max Signal Processing, while also panning the sound so that its movement in the stereo field corresponds to the eye projection and the servo-camera in Michigan. If the control wheel is turned slowly from right to left, the entire poem is heard.





Not You, Not Here
2000, Interactive telepresence installation

Visitors to the piece standing in front of a rear-projected live video image of the remote space. (left)

Visitors turn a control disc onto which an eye is projected, thus controlling the position of the camera in the remote location. The eye looks left or right to provide visual feedback on that position, while the image on the large screen in front also changes. (right)

Omnipresence ver.1

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The twentieth century was an age of mass production and mass consumerism. Our lives depended upon the consumption of huge amounts of energy sources such as petroleum as well as enormous amounts of other natural resources. However, it is said that fossil fuel sources such as petroleum will play out after another hundred years or so – meanwhile destruction of the natural environment around us continues, the environmental crises deepens, and in many ways eats away at our existence. Upon the threshold of the twenty-first century, one can only assume that we are facing an inevitable change in our lifestyles and concept of values.

This work consists of roughly 500 motors which make music by ringing bells while light-emitting diodes (LED) flash on and off in the darkness. The bells and light-emanating diodes are placed at varying heights and locations surrounding the one experiencing them. The bells are made of copper and brass pipes, making sounds and producing music from the striking of a wooden ball driven by a computer-controlled motor. The lights flash on and off by motor in synchronization with the music. The sound the viewer hears is only the slight sound of the copper bells themselves with no electronic processing or amplification. The luminescence of the LEDs is also something quite subtle.

What this work offers its audience is a chance to watch carefully and listen consciously. In our day-to-day lives, we come in contact with so many things and pieces of information that we may have gradually lost the inclination to actually watch and listen, to experience our surroundings. We must learn again how to watch and listen, to recover the will to experience our natural environment.

In the natural sphere of this world or of the cosmos, there is no specific center and all things exist as separate and independent entities. On the other hand, many things have a mutual and organic involvement with one another, as a whole forming a single living organism. In this work, sounds are produced in different places and resound to compose a harmonic state. In other words, each bell sends out a different sound but forms an organic and harmonious state, symbolizing a sort of multidimensional perspective of the cosmos.

Omnipresence ver.1
2001, Sound Installation, 40 feet x 25 feet x 7 feet

Poem Vacuum Cleaner

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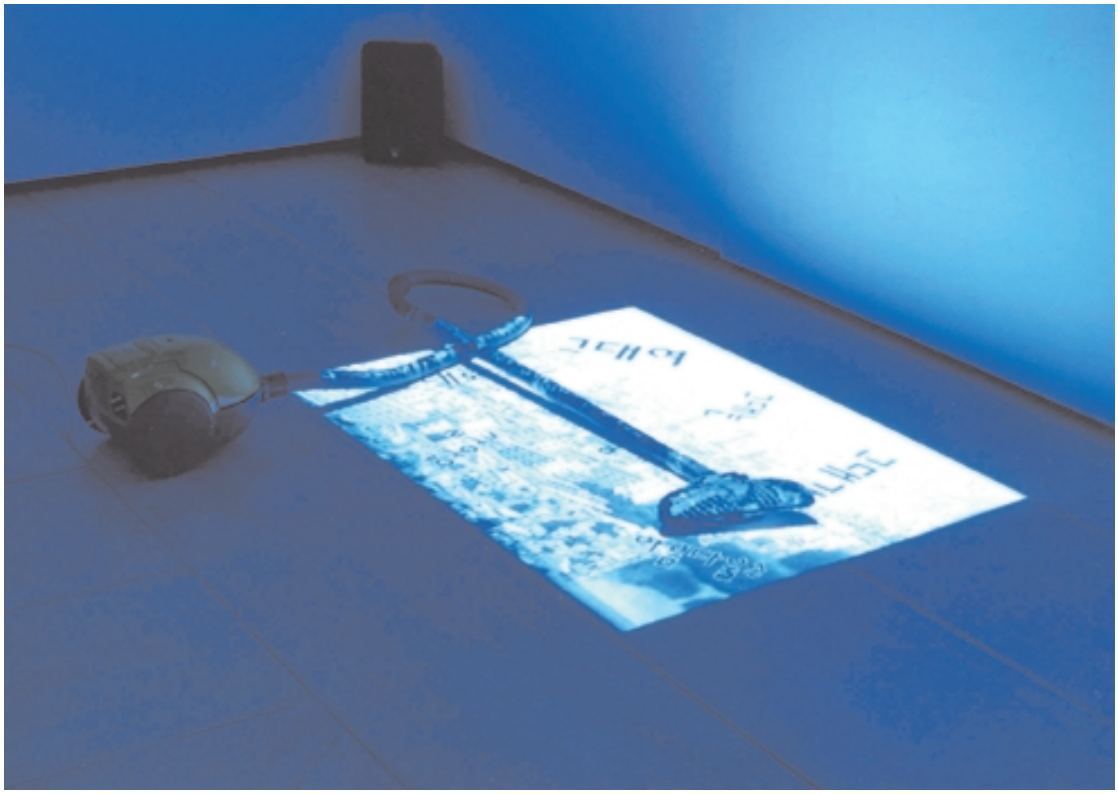
Reading poems purifies feelings of readers. When a viewer vacuums the poetic words projected on the floor, the word will be replaced by a flower. This work reflects that the role of a poem is like that of a flower in city life; with pleasing scent and color, the flower makes people relaxed and enriches our desolate urban existence.



Poem Vacuum Cleaner
2000, Interactive Installation, 2m x 2.5m

Protrude, flow

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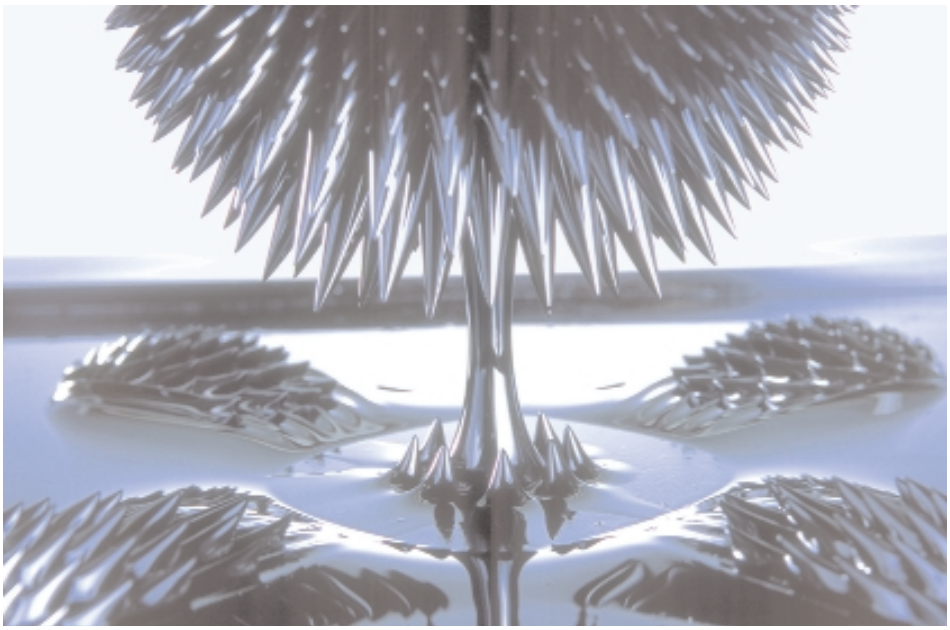
Minako Takeno

Modeling physical material more freely and making it move more flexibly is a dream long sought after by human beings, and many artists have created surreal illusions in pictures or moving images. But those were imaginary. Can we obtain a real object that transforms as we designed it? "Protrude, flow" is an interactive installation which expresses the dynamics of fluid motion of physical material, the dynamics of organic, wild shapes and movements of liquid, by means of digital computer control.

"Protrude, flow" uses magnetic fluid, sound, and moving images. Affected by the sounds and spectators' voices in the exhibition place, the 3D patterns of magnetic fluid transform in various ways, and simultaneously its flowing movement and dynamic transformations are projected on the wide screen.

The magnetic fluid appears as a black fluid. It is made by dissolving ferro magnetic micro-powder in a solvent such as water or oil, and it remains strongly magnetic even in the fluid condition. Therefore, it is more flexibly transformable than iron or sand, and so it is possible to create more complicated 3D organic patterns. These appear occasionally as pointed mountains or pliable organic shapes, sometimes as flowing particle streams.

The transformation of magnetic fluid is caused by the interaction with environmental sound. The sounds in the exhibition space (sounds created by artists and the voices of spectators) are caught by a microphone hanging from the ceiling; a computer converts these to electromagnetic voltage which determines the strength of the magnetic field. At the same time, the magnetic fluid changes its 3D patterns sequentially. Each pattern appears synchronized to the environmental sound and the points of the shapes move correspondingly. As a result, magnetic fluid pulsates according to the sound. A digital video camera captures images of the moving magnetic fluid, and projects it on the screen.



Protrude, flow
2000, Interactive Installation, 4m x 4m x 7m

Secrets of the Magdalen Laundries

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Fantasy is sanctuary.

The imagination is a threshold to an inner world, uncovering the tension between an image that conjures its mutable revelations and the *idée fixe*. This work embodies the hidden poetry of the ordinary, making visible what previously was hidden.

"Secrets of the Magdalen Laundries" explores the theme of imagination in the inner life. Dreaming, reverie, and fantasy are ways of being that make the reality of circumstances more tolerable.

The history of the Magdalen Laundries serves as a point of departure for the installation. These convent industries in Ireland existed from the mid 19th century until the late 20th century. The Magdalen Laundries institutionalized women who were smeared with the reputation of being immoral, or who were indigent, and kept them imprisoned through the social machinations of the Catholic Church. These misused women lived in punitive labor, lost to both their families and themselves. Henceforth, they became invisible, concealed beyond the margins of society.

At the boundaries of the visible exists the invisible.

In these images the women live in a private world of desire, longing, and unreachable fulfillment, forced into a mundane ritual of service without pleasure or amenities. Their vitality and eros, bound by the superficial morality of the Church, reemerge as images on the sheets that they repetitiously wash, a reminder of their stained existence.

They dreamed until the secret images were burned onto the sheets.

Sheets facilitate dreaming. They enfold the body, carry its warmth, desire, perfume, and wrap it in death. The discarded bedsheets give form to an imagination that releases desire in spite of circumstances. The sheets move from matter to metaphysics, reminding us of the body and its dreams. The portraits from the Magdalen Laundries appear and disappear as you move around them. Viewed from an oblique perspective, the images vanish like the women lost in time. Facing them, they assume their own dreaming existence.

The unique sound composition for "Secrets", created by Michael McNabb, brings a psychological fourth dimension to the work. Ten independent audio sources surround the viewer with the voices of women conversing in Irish Gaelic, transformed by the composer's software, using only processing with no synthesizers or conventional instruments.

There are two concentric four-channel layers. The inner presents an intimate perspective while the outer, more distant and manipulated, represents the deeper emotional desires of the women, transfigured by memory and imagination. Additional channels emanate from washtubs, their watery resonance a secret communication across time.

Secrets of the Magdalen Laundries
2000, Installation

Telomeres Project On Imminent Immortality

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Sound Credit
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SkyBoy Productions, Inc.
Telomerhapsody by (art)ⁿ

Produced by (art)ⁿ
Ellen Sandor
Director

Thomas J. McLeish
Fernando Orellana
Nichole Maury
Pete Latrofa
Keith Miller
Todd Margolis
Sabrina Raaf
Barry Flanary
Stephan Meyers
Janine Fron

Hardware/Software
Proprietary, SGI Indigo2, Macintosh, Microsoft NT, Maya 3.0, 3D Studio Max, Photoshop 5.5.

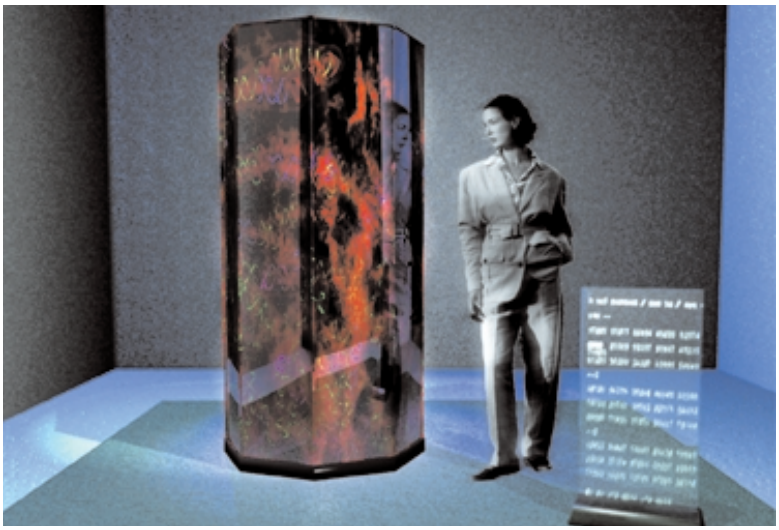
Gene therapy, bio-engineering, and cloning have captured the concerned attention of scientists, scholars, and artists alike. These fascinating issues are precursors to monumental debates that advances in DNA therapy will soon unleash. What is this cutting-edge DNA research about? In one word: immortality.

Currently, genetic researchers are focusing on one discrete area at the end of the human chromosome strand, where telomeres are located. These gene-free DNA sequences are fractionated with each cell division. While loss of telomere material causes cellular aging, telomeres do not always degrade and can be regenerated by the telomerase enzyme. If scientists succeed in controlling the regenerating telomerase enzyme, they will have not only the remarkable power to neutralize cancer and revive the immune systems of AIDS victims, but also the potential to make individuals immortal on a cellular level, initially doubling the average human lifespan. Within 15 years, researchers expect to be testing a life-prolonging pill or injection that will indefinitely freeze age and health, and possibly even reverse the aging process.

Though this may seem radically futuristic, it is tangible, invaluable, and ethically dubious. Who will receive and control distribution? Will longevity become a basic human right, and should the Ever-living procreate? Meticulous reverse-engineering seems reasonably justified to cure fatal disease and human suffering. But can wrinkling and aging be considered causes of unnecessary suffering? Why is immortality desirable, and how would it effect our consciousness?

(art)ⁿ's Telomeres Project On Imminent Immortality contains interpretive sounds of a genetic environment engaged by contact from participants: footsteps on the floormats surrounding its base. Illuminated from within, eight PHSCologrames evoke the feel of an imagined regenerative laboratory in the form of an octagonal sculpture.

Rotated computer-interleaved Duratrans and Kodalith films, plexiglas, fluorescent bulbs, ambient sound. GenConAD and AudioMegaTablet by SkyBoy Productions, Inc.



Telomeres Project On Imminent Immortality
2001, Interactive PHSCologram sculpture, 4 feet x 4 feet x 6 feet

Of Shifting Shadows

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"The origin is not a point. It cannot be defined, explicated, represented. The origin has no fixed coordinates. It is a continuum, a non-delimited space."

Taken from a commentary by The Author, a silent character in "Of Shifting Shadows," these words encapsulate the approach of this interactive hypermedia narrative in its attempt to represent the unrepresentable. Using video, animation, spoken word, text, and archival material (in English and Farsi), this CD-ROM presents the tales, past and present, poetic and abrasive, of three fictional women—Bita, Mina, and Goli—who lived through the 1979 Iranian Revolution and its aftermaths.

Portraying the shifting character of exilic existence, "Of Shifting Shadows" is driven by its content. Hashemi uses hypermedia technologies and artistic practices to intensify expression without overwhelming the senses, to play with form, to amplify dialogue, and to transform experience without the pretense of virtuality. The open-ended narrative unfolds in 48 segments, each layered with smaller narratives that are inhabited by bodies and voices, animated by metaphor and metonymy, and connected through movements that reenact a ritual of remembrance, personalized by each viewer's individual engagement. Although a narration of the Iranian experience, the work enters a universal stage as it embraces broader themes of displacement and alienation that permeate our collective histories of social trauma.

"Of Shifting Shadows" variously takes shape as a political history, a life story, and a poetic reflection through its use of the medium's affinity for the non-linear movements of memory. When the viewer's subjectivity suffuses and connects with the narrative's fragmented spaces in the process of "reading," the work engages the viewer as both witness and accomplice in exploring a highly specific, yet "non-delimited" space.

Visually lyrical, and full in charge of its medium, the interface deliberately uses a conventional interaction methodology that, aptly – and perhaps ironically, seems transparent because it allows the technology to disappear to let content speak for itself, though not by itself. As voices and histories are thus recovered, the work imparts a certain anxiety that characterizes responsibility, expecting the viewer to think and learn, not immerse and indulge. - *Carly Butler*

Programmer, Don Sinclair; director of readings, Philip Shepherd; narrator, Veronica Hurnik; dancer, Roula Said; sound designer, Scott Kennedy; videographers, Alina Martiros, Iraj Rahmani, Goli Moradi; photographer, Mina Rastgoo; art director, Bita Javan; composer, Gary Atkins; on-line editor, David Findlay; producer, Suzie Mukherji. Written, directed and produced by Gita Hashemi.

Of Shifting Shadows
2000, Interactive CD-ROM

A composite showing shots from four narrative segments that exist at the same level and are cross-linked. The four sections of the screen delineate the individual spaces of the characters. The three sets of three arabesque motifs function as navigational tools that allow for linear reading through the characters' stories (the author's segments at the bottom are non-navigable and are triggered by the other characters' stories). Lateral movement is possible by clicking in a different character's space. (left)

Extracted stills from some of the hand movements that mark the beginning of most video segments in Of Shifting Shadows. The choreography incorporates elements from the richly symbolic dances of southwest Asia. This composite also appears on the cover of the CD-ROM. (right)

Texas Moments

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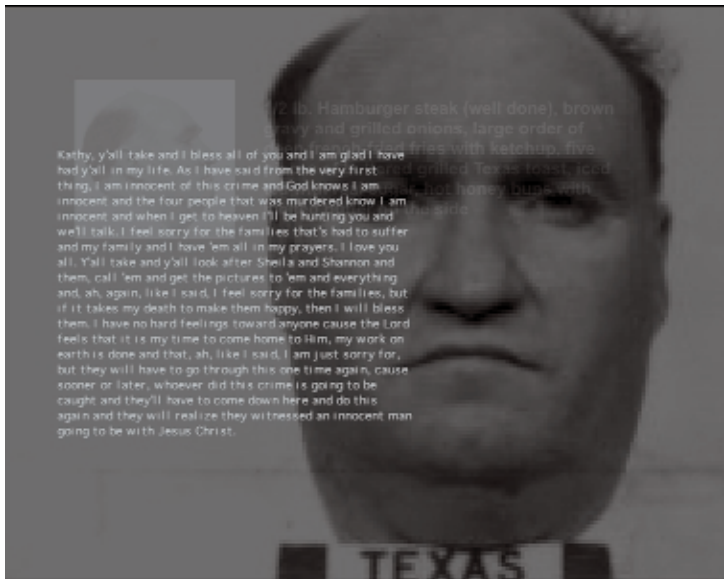
"Texas Moments" is a screen saver whose subjects were all executed by the State of Texas in the year 2000. The whimsical flying toasters we have come to expect from screen savers are instead replaced by 40 Death Row inmates slowly scrolling by, following the contents of their last meals. They cycle, one after the other, in the order in which they were executed. When a user rolls over an inmate's thumbnail image a larger picture of them fades in with their final statement.

"Texas Moments" uses our idle computers' monitors as a platform for social commentary. The piece was first exhibited as part of "Refresh - the Art of the Screen Saver" and has since been updated to include all of the individuals executed this past year.

All images and text were culled from the Texas Department of Criminal Justice Web site. The screensaver is freely available at www.texasmoments.com

Texas Moments
2000, Screen Saver



Texas Moments
2000, Screen Saver

Artificial Paradises

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Within the self-created genre, that of the "physical digital," "Artificial Paradises" is the first total system for cross-media data generation re-working of the computer as a symphonic, balletic environmental system; as a body without organs.

It returns the computer to its true architecture, with systematics made evident and visible rather than divided up according to the needs of capitalist economics; multiple discordant applications and file formats existing in dead time – waiting for automated human input.

Against this we propose the unlimited, the future, and the true artistic use of technological structures.

This system is modular and extendible, approachable from any number of viewpoints which make it difficult to pin down here.

The full modular system is made up of an ever increasing number of salvaged 486 computers and pentium machines (currently 12), analogue sound modules, camera control, video and audio input/output modules, record and tape player modules, and process nodes.

The system premiered in performance with three protaganists at the Interferences festival in Belfort, France in December 2000. The networked nature of the project means that the system is constantly expanding, with new modules being added to its basic architecture. These will include film-transfer modules and additional record player control modules.

Most of the hardware is custom-built and all software on which the system runs is custom coded in C and assembly under the GPL license.

Web site: www.1010.co.uk

Artificial Paradises
2000, Performance

Chaotic Robotic Synesthesia

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Inspired by the theories of Jean Dauven ("Couleurs", No. 77, September, 1970, Paris), and fascinated by synesthesia – the producing of a subjective response normally associated with one sense by stimulation of another sense – we have created an environment in which we can investigate a synesthetic experience. Our performance, "Chaotic Robotic Synesthesia," explores the sharing of the senses; the vibration of music and color through the overall fusing of the minds of machines, artists, and musicians. This performance includes two infrared robots, one programmed platform, seven human musicians, and two human animators. In this performance, the music is propelled by the mixing of the colors and the sharing of the frequencies. The active forging of tactile, aural, and visual perception between humans and in collaboration with technology, asks questions which can yield ways of better understanding, seeing, and hearing natural order.

Chaotic Robotic Synesthesia
2000, Performance, 13 feet x 13 feet

Intuitive Ocusonics

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"Intuitive Ocusonics" is the five-year effort of Andrea Polli (www.andreapolli.com) , an experimental programmer, sound artist, and technologist who takes social implications of new technology to the extreme. She is a neo-concretist, merging and re-framing ideas of concrete art, music, and poetry. "Intuitive Ocusonics" melds visual and aural information through high end data transfer and tracking technology first developed by the US military. "Intuitive Ocusonics" is a continuing experiment into visual and tactile perception, motion, and response.

"Rapid Fire" is an improvisational collaborative sound performance focusing on the exploration and implementation of "Intuitive Ocusonics," a process in which voluntary and involuntary eye movements create a visual and aural landscape. "Rapid Fire" turns the voyeuristic lens back on itself by tracking the observer – a "virtual fire."

Seeing is active. Vision itself cannot occur without finely tuned movements of the eye, taking in patterns of light and color on the retina which the mind must then translate into a coherent world. In all cultures, the eyes are used to convey a wide variety of messages. Currently, technological means of communication often lack the speed to communicate the subtleties of these movements or don't employ them at all. "Intuitive Ocusonics" attempts to return the power of active seeing.

There is a considerable body of research on eye movements. Such movements have two major functions: fixation, to position target objects to the center of vision; and tracking, to keep fixated objects in the center of vision despite movements of the object or the observer. Eye movements can further be divided into three distinct types that can be under voluntary control: convergence, smooth pursuit, and saccades.

Saccadic movements, used primarily in the performance, are rapid jumps of the eye used to shift gaze to a chosen object. Saccadic movements are very fast, typically taking only 30 milliseconds to complete, and reaching speeds of 900 degrees per second. An increase in the speed of saccades can be learned or trained with daily practice, and many researchers indicate that saccades are planned, controllable activities.

Fixation occurs in the intervals between saccades. Intervals between saccades can be as long as several seconds during steady fixation; and in reading, about three times each second. Even when fixating, the eyes continue to move. They tend to drift and flick involuntarily and to oscillate back and forth continuously, although these movements are extremely small. The "Intuitive Ocusonic" system also utilizes these intervals by employing a timed gaze as the manner of interaction.

Are all eye movements voluntary? There is not a clear demarcation between voluntary and involuntary eye movements. It is known that the mechanism for eye movement is different than the mechanism for known voluntary movements of the body, and many steps in the pathways for eye movements are still unknown. When interacting with media, humans blink less, displaying a fixed stare not unlike gazing at an object of love or adoration.

Performers
Hans Fjellestad (www.hansfjellestad.com) has composed for film, video, theater, and dance and has presented his music and video art in the United States, Europe, Japan, Mexico, and Brazil. He is active in the Southern California creative music scene, performing regularly as a solo improviser-pianist, and also as keyboardist with several ensembles.

Improviser-guitarist Damon Holzborn performs regularly with Donkey, Trummerflora, and Lower Left (with keyboardist Hans Fjellestad), and also as guitarist with several ensembles. He is co-creator and designer of zucasa.com, recently named one of the top 25 essential online music resources by The Wire (UK).

Marcelo Radulovich (www.marceloradulovich.com) is a sound/visual artist who has contributed music to independent films and industrial videos, and produced his own solo albums, and other titles for Accretions Records. He takes a multi-instrumental, multi-faceted, and multicultural approach to music.

Nathan Hubbard (www.returntoone.com) is a percussionist who utilizes a wide variety of performing possibilities and influences to create his musical style. He has studied in many areas, including: contemporary classical, jazz, electronic music, and the musical traditions of the Caribbean and South America, West Africa, Eastern Europe, and Indonesia. He is the main composer for RTO, with compositions of solo pieces, chamber ensembles, electronic tape pieces, and large ensemble pieces for orchestras or traditional big bands.

Credits
Interface for the performances designed by Andrea Polli ; eye tracking software: BigEye from STEIM; sound processing software: Opcode's Max and MSP.

Intuitive Ocusonics
2000, Performance

That Brain Wave Chick V

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"Brain Wave Chick V" is a collaborative brain wave concert performance by Mark Applebaum and Paras Kaul. "The Ganglia's All Here," designed by Paras and Bill Vitucci, provides an animated background for the performance. This video incorporates 3D computer graphic animation and video motion graphics created using Alias|Wavefront Maya, Alias|Wavefront Composer, Adobe AfterEffects, and Adobe Photoshop. Roddy Schrock, music composer from Japan, will be technical assistant for the performance.

The neural environment, based on Paras' research in neural audio imaging, is surrealistic and features sound sculptures, designed and played by Mark. These sculptures are the result of research begun by Mark in 1990. Since that time, he has engaged in the design and construction of sound-sculptures, musical instruments intended for their visual, as well as sonic properties. From the research, he has produced the mousetrap, the mini-mouse, the duplex mausphon, the midi-mouse, and six micro-mice, instruments consisting of junk, hardware, and found-objects mounted on electro-acoustic sound boards. The sound-sculptures are played with the hands, chopsticks, combs, plectrums, and a violin bow. Their sounds are acoustic, electro-acoustic (amplified via piezo contact pickups), and electronic (modified by external signal processors).

These instruments have been employed in "formal" compositions (such as "Zero-One," performed by Steven Schick in Darmstadt, Germany, and "Scipio Wakes Up," commissioned by the Paul Dresher Ensemble) as well as improvised works (such as a 1993 collaboration with the Merce Cunningham Dance Company), and the Innova CD Mousetrap Music.

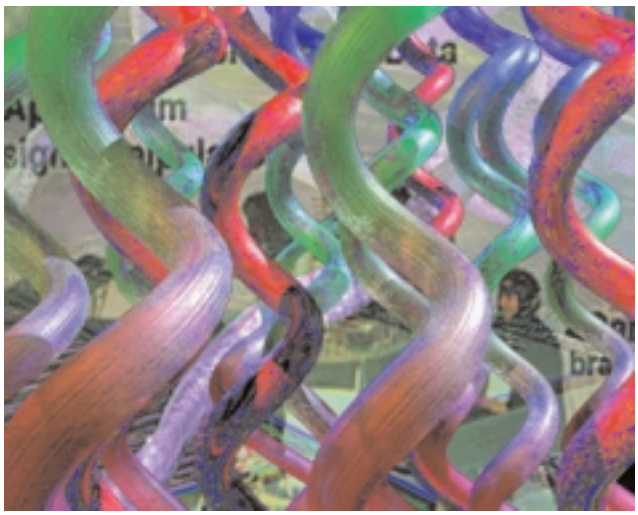
During the performance, the nature of the external signal processing is determined by Paras' brain waves, as interpreted by a MAX digital audio patch described below. Neural data are provided by Paras in real time via a brain wave interface system configured on her computer. Using this interface to the computer, Paras' neural activity is transformed into real time MIDI data and transferred to Mark's computers. The brain wave interface system is IBVA, which utilizes standard EEG monitoring of the neural activity. Amplitudes are converted to MIDI velocities and frequencies are converted to MIDI note numbers.

A MAX software "patch" examines the brain wave (MIDI) activity. Events may be left unchanged, filtered, distorted, transformed, modulated by other events or tendencies, responded to, etc. By choosing what to play and how, the patch circumscribes the audio aesthetic. The patch is "played" by Mark with a continuous MIDI controller, and by Paras through initial neural activity and by her responses to aural articulations. Variable in this collaboration are the activities of the two individuals as well as the patch; these engender results that vary from probable/stochastic to unpredictable/random.

The video projected animation uses symbolism to represent a variety of mental states that are mimicked by Paras' brain wave switching among frequency domains ranging from high beta, low beta, alpha, theta, and delta. A feedback loop exists between the three computer systems, two operated by Mark, and the other by Paras. The result of this process is a continuous play of communication between Mark and Paras.

Mark uses two Macintosh G3 computers. One computer will run the MAX patch that receives and modifies the midi data converted from Paras' IBVA interface. It will trigger Yamaha EX5R, Proteus 2000, Oberheim Matrix-1000, and Kurzweil 1000PX sound modules. The second computer will run the MAX/MSP patch that modifies the signal processing of the sound-sculptures. This includes sound routed through various external processors as well as processing associated within the computer itself (via MSP) and output through a Digidesign 001 interface. External processors include a Lexicon MPX1, Electronix Filter Factory, Yamaha SPX50D, Ibanez DM1000, Korg SDD-2000, DOD D12, BBE422A, Roland VP-70, and Roland RE-301. Data on two computers will be modified by a Peavey 1600X midi controller.

The Animation
The animation provides a moving background for the performance. The frequency of events in the animation, color, and symbology are designed to reflect a variety of mental states. Paras will mimic brain wave states reflected in the animation. During calm sections, her brain wave activity will reflect the low frequencies and low amplitudes of alpha and theta signals. When the animation is chaotic in nature, she will switch brain wave signals to higher beta frequencies and amplitudes. Since the brain wave signaling directly effects the audio, a direct correlation will exist between the audio and visuals.



That Brain Wave Chick V
2001, Performance

VR Keith 2.0

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"VR Keith 2.0" explores the interface between interaction, performance, and avatars. Using comedy, irony, and cheesy quotes from cultural theorists, etc., "VR Keith" interacts with the gallery audience in a direct fashion. "VR Keith" argues how much better virtual and robotic humans are than real ones.

VR Keith 2.0
2000, Free-roving video sculpture, 3 feet x 3.5 feet x 3 feet

The Smoker

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The original concept for this piece was formed on a trip to my hometown near Pittsburgh, in the spring of 2000. I was driving along a highway that followed a very industrialized portion of the Ohio River. My view was dominated by a mass of steel factories and their billowing smokestacks pouring unknown amounts of damaging byproducts into the surrounding environment. I was struck by the random beauty of the smoke against the amber glow of the factories at night. I too, was smoking; a habit that is especially hard to break on long drives. That's when the connection occurred to me: I am no different than these factories. I am a living machine that consumes and creates.

I have combined this point of inspiration with ongoing research I am currently conducting with interactive sculpture and its ability to create "random" byproducts through user interaction.

In my interactive sculpture, "The Smoker," these byproducts possess their own aesthetic. There are random ash piles that build up over time creating a beauty of their own. There are billowing smoke patterns, which the viewer is able to influence through exhaust fan switches on the control and filter boxes. Finally, there are random yellow and brown tar stains, which form in the filter device itself. The filter box has been designed to include removable filters. With enough time, these tar-stained filters could be displayed along with the piece, referencing the tar that coats all smokers' lungs.

Other intentions seemed to emerge during and after the completion of this work. "The Smoker" can be seen as an attempt to show the sublime beauty involved in smoking tobacco, while also acknowledging the damage and evil that is inherent to the act. This sculpture simulates the actions of the lungs during the process of smoking. These ideas are stressed by the sounds of my own breathing and coughing, which can be heard as the pump breathes in and out. The speed of the breathing matches the speed of the pump, which is controlled by the viewer's interaction with another dial on the control box. The heavy mechanical nature of this machine stresses the toxic nature of smoking. The single cigarette at the heart of this machine shows the isolation that is placed upon smokers in today's society but simultaneously points to smokestack industries as polluters that effect the collective lungs of all.

One final goal of this piece was through a closer examination of the act itself for me to quit smoking. Unfortunately, this has not worked out so well. I find myself smoking with the machine as though it was a friend on a smoke break. It has surprised me – that this machine has begun to take on a personality of its own through its ability to mimic a simple human act. In the end, I realize that though there is an intrinsic beauty created by a cigarette's byproducts, the good still does not outweigh the evil.

The Smoker
Interactive sculpture

Proximal Actuator

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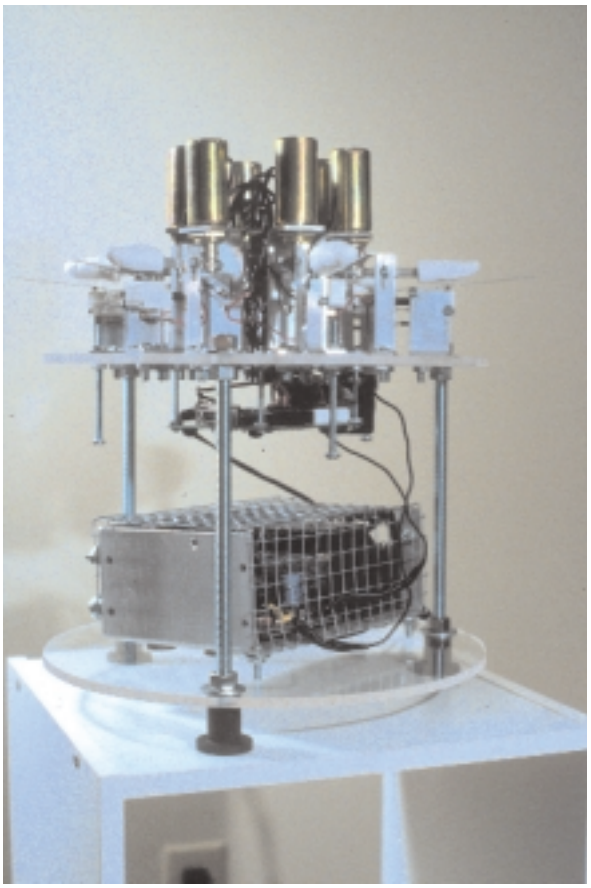
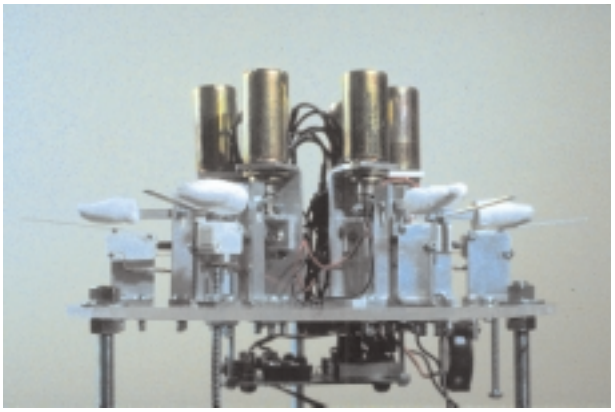
"Proximal Actuator" is a metaphor for modern society's technologically mediated interconnectedness. Our fingers are both actuators and mediators of many forms of communication. In this work, fingers are cast from each member of the artist's family, incorporated into the system, and serve as a metaphor for family connection. While we remain in contact, our connections are not physical but are transmuted by our communication devices. They are detected, digitized, interpreted, compressed, relayed, transmitted, and reconfigured into something that is often less than human and detached from the source.

"Proximal Actuator" is an interactive open system. It requires an input of energy to be active. Here the viewer's fingers set off chain reactions, bringing the piece to life. "Proximal Actuator" falls silent when there is no viewer interaction. This reflects the primary reality of relationships: that they cease without interaction.





Proximal Actuator
2000, Robotic sculpture

Tina Bell Vance

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"Heroine in Peril" is inspired by the Sumerian myth of Innana, who traveled to the underworld to rescue the laws of Sumerian society. Innana died while in the underworld and was resurrected to return to the living world with the laws.

Heroine in Peril
2000, Gallery framed inkjet print on watercolor paper, 16 inches x 20 inches

Lyn Bishop

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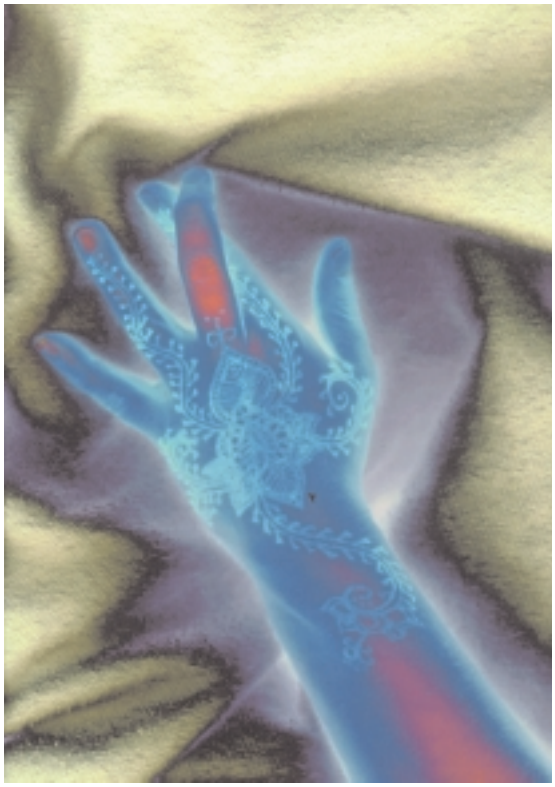
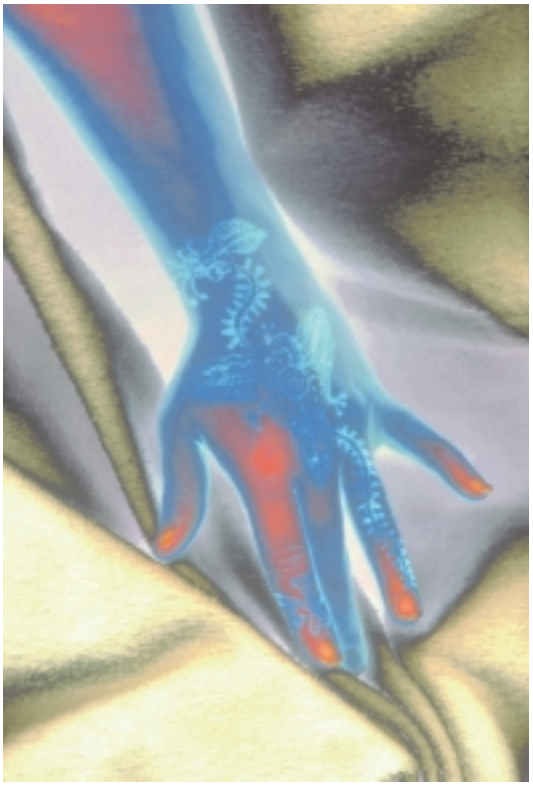
The "Gestures" series represents the balance between opposites. Through the use of the traditional feminine art of body painting, the strong gestural hand motions, and modern technology, this dyptich speaks to the male and the female, the yin and the yang of our own expressions.

"Gestures IV" and "Gestures V" embody a message of hope that each indigenous culture may enter the increasingly homogenized 21st century with its unique cultural blueprint in tact. In the race towards economic and technological advancement and the quest for globalization, we run the risk of sacrificing cultural diversity. These pieces reflect my wish that technology be used as a means to preserve and celebrate cultural diversity rather than destroy it. My art reflects my desire to preserve the gentle balance between honoring cultural traditions, and embracing the future and all that it brings.

In my art, I begin by traveling throughout the world, where I find intrigue in the human cultural elements encountered. The simple, unsophisticated and organic details catch my attention. Each place and culture reveals its beauty to me in its everyday traditions. Capturing the unexpected interplay between color, texture, and imagery is at the heart of my work. By blending art, culture, and technology, I aspire to honor and show reverence for traditional cultures while dancing in step with modern technology.



Gestures IV
2000, Framed and matted digital fine art prints, presented in diptych format, 24 inches x 34 inches



Gestures V
2000, Framed and matted digital fine art prints, presented in diptych format, 24 inches x 34 inches

Gloria DeFilipps Brush

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These images are about the aura of language, the trajectories of words forming and attempting to move toward some syntactic position.

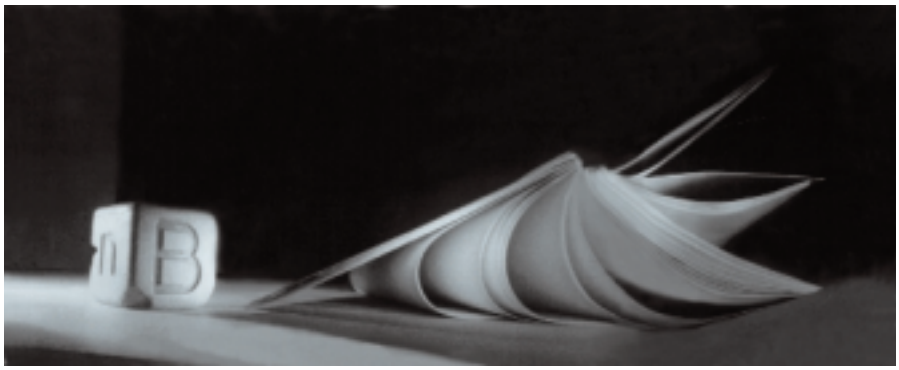
Meaning is devised, relocated, de-created.

Language slips, revealing and reviving, negotiating the soft terrain of ellipsis and substantiation.

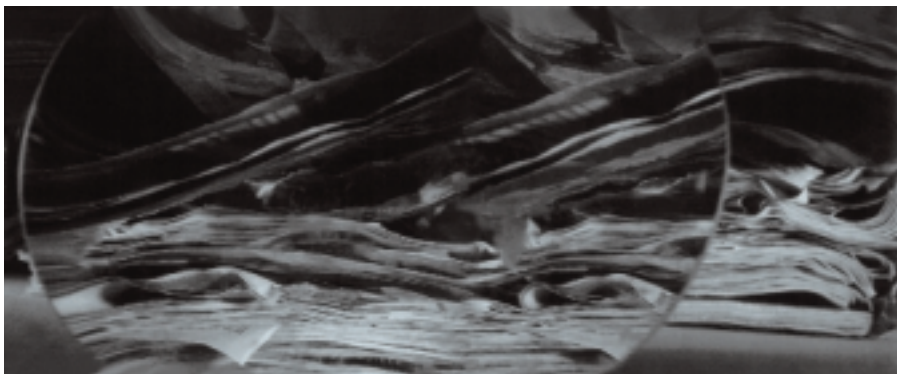
The images in this series have their sources in photographs made with a scale model architectural camera. These sources are computer mediated and published via an archival inkjet printer.

Assistance for this series from the Minnesota State Arts Board and University of Minnesota Grant-in-Aid of Research program, and the University of Minnesota Duluth Visualization and Digital Imaging Laboratory.

7369
1999, Archival inkjet print, 24 inches x 20 inches



7450
1999, Archival inkjet print, 24 inches x 20 inches



7471
1999, Archival inkjet print, 24 inches x 20 inches

Kimberly Burleigh

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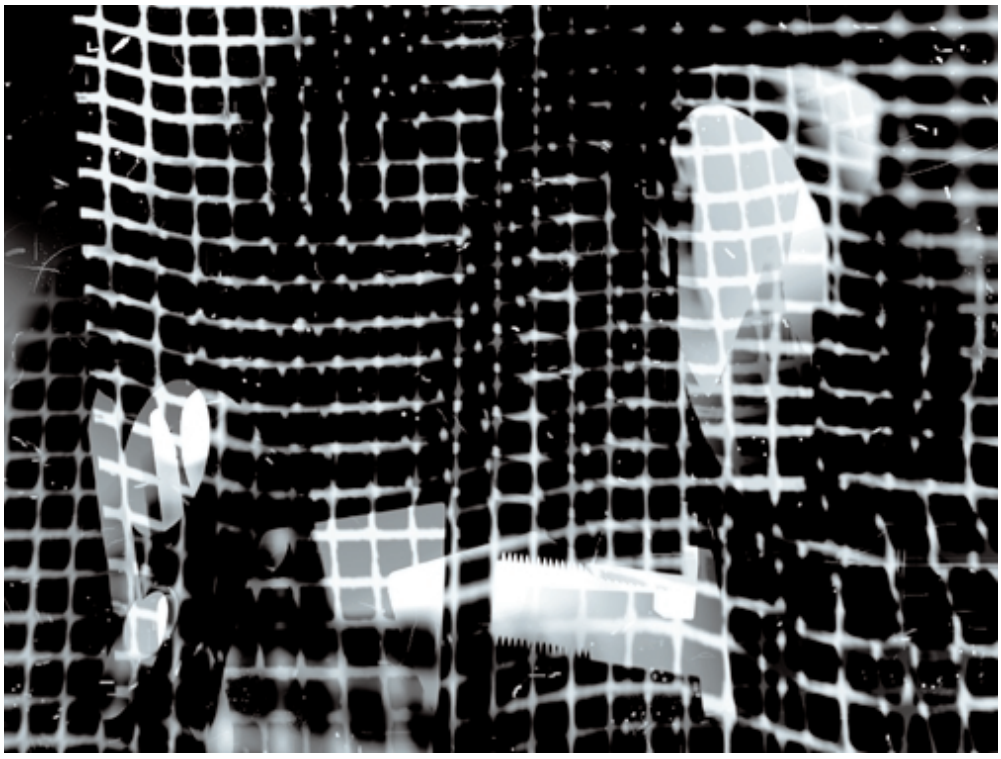
This work utilizes sophisticated technology to emulate an early experimental, low-tech photographic procedure – photograms. Forms derived from terrorist equipment are used in place of the everyday objects used in early photograms. This not only creates more evocative images, it also invites a connection between photograms and X-ray surveillance technology.

These photograms are counterfeit. Real photograms are created through a simple photographic process in which solid or translucent objects are placed over light sensitive paper. The paper is then exposed and processed, resulting in images which look like negative silhouettes and shadows. In making these counterfeit photograms I have devised an integration of this early experimental photographic process and computer graphics. My intent is to produce a plausible reality through artificial means. In Strata Studiopro, a 3D modeling computer program, I construct a digital or virtual model that – if it existed – could produce a real photogram. I create 3D objects, assign properties to these objects (e.g., transparency, reflectivity, etc.), arrange these objects over a surface, and cast lights over the whole arrangement. I then isolate the objects' shadows that fall on the surface and invert the image of this into a negative image using Photoshop. The final image is inkjet printed with Quad Tone Black inks and an Epson printer on archival paper.



Closed Concealments
1999, Quad Tone Black inks and an Epson printer on archival paper, 9 inches x 12 inches

Hans Dehlinger

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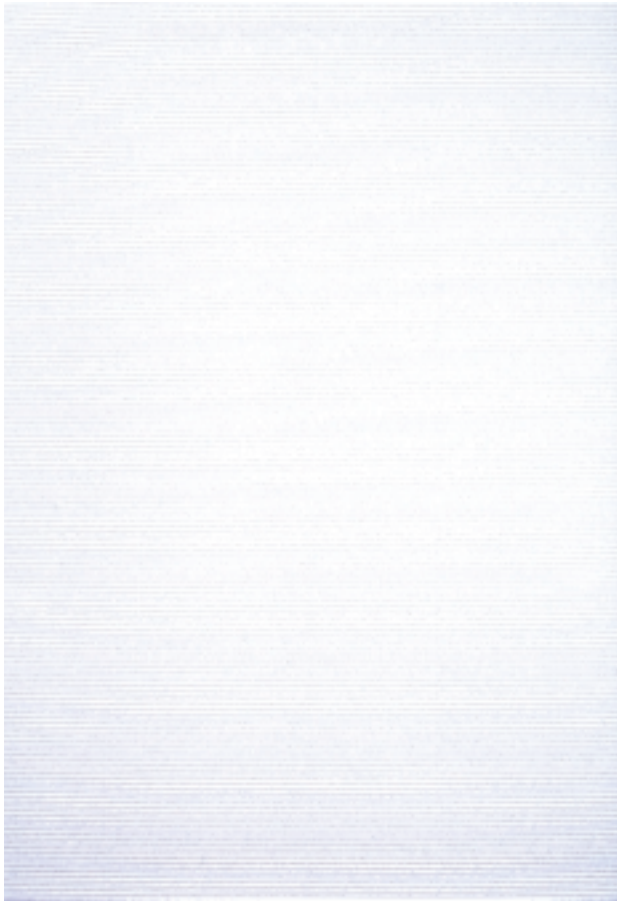
The triptichon is visualizing the 800,000 Kosovo war refugees by representing each one with an individually generated line, consisting of five line-segments. The figure of 800,000 is a conservative estimate, published in the German newspaper *Die Zeit*. The triptichon may be seen as an interpretation of the SIGGRAPH 2001 Art Gallery theme, "N-Space," where the dimension of the space I refer to, is the space of "social consciousness."

It reminds us of the impact of war, as we look into the faces of the affected – individual human beings, suffering and deprived, displaced from their homes and cast into the void.

The "counting table" at large is an open-ended listing, a metaphor for meditating about humanity.



Excerpts from the 1999 War Refugees Counting Table
1999, Plotterdrawing on paper, pencil version.

Detail.

Hans Dehlinger

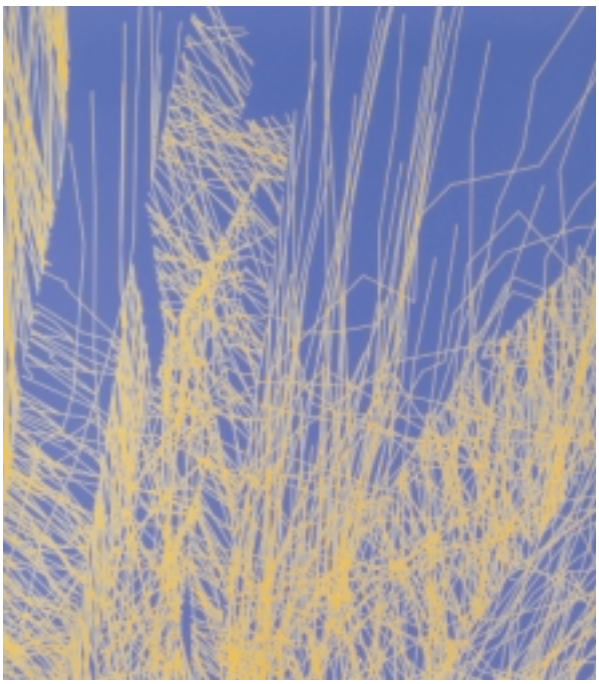
Yellow strokes in blue space. Algorithmic generated drawing. Lines are polygons. The plotterdata are converted to printer-output.

Some remarks on algorithmic generated lines:

Artwork based on line drawings is challenging for a number of reasons. It makes use of one element only – the line – and it relies entirely on its calligraphic qualities. Drawing is more related to writing than to painting, and it has a transient element to it, which is attributed to the movements of the pen-equipped hand.

Besides the heritage of hand drawing, which we conceive as a fantastically rich universe, we may conceive an equally fantastic universe of machine drawings. Line drawings that populate this universe should exhibit qualities in their own right, i.e. they should: exploit algorithmic techniques; be non- reproducible by hand; show that they have been drawn by a machine; achieve a distinct and unique type of structuring; belong to an identifiable universe; exhibit strong calligraphic qualities; and make the question "how was it done?" entirely beside the point. My art experiments focus on drawings, generated by algorithms. The drawings are usually plotted on paper with ink, pencil, and ballpoint pens. The basic line element is a polygon. A number of parameters like length of segment, angle, number of segments, spread, and so on are used to control the development of such lines. Since pen-driven plotters are becoming extinct, new print technologies are used, which also allow for exploring new ways of interpretation.

Earlier versions of the program were running on a Tektronics 4052 and later on a PC. The program in its present form is written in Fortran using GKS and is operable on a Siemens WS 430 workstation. It was implemented as a partnership-project between the North China University of Technology in Beijing (Qi Dongxu, Xu Yingqing) and the University of Kassel (Hans Dehlinger).



Yellow Strokes
2001, Print from plotterdata; paper with UV-shielding

Petra Evers

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This image is based on an explosion of rolling heads and growing sea anemones.

Randomness made a universe, a sense of beauty, and an awareness of time.

This image is created with a 3D software program. Nothing has been scanned, no photography captured from our world has been used. The light and depth of this image are important elements to give this computer-generated work the weight and the vibrating warmth of the classic art forms in an otherwise cold and synthetic media.

Rebirth of the VooDoo Child
2001, Colorscan printing paper

James Faure Walker

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"F-G and the Iron Clocks of Film" was a by-product of some research I was doing at Kingston University for an exhibition last June entitled "Silent Motion." This exhibition juxtaposes Muybridge's photo sequences of the 1880s with present-day digital work. Muybridge came from Kingston, near London, and spent his last years there. Contraptions such as his "zoopraxiscope," or the Friese-Greene camera-projectors in this picture, represent pioneering hardware – some would say extinct media – that hold iconic status for artists working to come to terms with the hybrid forms of digital art. In 1889, William Friese-Greene made a film in Hyde Park; the film was stereoscopic, made of paper, and looks like a Seurat painting. I photographed these cameras in Kingston Museum. Damaged by fire 100 years ago, they were salvaged from an Islington factory and given to the museum in 1974. They also appear reproduced in the 1948 biography by Ray Allister – a pseudonym for Muriel Forth. By the time I photographed the cameras, the reels had been transposed.

F-G and the Iron Clocks of Film
2000, Giclee iris print presented framed in window mount with four inch border, 28 inches x 36 inches

James Faure Walker

I have made several pictures on the theme of indecision. I also find it interesting to work on impulse – digital cameras being so small – in a meditative genre like still-life. "Global Coffee" hints at how the best ideas sometimes flow when you are creatively offline, looking at your coffee cup. The title was prompted by a visit to the Global Cafe, a meeting place for media people near Piccadilly Circus, where I attended a meeting about installing digital pictures as background decor. It didn't work out.

Global Coffee
2000, Giclee iris print presented framed in window mount with four inch border, 26 inches x 36 inches

Michael Field

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Technically speaking, the images I create are realizations of symmetric chaotic dynamics. Although at first sight, "Designer Chaos" seems an unlikely prospect, the reality is that chaotic dynamics often have great statistical regularity. My pictures represent that regularity.

"HellFire III" was created using methods based on random dynamical systems. Characteristically, random dynamical systems often produce images that possess complex textures while deterministic dynamics result in significant edge data and fine detail. For some examples of images constructed using deterministic dynamics, see my Web page (nothung.math.uh.edu/~mike/ag).

Symmetry imposes a unity and harmony on a design. The particular symmetry type used in the design can also have a psychological and physiological impact. "HellFire III" is a two-color repeating pattern: symmetries of the pattern either preserve or reverse colors. The three-dimensionality of the design is characteristic of certain types of two-color design. Different symmetry types can lead to different effects and illusions.

I have developed the programs used to design and color "HellFire III" over the past twelve years, and from time to time, I use the programs as the basis of an Art and Design class at the University of Houston.

HellFire III
2000, Photographic paper, 20 inches x 20 inches

John Fillwalk

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Electronic Arts
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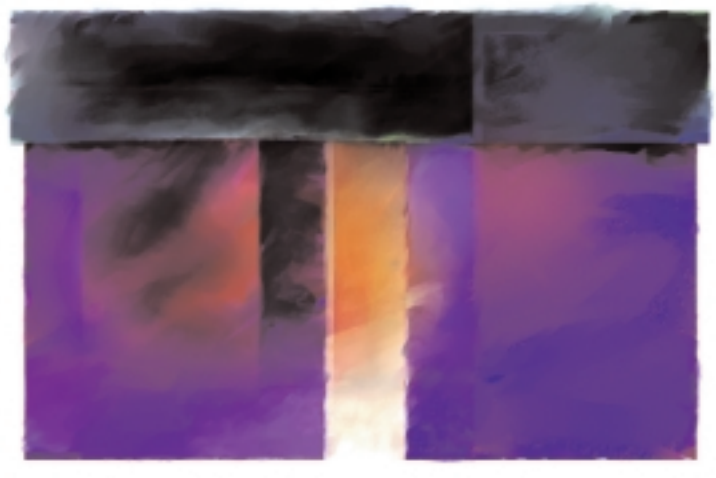
These works are from a series of digital prints entitled "Intercere." I have developed this series entirely in a digital environment from origin to output. They are created using painting, imaging, and proofing software and a graphics tablet. For output, I work in a calibrated Giclée printing process, utilizing archival inks and papers.

Conceptually, I position the work to act as a threshold between physical and implied space, dealing with notions of the potential transformative nature of the image. Approachable, accommodating space becomes increasingly more interior and condensed. Providing the viewer opportunities for re-orientation in the experience of the work has other implications as they activate, discover, and uncover subtleties of the experience.

I find that the ephemeral nature of electronic art can transcend the traditional modes and expectations of art making. The importance of the tangible object becomes more fleeting, placing emphasis on the experience.

Digital work not only extends the range of the traditional fine arts, but also establishes a new palette of time, interaction, and virtuality. The electronic arts by their very nature are inherently dynamic and transformative, creating a context for collaboration and inter-connectivity, not just of technologies, but of traditional studio areas themselves.



Intercere #11
2000, Digital painting; Giclée digital print; archival inks and paper, 24 inches x 30 inches

Intercere #17
2000, Digital painting; Giclée digital print; archival inks and paper, 26 inches x 30 inches

Phillip George

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The "Waterworks" image exhibited in this years SIGGRAPH "N Space" Art show is from a file started in 1990. There have been several descendants of the file previously exhibited at SIGGRAPH art shows. They have taken many forms, including installations, interactive installations, and various types of prints:

"Touch ware" SIGGRAPH 98 Art show, Orlando Florida – work title "Towards the Event Horizon"; "Ongoings" retrospective SIGGRAPH 97 Art show, Los Angeles – work title "Tangent @23"; "The Bridge" SIGGRAPH 96 Art Show, New Orleans – work title "Mnemonicon 4"; "Art Show" SIGGRAPH 95 Los Angeles – work title "Mnemonic Notations" interactive CD-ROM; and SIGGRAPH Art Show McCormick Place, Chicago – work title "Headland Mnemonic Notations."

This ongoing format of file modification has served to frame particular interests of mine pertinent to the time of modifying the file/image: the visual diary.

The "Waterworks" image draws upon a developing interest in the fluidity of memory. And the water-like quality of memory in "Waterworks." The mnemonic detritus washes up towards the top side of the image bobbing around, some detritus rising to the surface and some sinking out of vision and memory. Forming a dam at the top of the image are the roof tops of the Forbidden City, captured from Tiennamin Square New Years Eve 2000, another addition to the diary.

An apparition appears on the rocks of a coastline. The coastline images literally take the idea of the mind's double take. On the rocks, icons appear, washed up either in the distant past or perhaps just for a moment in the present; only just discernible on the rocks leading us to question the reality of what we might see, or in-fact if we have seen; validating the reality of the image surface are questioned.

There are layers of influence and layered ways of perception at work within the image. Notions of the digital as fiction arise, documentation as illusion, illusion as document, and ultimately illusion as history. Is illusion the future of history in a digital age? Or has history always been an illusion?

Other issues surface, from within the work: Australia as a majority coastal society, living on the edge of a vast, hot and largely empty space. The edge of the Australian continent is seen to act like a sponge absorbing the latest arrivals. Flung upon the beach, wave after wave, tide upon tide, visitors find a foothold, collect themselves, leave a marking, and blend into the grains of the coastline, icons and artifacts left embedded into the rock, monuments to a passing.

These pasts push other histories through the coastline mutating past to present. Time as sedimentation is documented and sedimentation of time documented.

This work arrives from out of the south pacific it is work geographically placed at the intersection of land and water in an area of transition. Here the water is navigated with just the same familiarity as land, there a pathways sign posts steams within streams all fluidly interacting. The interface of vision, the multiple methodologies of mapping the world are under investigation here. What is it that we use to reliably negotiate a fluid space?

Waterworks
2000, C Type Color Print, 64 cm x 150 cm

Whitewater
2000, C Type Color Print, 110 cm x 145 cm

Harvey Goldman

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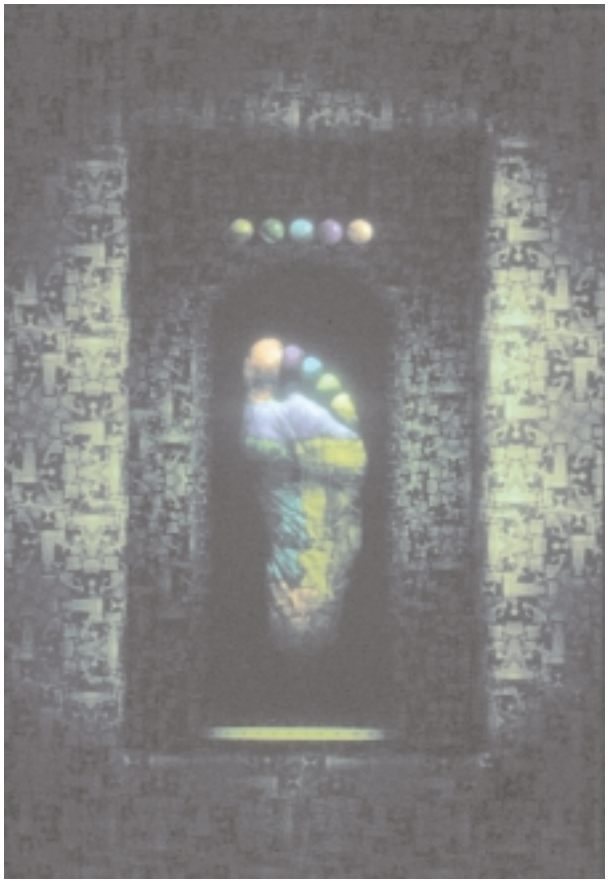
The intention in this series of work is to pay homage to our most primary of tools – the human hand, foot, and head. The delicate and complex anatomy of our collective feet, hands, and heads, and their transcendent efficacy in relation to early tool development and usage, their gestural communicative capacities, and their potency as primal tabulation and measuring devices, gives them a signification that I find fecund with metaphorical meaning and energy. Our rarely examined soles/souls and their evolutionary relationship to the world of high technology are an ongoing source of wonderment and contemplation.

angst in the land of frozen syllables
2000, Iris print, 20 inches x 16 inches

courage
2000, Iris print, 20 inches x 16 inches



one foot
2000, Iris print, 20 inches x 16 inches

Ian Gwilt

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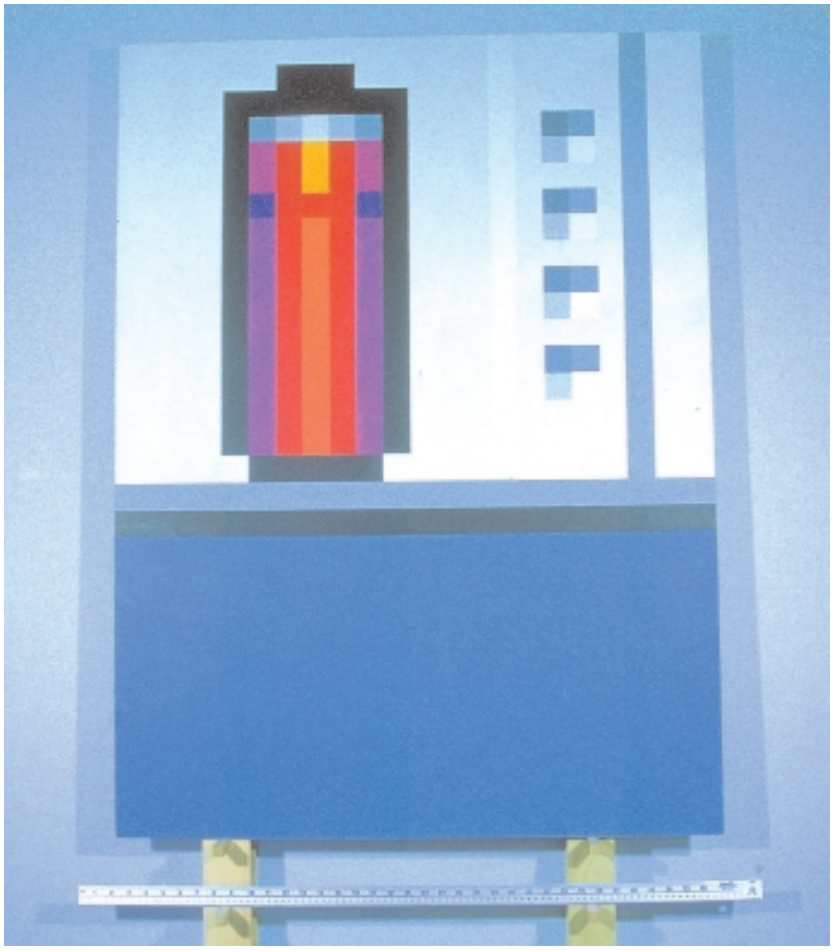
We are increasingly asked to input our time, energies, and ideas into the computer-driven environment. This painting is from a series of works that use details from the ubiquitous computer interface (as a starting point) and reverses the usual "input/output" process (physical to digital) by taking from the digital and creating the physical. Giving a physicality to images that normally exist only "onscreen" we can change context, and challenge the way we look at (or look past) the digital visual environment. Changes in scale, and the textural nature of paint on board, also add to the disenfranchisement of the original images.



Paintings from the Interface: Battery Power
2000, Acrylic, board, and pencil, 90cm x 120cm

Melissa Harshman

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For the last three years I have been exploring ways in which to incorporate digital images into traditional printmaking practices. Thus far I have experimented with serigraphy, Xerox transfer to traditional litho plates, Pronto industrial litho offset plates, and photo positive litho plates. Currently I am using photo negative litho plates to transform my images from digital files to a finished print. The image "A Piece of the Pie" was made in Adobe PhotoShop and then printed in four-color CMYK separations with photo positive litho plates. Additional silkscreen runs were added to complete the work.

A digital portfolio that I was invited to be in, "Pictionary," inspired my current body of work entitled "Word Play", which includes "A Piece of the Pie." The only requirement for inclusion in the portfolio was the image had to contain either a dictionary or encyclopedia image. I especially liked using the dictionary image and started my hunt for old dictionaries at flea markets and antique stores. Each of the prints in "Word Play" began by scanning in an image that appealed to me from an old dictionary. I would then respond and build upon that image. Some of the pieces are completely whimsical while others have underlying political content. All use text in some form. My goal was to create prints that were aesthetically pleasing and conceptually significant, often playing off the meaning of the chosen icon.

A Piece of the Pie
2000, Lithography, serigraphy, 17 1/2 inches x 16 inches

Melissa Harshman

For the last three years I have been exploring ways in which to incorporate digital images into traditional printmaking practices. Thus far I have experimented with serigraphy, Xerox transfer to traditional litho plates, Pronto industrial litho offset plates, and photo positive litho plates. Currently I am using photo negative litho plates to transform my images from digital files to a finished print. The image "Breast Stroke" was made in Adobe PhotoShop and then printed in four- color CMYK separations with photo positive litho plates.

A digital portfolio I was invited to be in, "Pictionary," inspired my current body of work entitled "Word Play," which includes "Breast Stroke." The only requirement for inclusion in the portfolio was the image had to contain either a dictionary or encyclopedia image.

I especially liked using the dictionary image and started my hunt for old dictionaries at flea markets and antique stores. Each of the prints in "Word Play" began by scanning in an image that appealed to me from an old dictionary. I would then respond and build upon that image. Some of the pieces are completely whimsical while others have underlying political content. All use text in some form. My goal was to create prints that were aesthetically pleasing and conceptually significant, often playing off the meaning of the chosen icon.

Breast Stroke
1999, Lithography, 16 inches x 16 inches

David Haxton

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A synthetic space is depicted with ladders that are not confined to the controls of real world gravity

Oculadders, part1
2001, Photographic print of computer image, 38 inches x 48 inches

Jean-Pierre Hébert

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I have always admired calligraphy, sketches, drawings, and etchings, for these works show so clearly the artist's hand and the eye and mind guiding it. I have always liked to draw. But for 20 years, I have also endeavored to use mathematics, personal software, and computer driven devices to conceive and produce drawings of a compelling quality, matching the masterpieces of past tradition.

This work is an exploration of the world of lines; supple watercolor lines building surfaces like threads make fabrics in abstract landscapes, concrete geometries, or minimal scenes. Flexible, innumerable lines, their crafted rhythms organize shapes and shades.

Their accurate arrangement is planned by precise calculations. These calculations are organized by a master plan composed as a framework uniquely describing the piece. A piece results from its conception, from a plan, and made visible by drawing lines. Preliminary sketches and studies are usually necessary before a good size piece can be completed.

The hand is too impatient to render the accuracy and intricacies of the final design. As a weaver needs a loom to manage one's thread, mechanical help is required to guide pens faithfully and save the elegance and details of the work. Thus empowered, the mind can request and perform what hand alone cannot do.

Each piece is unique and rendered with light fast inks or leads on quality, acid-free paper. According to size and complexity, a few hours to a few days are needed to set-in inks the few yards (or the few miles) of lines to create the piece.

Help comes from a mechanical device: the plotter. A computer is needed to drive this plotter. It can also help in the computations mentioned before – as a piece is defined by thousands (or millions) of points – and in composing the computations plan. Only custom software that I write myself is used here. This allows for an intimate dialogue with the computer and insures the complete originality of this work.

Although a computer is involved in the creative process, this work is nothing but a tribute to and a continuation of thousands of years of drawing, geometry, and fine art from all civilizations past. In fact, the computer as a tool fades entirely behind the aesthetic and spiritual concerns that art builds upon.

More recently, I have ventured into new media: from Gicle prints to etchings, from works on wood and steel, to glass and sand. In this diversified approach, the above process remains exactly the same. In fact, the power of the process is a clear invitation to explore new media as new production techniques extend the process reaches, and new means render my conceptual lines in new ways. So I continue creating images by writing software, abstract description of visions that I then translate to the world of objects.

Four Scenes of Mount Tai'
In empathy with Carl Jung's concept of unus mundus, and feeling that numbers are in the same continuum as our minds and souls, I was tempted to try a series following the classical Chinese scholars' fantasies, in my own algorithmic way. I chose the most venerated of the five sacred Chinese mountains – Mount Tai in the Shandong province – as the location of four scenes.

The Primary Lady of Blue Mist was the goddess sharing Mount Tai with the Mountain god, who controlled the life and death of all individuals. Shandong Mountains, a diptych, draws a symbolic map of the whole area. Ascending the South Heavenly Gate was a 6,000 stone steps grueling effort, a preliminary to offering the Feng ritual to heaven.

www.solo.com/

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Von Frantz, M-L. (1974). Number as the basic manifestation of the mind. In *Number and time: Reflections leading toward a unification of depth psychology and physics*. Evanston: Northwestern University Press.

Shandong Mountains
2001, Ink and graphite lead on paper,
4 inches x 23 inches x 31 inches

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Exponential

The images in this series render electron flow paths in a "2D electron gas." They were inspired by the experiments of Mark Topinka, Brian Leroy, and Prof. Robert Westervelt at Harvard University. Eric J. Heller, Professor of Chemistry and Professor of Physics, Harvard University, and Scot Shaw, a graduate student in the Physics Department at Harvard, conducted the theoretical work for the experiments.

A word about the process: each print is an original created by sending a digital file to a LightJet imager, which writes to 50 inches wide photographic paper. The images are then developed through the normal photographic process. The resulting prints have a 60-year archival life under normal lighting conditions. Autumncolor in Worcester, Massachusetts handles print management.

"Exponential" depicts electron flow patterns generated by electrons riding over a bumpy landscape. I have created numerous versions of the same phenomenon; the point being that electron flow is not so much of an object or occurrence to be captured or "photographed," but rather is a fluid medium with which one can paint scenes. Using electron flow becomes analogous to using watercolor, which flows on paper in nature-mimicking ways that are often exploited to good effect. In "Exponential," we may see landscapes or a monstrous bird with feathers. The tendency of nature to mimic herself on many different scales and in many disparate contexts is being highlighted and exploited at the same time. For me, the southwestern motif colors and the gradient sky evoke a sense of universal erosion patterns on landscape; the effect is of the landscape being poured out from the upper right. Together with the bird, this image is primordial, showing the creation of landform and life on the earth, making clear their unity.

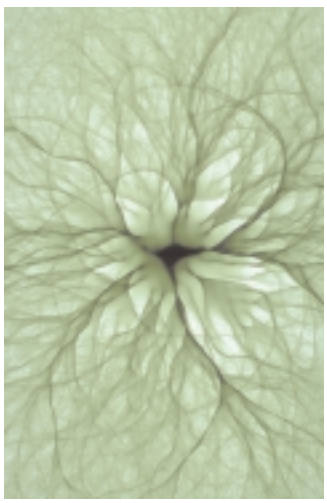
Exponential
2000, LightJet - using Lumniange process printer
on archival color photographic paper, Fuji Crystal Archive
48 inches x 36 inches

Transport II

"Transport II" shows the flow pattern for electrons riding over a bumpy landscape. The bumps are caused by the irregular arrangement of nearby atoms, some of which donated the electrons, and are thus positively charged. The electrons have more than enough energy to ride over the highest bumps in the landscape. The concentrations of electron flow into branches are newly discovered indirect effects of that bumpy ride. The branching seen here was not anticipated; it was thought that the flow would be more evenly spread out some distance from the center. This has significant implications for small electronic devices of the future. This image comes from a numerical simulation which closely approximated what is seen experimentally, using extremely sensitive probes which can sample thousands of data points inside a space as small as a typical bacterium. The whole picture occupies a hundredth of the width of a human hair.

About 60,000 individual electron tracks are shown here. Each track added grayscale density to nearby pixels as it passed by, so the dark areas depict where many electrons went, one at a time. All electrons were launched at the center and were sent in all directions equally. The existence of dark branches rather far from the launch point is surprising, as no valleys or other simple features of the landscape guide the branches. A color map change to green tones and some sharpening and contrast control provide the organic allusions.

This image was used as the cover of the March 8, 2001 *Nature* magazine, in conjunction with publication of the article about the science.



Transport II
2000, LightJet - using Lumniange process
printer on archival color photographic
paper, Fuji Crystal Archive,
50 inches x 36 inches

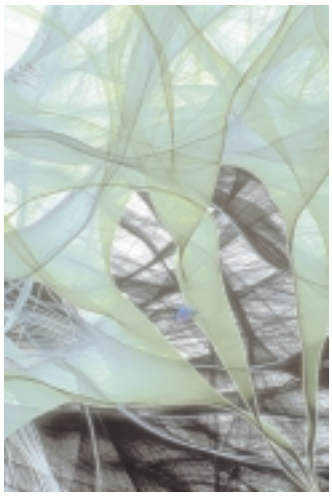
Eric Heller

Transport III

"Transport III," another image in the electron flow series, emphasizes the phenomenon of "caustics," or lines of accumulation where we look edge on. Loosely speaking, caustics are edges, lines along which one object or space ends and another begins. But edges are usually much more. In a drawing, caustics determine where a line should fall, and where it should begin and end. If the object being rendered is a smooth, 3D, light will usually collect or diminish rapidly at an edge, and detail will accumulate there. This is because the caustic of a curved surface is where we look tangent to (i.e. along) the surface. If we imagine the surface as a thin shell of smoky plastic in front of a uniform gray sky, then the caustics will be very dark, because there light must pass through much more material to get through than at a typical place. Whether by training or by instinct, we associate a line in a simple drawing with a caustic in the real world. Even the cave painters 50,000 years ago knew these tricks and rendered some images of animals with subtle use of line to represent caustics.

But caustics are not always found at the obvious places. Caustics are found whenever there is "projection" to lower dimension. When we see something which is really three-dimensional, we automatically are projecting it onto the plane of our retina, using only two dimensions. Nowhere are caustics as beautiful as when looking through a thin folded translucent sheet, such as translucent kelp. One of the caustics we are bound to see is called a "cusp." It happens when a flat part of the kelp develops a fold as we follow up along a blade. At a definite point, we start to see two new edges or caustics arise where before there were none.

Once again, nature has mimicked herself and given us the appearance of an underwater scene even though the medium is the flow of electrons on the micron (one millionth of a meter) scale. The fish was added to emphasize the aquatic allusions.

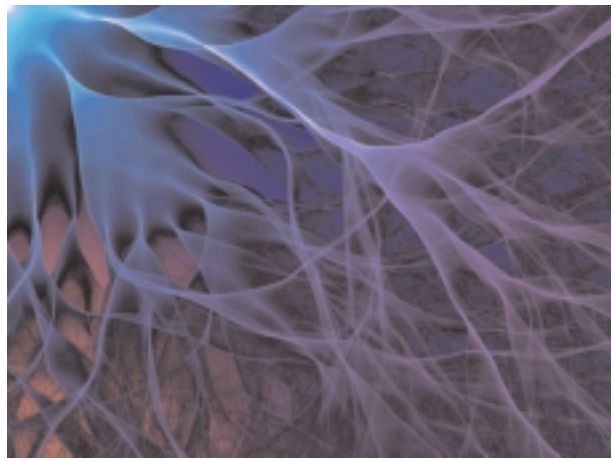


Transport III
2000, LightJet - using Lumniange process printer on archival color photographic paper, Fuji Crystal Archive, 48 inches x 32 inches

Transport VI

"Transport VI" is perhaps the most abstract of the transport series. A grayscale image, made by accumulating tracks of individual electrons, has been color mapped and sharpened, gradient filled, etc. to evoke something beyond the data itself. I see vaguely familiar things, such as pine trees with snow, a red sunset behind.

There is a connection, a feedback from the science to the art and back again. In me, this has happened many times and has led to new scientific discoveries through the attempt to produce art. I want the scene being rendered to evoke emotion and familiarity. The viewer can project this back onto the science behind the image and sense the power and mystery in the world of quantum mechanics and the domain of the atom and the electron.



Transport VI
2000, LightJet - using Lumniange process printer on archival color photographic paper, Fuji Crystal Archive
25 5/16 inches x 32 3/16 inches

Paul Hertz

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Two ideas underpin the work I have done over the last 20 years: the simultaneous composition of visual and sound events, and the participation of other people in my creative process. In my pre-cyber days, I worked with theatrical performers and musicians. Now computers and networks let me control streams of sounds and images, and involve other people in the process of creating art. Not so long ago, I found a third concern: the rupture of purely formal art by elements that expose cultural conflicts. Some of my early computer work focused directly on issues of censorship and colonialism. In my "Deadpan" series of 1996-97, I began to bring this socially critical impulse into the formal realm of my earlier work by developing compositional techniques that turn abstract elements into frames for representational or symbolic elements. Considering that the geometric tiling patterns I use in many of my compositions originated as abstracted frames (a rectangular hole inside a rectangle), this seems oddly appropriate.

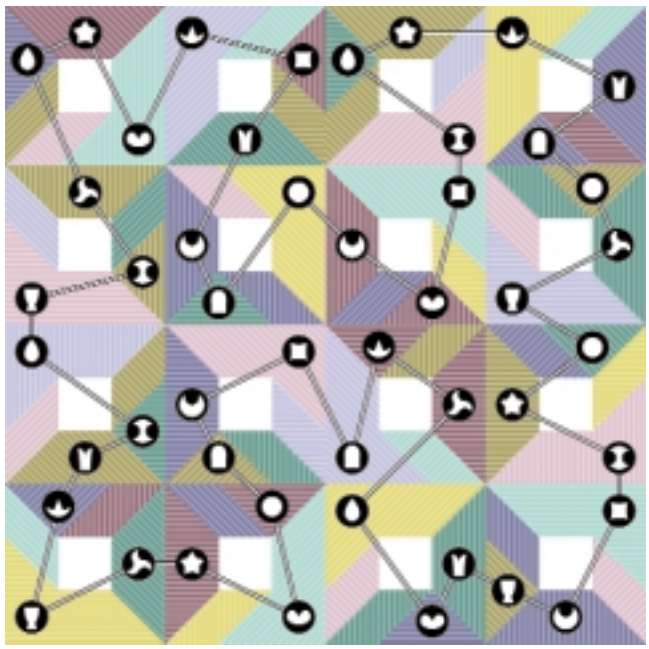
The work which I am presenting in SIGGRAPH 2001, "Time Cycle," is based on the geometric tiling patterns which I have been working on for many years. It presents one of the basic "pattern modules" which make up my larger compositions. I call these modules "ignosquares." Each ignosquare is a 4 x 4 array of rectangular tiles, where each tile is composed of five different geometric shapes in four different configurations. The same configuration is never repeated in any row, column, or quadrant of the module.

Early on, I invented various games with cards that allowed other people to generate "ignosquares" and receive something in return – for example, a fortune told by a dysfunctional mage, or the opportunity to post their opinions to a graffiti board. The "ignosquares" would be incorporated into my paintings. Later I developed a suite of computer applications for producing large graphical compositions from "ignosquares." The latest applications implement elements of artificial life programming. Rectangular arrays of many modules such as the one used for "Time Cycle" combine into larger compositions, with rules for coloration and creation of new shapes by merging polygons. New forms emerge as a result of this generative process. The properties of the new forms can then be used to determine the fitness of modules to survive or reproduce.

The tiling patterns and the isomorphic graphs that can be derived from them have also emerged as a compositional system for producing visual and auditory art from a common set of structures – an "intermedia art," to use Dick Higgins's term. "Time Cycle," shows how coloration and texture rules can affect a single module, and shows part of the derived graph for the module. "Time Cycle" was used as the basis for a lecture I delivered at the Intersens conference in Marseille, France, in November 2000, and will be used again as the basis for a different presentation in a panel on "Digital Intermedia Art" at SIGGRAPH 2001. At Intersens, the four colors used in the composition corresponded to four different topics, and the graph traced the order in which I skipped from topic to topic, shuffling topics together in a way in which I hoped would allow ideas to rub up against one another and produce some interesting frictions. A hypertext version online provides more complex navigational possibilities.

The icons used in "Time Cycle" represent yet another layer of composition within the modules. There are twelve different icons. In the parametric spaces I use for musical compositions derived from the "ignosquares"; these correspond to the twelve tones of Western avant-garde music. Here they potentially represent different aspects of society – commerce, war, crime, education, etc. Or maybe they don't mean anything at all. In many respects, my work is less about a concrete suite of symbolic functions than it is about the impulse to create symbolic systems (polymorphous, dense, and overdetermined) as a fundamental aspect of being human.

Documentation of my compositional techniques can be found on my Web site: www.northwestern.edu/people/paul-hertz/



Time Cycle
2001, Somerset velvet paper, 36 inches x 42 inches

Kenneth A. Huff

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Included in all of my work is a level of detail which mimics that found in the natural world and creates an illusion of reality even while the viewer is confronted with the practical knowledge that the objects shown physically do not exist.

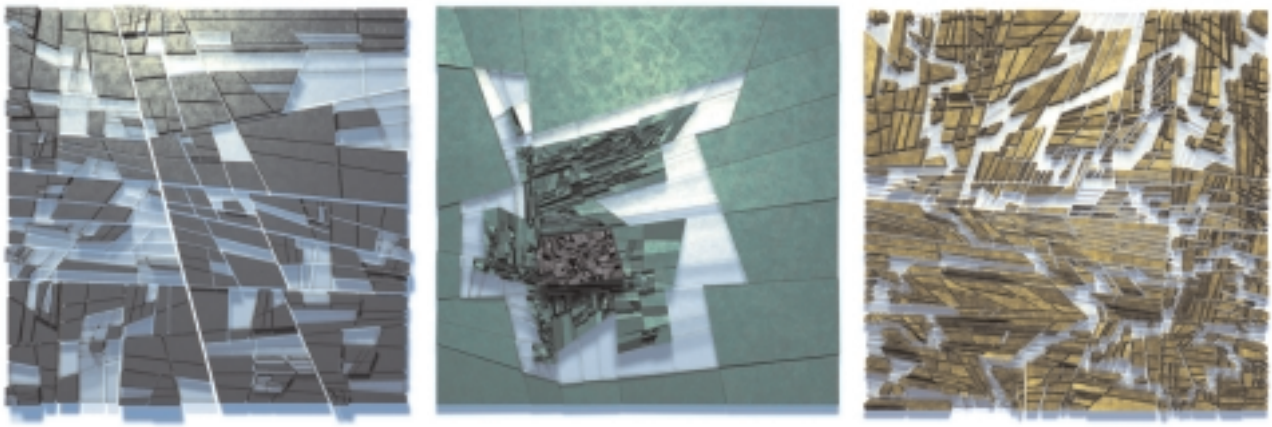
I not only look to the surface details of the physical world, but also to the forms and patterns which surround us. Patterns are not just sets of regularly repeating identical units, but also include groupings of units which are similar, but not necessarily identical and units which repeat, but not necessarily with a well-defined symmetry.

The "Six-Part Pattern Series" is based on ideas of subdivision of space. A large object is divided into six sections by one vertical and two horizontal breaks. Resulting objects are then divided by the same technique, recursively to a predetermined limit. The pattern of division is rotated 90 degrees for each horizontally or vertically adjacent section. The series was partially inspired by aerial views of agricultural land in the North Central Plains of the United States.

In "2000.3," the division process was taken to three levels throughout this image. Once at that third level, one section from each group of six was further divided a fourth time. In addition to the structural patterns, there is an order to the use of the solid and transparent materials. At each level of division, one section from each group was switched to the alternate material for the group.

At the second level of division in "2000.5," the outer perimeter of objects was removed from subsequent division processes. Surface depths and materials were varied at each level to further highlight the differences.

"2000.6" contains a non-overlapping path of adjoining sections created by the use of the transparent material. The endpoints of the path are in the upper-left and upper-right corners. In this image, the division process was repeated five times.

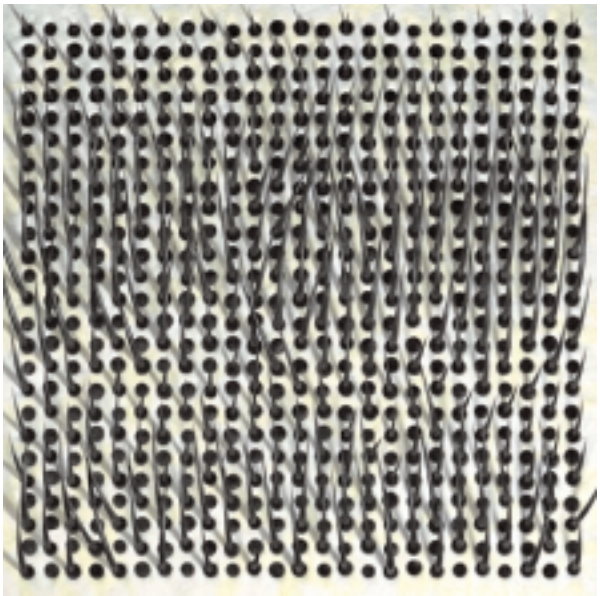


Six-Part Pattern Series: 2000.3; 2000.5; 2000.6;
2000, Laser-exposed color photographic print paper, each panel 34 inches x 34 inches

Kenneth A. Huff

Inspired by the random, yet structured beauty and minute details of nature (flora, fauna, and mineral), it is common for my images to include many objects which are similar in form, yet always unique in their structural and surface details. Contrasts also are an important part of my work. For example, organic forms are often implemented using inorganic materials or the rigid structure of a grid may be contrasted with chaotic elements.

In "2000.12a" and "2000.12b," inversions are used to create much of the contrast. These inversions go well beyond the obvious use of color within each image and between the pair of images. The pointed objects come out of alternate sets of holes and point in opposite directions. Also, the length of the objects is inverted – where the objects are long in one image, they are short in the other.



2000.12a and 2000.12b
Laser-exposed color photographic print paper, each panel 34 inches x 34 inches

Yelena Ilkanayev

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"chelovechki-01" ("little people") – a surreal representation of human emotions, thoughts, feelings. It is a fantasyland of our unconscious.

chelovechki-01
2000, Digital print in canvas, framed and mounted under plexiglass, 43 inches x 25 inches

Robert J. Krawczyk

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Algorithmic generators and transformations are used to develop a series of designs that at one time elicit images of a far-off future, while at the same time remind me of past ritual icons and patterns. The starting linear and resulting curving forms remind me of the past as the lack of color and the sharp edges envision one possible future.

The series of images included are part of a larger series investigating the formation of 2D designs leading to 3D architectural forms using basic mathematical concepts. This series is based on a mathematical figure called a "spirolateral." These images are based on "spirolaterals" that are curved by antiMercator, circular, and inversion transformations.

My interest is to investigate methods that can develop forms which are in one sense predictable, but have the element to generate the unexpected: the unexpected in a predictable way. The custom software becomes the instructions for producing the work itself. My primary focus is to develop methods and instructions and leave the production to the computer. This approach allows variations to be investigated in a repeatable way, thus enabling me to fine tune an idea by repetition. An interesting aspect of this method is that variations may be discovered by others which I have never seen. An interactive version of this series is located at www.netcom.com/~bitart

It is important to me not to hide the technology and the mathematical basis on which this piece is based. There is a natural beauty that should be seen, one that does not require color or context. I believe that they are powerful enough to stand on their own.

Curving Spirolaterals
2001, Laserjet print, 4 inches x 4 inches

Jessica Maloney

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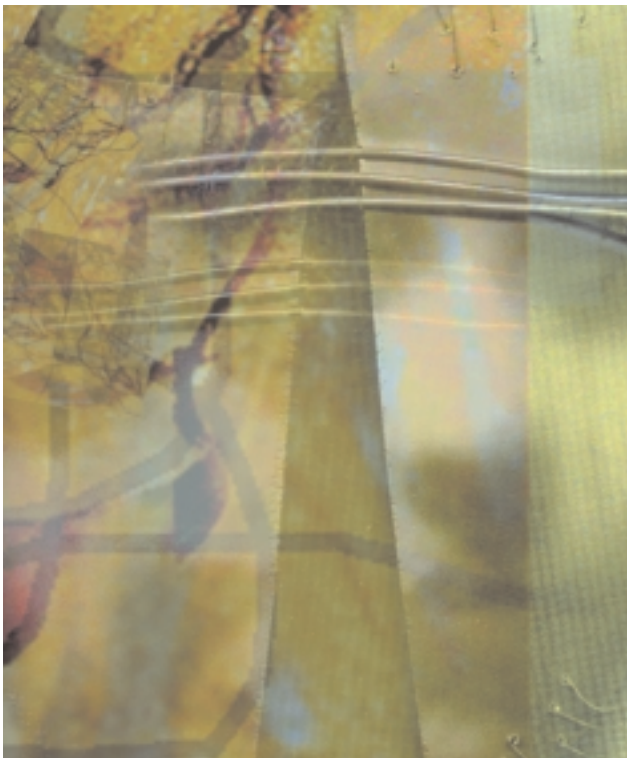
We all sometimes feel overwhelmed by the various aspects of our lives. It is only natural to, at some point in time, start to wonder where we really belong. This piece speaks of the various layers that make up our existence. Social, moral, spiritual, and emotional layers, along with many others, combine to form who we are.

Connecting with the outside world is essential in life. The wires shown in the image are going in and out of the mind. These wires are carriers of energy and information. We are constantly taking outside experiences and bringing them in, building more layers.

It becomes hard to make sense of all the information because the layers become so meshed and intertwined. Although it is often difficult to see past the mass of layers, we must try. We may not know where we belong at the moment and what it is that we are meant to do, but we should never give up hope. When one takes a step back and looks at the overall picture (in other words: life), one can see that there is an undeniable consistency and overall beauty throughout.

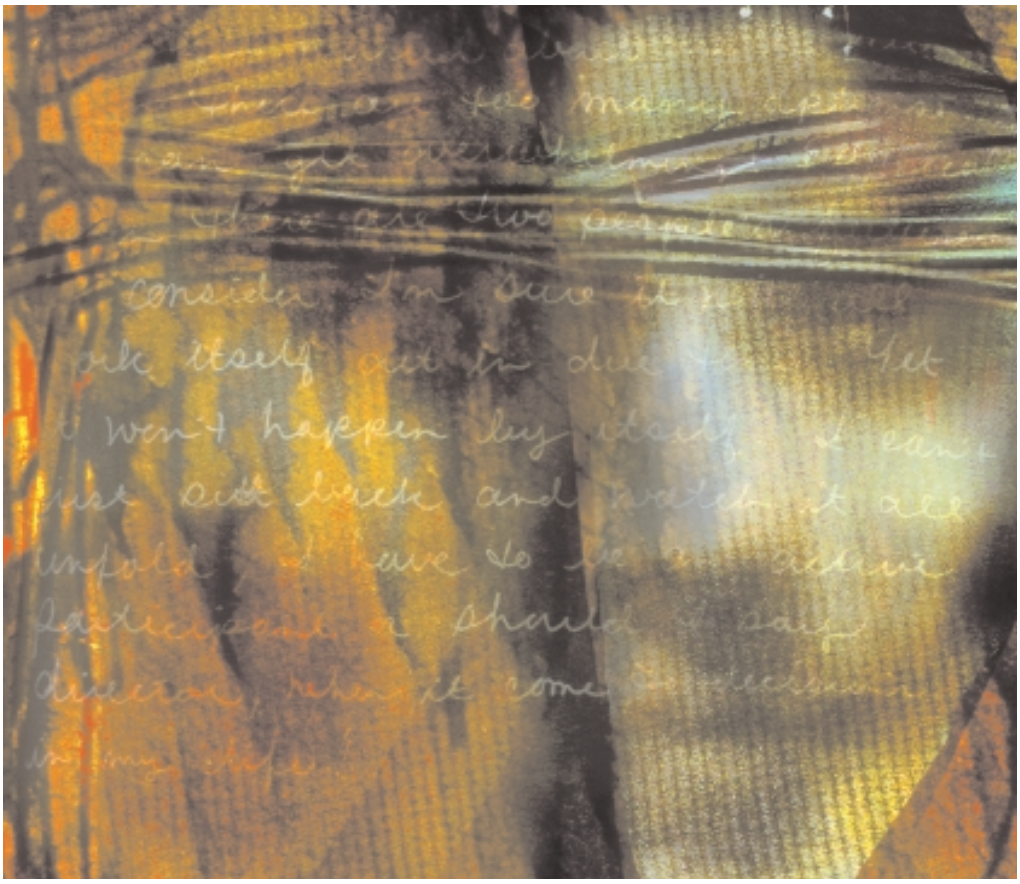


Disoriented but not Confused
2000, Iris Print, 17.5 inches x 15 inches

Jessica Maloney

We all have hopes and dreams that at times may seem far away and distant. The irony of this is that our hopes and dreams lie within us; coexisting with the potential to fulfill them. We are constantly in search of who we really are and what we really want in life. Yet it is all too easy to get caught up in the image that others build up for us. In order to find our true selves we must shed outside constraints and look deeper inside. There we will find the pure energy and desire needed to move us forward. While chasing our own dreams may appear to be selfish, in fact it is just the opposite. Living up to our full potential will allow us to give to the world the gifts we, as individuals, were meant to give, instead of the gifts others think we should have.

The deep warm hues throughout the piece speak of energy and passion. The face represents the self, mainly the inner or spiritual realm. Wires run across the top of the piece because they are known to transport information and energy. This transfer of information is necessary, especially the transfer between the conscious and subconscious levels of our being. Our desires and thoughts are abstract but as the words show, with much searching can become more concrete and possible. The words are also a way to transfer inner thoughts to the outside world. Overall, the texture of the piece ties everything together, in that it shows that the process of self-discovery and self-fulfillment is never a smooth one. It is instead filled with a fine grain combined with both a coarse line and jagged edge.



Undefined
2001, Iris print, 23 inches x 25 inches

Jessica Maloney

The key is often a mystical symbol sometimes referring to the unconscious world. It has been known to represent discovery, possibilities, and answers. The image I created depicts several keys all attached to separate wires. The largest key (in the foreground) focuses our attention on the detailed glass structure of the key itself. Many keys mean many possibilities. In life there are various paths that present themselves to us. The question is which one should we choose to follow, or should we even follow a beaten path at all? When keys are held out before us there are a number of questions that arise. Who is holding the key? Is it out of reach? Which one do you take and how do you grasp it? It is necessary to ask these questions because as opportunities present themselves we must be aware of the sacrifices that are attached to them. Wires are attached to the keys because in a way, although keys can be the link to freedom and happiness, they can also have other meanings. The wires represent restrictions. As we make decisions in life we have to make sure that we are being true to ourselves. It is often tempting to follow in another's footsteps or take someone else's advice. We must choose the key that is engrained within ourselves, not one that is attached to the ideals of others.

Ask Yourself
2000, Iris print, 27 inches x 23 inches

Leslie Nobler-Farber

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This artwork involves personal exploration via digital imaging, manually reworked, using paint, pastel, and other media. Through both the use of mixed media (actual/by hand and virtual) and the content, the work deals with the interplay between realism and abstraction. I try to synthesize a connection, akin to a gateway or portal, between the two. This intent partially explains the key imagery, along with the use of layered collage, and tangible – and virtual – textures.

The abstracted tactile shapes are collaged with photorealistic and shadowy keys, much like the multiple levels occupying our thoughts simultaneously; the brain processes reality but also imaginary, abstract, or subconscious thoughts. Metaphorically, the key expresses various psychological states. One refers to locking or closing doors, i.e. "saying goodbye" to phases of one's life. In another, the key signifies protection, keeping oneself safe. While one might be aware of her secured space, on a less rational level, a woman once threatened may still feel unsafe and subconsciously recognize that a lock does not provide safety in domestic abuse cases. The imagery also speaks of opening up and revealing new chapters in life. It alludes to the mystery of unlocking a door and finding what awaits – to anticipation and future potential. The keys take on an otherworldly, object-like presence, yet also reflect the wearing away of time (and emotions) of the natural world.

Surfaces of grid-based patterns define 2D abstractions; the space is flat until a photographic/*real* key interrupts it, creating spatial ambiguity. This work builds curiosity about space and texture. The keys' environs are haptical and tactile, suggesting touch, in this changing world of *virtual* interactions between art and viewer. My use of patterns and talisman-like objects tie my work to a rich heritage of handmade art, while adding a sense of "contact" to digital output.

In "Don't Say Goodbye: Variation 1" the keys virtually displace patterned, abstract planes. The resulting digital output is physically attached to purposely "deteriorated" printouts gone amuck. Here I juxtapose output on canvas specially coated for inkjet technology with standard canvas. The backgrounds, printed on untreated canvas where the inks smear and run, result in wonderful disasters when water is introduced – which I further embellish by hand. Since the triptych deals with "closing doors," the canvas is layered upon wooden forms with the approximate depth of a door, bringing the work into our 3D space.

"Used Chambers" is a monoprint on fibrous handmade paper which I (not a factory) pretreated, rendering softer, less distinct output. The print is enhanced by overdrawing, as I focus on the hand-applied media's interaction with the printout's formal elements and surface texture. Just as the artwork is multi-layered, the title has levels of meaning. It refers to private spaces within one's mind and heart that feel used up, but that must regenerate in order to go on. It has real world significance in that the key unlocks an old armoire, discarded by unknown families, then kept, as the *door closed* on a marriage, to provide space for the children's new belongings, new chapters. The *chambers* are at once closed, yet still growing, compartments of a life or a weary heart.

In these works, the interplay between the *concrete*, either photorealistically rendered or handmade, and the *virtual* (or abstract) creates an important dynamic, on both a formal and conceptual level. In this vein, the objects/forms must suggest recognizable ideas and touch those who look at and explore it. My work combines the human hand/touch and emotion with the power of 21st century technological systems, hoping to provide greater depth of meaning to the viewer.

Don't Say Goodbye (Variation 1)
2000, mixed media piece on three separate canvas panels, digital prints on canvas, acrylic paint, pastel, and wooden box-like supports, each panel 9 inches x 12 inches

Used Chambers
2001, Digital print onto textural handmade paper enhanced by pencil, pastel and ink, 9.5 inches x 8 inches

Kent Oberheu

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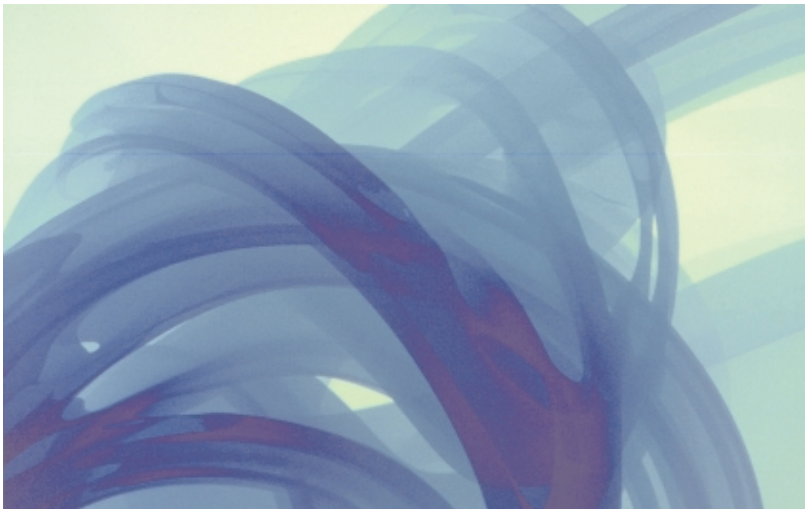
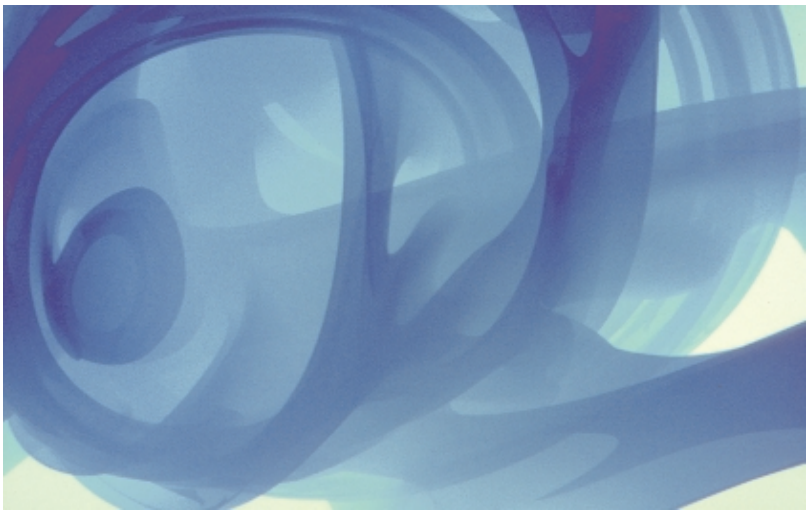
"Detail 1" illustrates a sweeping 3D fractal rendered not by light but through transparency and depth.

"Detail 2" shows the arc of the fractals travelling off into distance, revealing the subtlety of form inherent in the mathematical object.



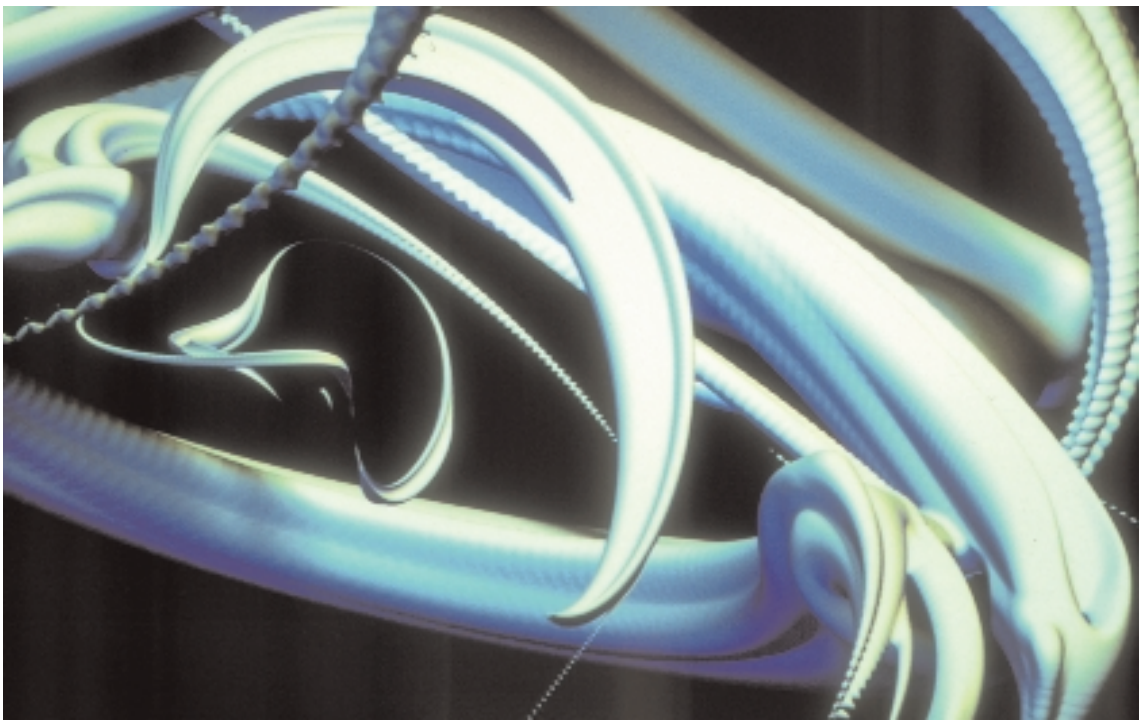
Blue Suspension, Detail 1
1998, Framed Giclee Iris print on watercolor paper, 12 inches x 8 inches



Blue Suspension, Detail 2
1998, Framed Giclee Iris print on watercolor paper, 12 inches x 8 inches

Kent Oberheu

This detail illustrates a morphological study as a progression of form sweeping through space, taking on a new shape as it traverses the fourth dimension of time.



Tentacular Continuum, Detail 3
1998, Framed Giclee Iris print on watercolor pape, 12 inches x 8 inches

Michael O'Rourke

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This image and the others in its series deal with the passage of time, mortality, sex, sexual energy, vulnerability, power, the energies of being alive, and the passing of those energies. Many of these issues, considered in combination, feel incompatible to us, yet all of them co-exist simultaneously in us. How is it that we can be moving towards our death, and at the same time be so alive? How can we reconcile our power and our vulnerability?

The image has no clear edge, no clear boundary. Its elements spill over beyond the standard rectangle of traditional pictorial space and stray into the empty white space of the paper. Where does the image end and the non-image begin?

The composition combines normally disparate types of imagery – photographic/hand-drawn, representational/abstract, realistic/iconic. The fusion of traditionally unrelated, even antithetical, imagery into a coherent whole raises questions about image-making itself and about our process of categorization.

In the same vein, the images in this series reference other imagery from the history of human image-making. How do we use the imagery of earlier cultures? How do the images I create become part of the language of my cultural successors? The electronic age assures that we can no longer draw from only one pictorial tradition. Our imagery, across the planet and across time, is shared. The styles intermingle; the vocabularies, the icons, the meanings intermix.

The central element of Forehead is a close-up photograph of the artist's face. This photograph was taken using a scanner as a digital camera, holding the scanner up close to the face. Because the technology of scanners is not designed for this purpose, the resulting image de-focuses and distorts beyond a few inches from the scanner surface. This produces an image that has an intimacy that is almost confrontational, as when a stranger stands too close to you in conversation.

Intermingled with this central image are several overlapping scanned graphite drawings of images and objects from our cultural past and present – a hand-drawn rendering of Ingres' famous painting, "Turkish Bather"; a hand-drawn sketch of a figure from a contemporary soft-porn magazine; a sketch of a ceremonial mask from central Africa; an abstract squiggle of lines. At top-left is a mechanically precise sequence of rectangles, like the dashes of light seen on the face of an electronic device.

The image is printed in a limited edition of 30 with the Iris printing technology, using archival papers and inks.

Steven Ramsey

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All art is about pursuing a personal vision, however epic or individual the scope of that vision may be. How the artwork is done should really be secondary to the success of the work. That being said, every artist asks him or herself what unique qualities the media (digital or otherwise) can do for me that facilitates the vision or content without allowing technique or technology to become the major focus. Keeping this balance of content and technique in mind, I try to develop images that create an interest in my subject beyond the interest in the technology involved, while still retaining the artistry derived from working digitally.

Gatorman
2000, Photograph, 20 inches x 20 inches

Octoboy
2000, Photograph, 20 inches x 20 inches

KnobHead
2001, Photograph, 20 inches x 20 inches

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Once our bodies are no longer here, we leave in our wake a trail of artifacts and places that we have shaped, constructed, designed. I am particularly interested in the power of places and artifacts to tell the stories of people who may have passed through. I am not documenting real people; rather I am intrigued by the suggestions triggered by the artifacts I have found and the places I have visited...an invitation to the imagination to fill in the missing pieces. Although the series was initially inspired by my travel through ghost town ruins, my current "research" takes place in basements and attics, where I perform "archaeological digs."

These works also explore memory and the passage of time. Peeling wallpaper, which appears throughout, is a metaphor for digging back through layers of time and memory. The peeling wallpaper in these images reveals an underlying layer of newspaper, typically used for insulation 100 years ago, the headlines of last century still readable. My working process also bears reference to the peeling wallpaper – the collographs layered underneath the digital prints emulate time-beaten walls.

In order to achieve a built-up surface in my digital work, I mix the illusory textures of the digital inkjet prints with the tactile qualities of printmaking, drawing, and collage. Initially, I use Photoshop to rework, collage, and transform my photographs, drawings, paintings, and prints. The digital image is printed on top of a heavily embossed collograph print or collage of torn paper. This process is sometimes followed by further overprinting with additional digital print processes, i.e. digital lithographs or digital serigraphs. The final layer is created with direct drawing – pastel, charcoal, and graphite. I enjoy the mixing of new and old processes, for the physical and conceptual qualities of old and new, future and past.

The "Ghost Town Artifacts" series is constructed in layers within the 3D space of a deep wooden box with hinged glass lid and padlock. In these works the artifacts are preserved, perhaps along with the memories they evoke.

Ghost Town Artifacts: The Keys
1999, Inkjet print, collographs, charcoal, pastel constructed in a cherry wood box with hinged lid and padlock, 17 inches x 14 inches x 4 inches

If These Walls Could Talk: Bubby's Story
1998, Iris print on collograph

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This life-size image is from a series of synthetic architectural interior spaces entitled "Intersections." Space is as much a virtual or psychological construction as it is a physical reality. The use of computer technology is used to heighten the psychological read of the space while the spaces are charged with artifacts from everyday experience, traditional structures, a shadow, a drawer. These items are arranged in a way to suggest possible narratives, which the viewer will project into the space using their own memories. This process of the projection of our narratives into a virtual space leads to a sense of dislocation and the uncanny.

Intersections
2000, 3D modeled still, 6 feet x 8 feet

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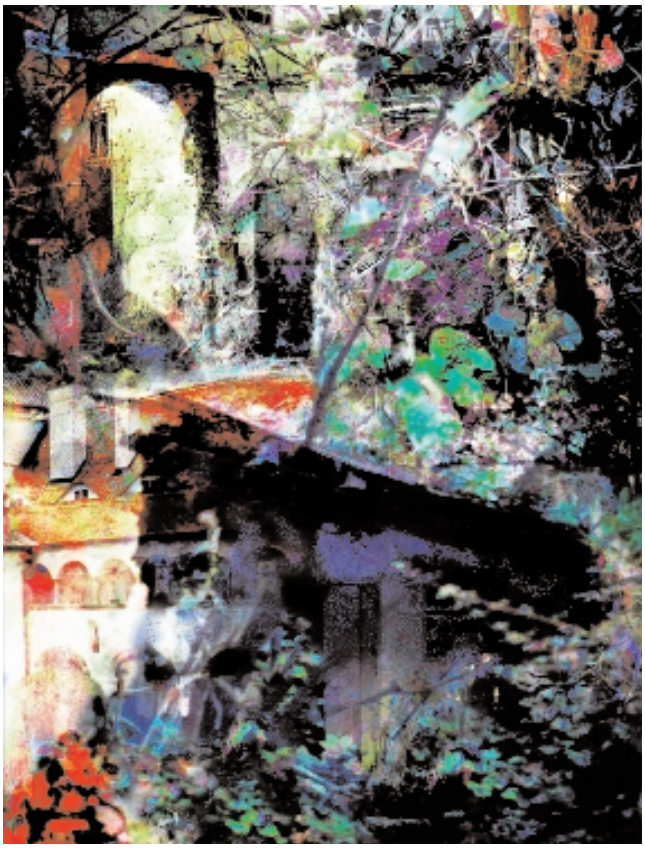
Hidden in the woods and brush near Topolcianky, Slovakia, is an old house completely enveloped by twisting trees and vines. The house is located just past the castle that once was the summer residence of the Hapsburg family, where Marie Antoinette spent her summers as a child. This is one of those special places where the visitor feels connected to history, where rather than feeling the cold depression of abandonment, one immediately senses happy times of an elegant bourgeois family walking through the many rooms, and sitting on the front porch that still bears traces of frescoes. It is possible to imagine that, in such close proximity to the castle, the family played some role in royal life, and lived knowing that they were dependent on the monarchy. One even senses the power of the Revolution, and of the changes that it set in motion.

Time does not stand still as one moves through this place; it fluctuates from distant past, to upheaval, and then to the present. Nor are the visual reflections of the visitor singularly focused; in the moments of actually looking at the houes, and of later thinking back to the visit, the images of the house, the overgrown garden, the woods, and the castle all become intertwined.

Digital imagery is the ideal medium for creating the synthesis of imagery that is essential to descriptive narrative. The process of composite fragments from various photographs renders an image of remembering, complete with the unusual juxtapositions and distortions that are the very heart of memory. Separate representations of each element would not tell the story of the experience of visiting the house in contemporary times. Only composite, intertwined imagery can provide the proper description of an experience which is itself a composite experience.

"Old House in the Shadow of the Castle" is part of a series of images built out of the remembering of places which contain echoes of past lives.

Printed by Eastman Kodak Company, Rochester, New York. Printed on a Kodak Professional 4760 Large Format, using Kodak Professional EI Lightfast Plus Inks and Kodak Professional EI Premium Photographic Glossy/270g



Old House in the Shadow of the Castle
1998/2001, Kodak Professional EI large format inkjet print, 32 inches x 42 inches

Karin Schminke

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"Tidal Pool" endeavors to bring the viewer into an intimate experience of nature. Subtle textures and patterns are interwoven in a complex manner that is reminiscent of the natural world. The sense of discovery when coming upon a tidal pool is recreated by the dimensional shift encased in the lenticular center panel. Suddenly, the view beneath the surface is exposed for exploration. The illusion of real depth invites viewers to linger and explore, as their movements in front of the image effect their view of the image. The audience employs their own perspective in resolving the elements presented. In this way the work becomes a focus of contemplation and meditation, mirroring the role of nature in our lives.

Xrossings: Tidal Pool
2000, Center panel: 3D lenticular
Outer panels: mixed media (acrylic paint, collage and digital print transfer)
32 inches x 32 inches

Leslie Sobel

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My work starts with photography altered through digital media, painting, drawing, and collage. I have been involved in the field of adaptive/evolutionary computing for many years and have tried to bring the ideas used in that area to bear in my art. Therefore I am interested in seriality, in recursive evolution, and change of ideas and forms. I work in series – exploring an idea as it evolves and changes.

The current series of prints are all based on digital video shot at 48 Hours of Making Art, a residency at Lake Erie College sponsored by the Ohio Arts Council. I attended 48 Hours in October 2000 and worked with a dancer, Sarah Morrison, shooting her improvisational performances with a digital video camera. Frames from Sarah's performance evolved into a set of digital prints. Sarah danced draped in large sheets of fabric, making her figure both anonymous and archetypal. I find that working with video images enables me to explore ideas about the figure, about movement, and seriality in a way that has not been possible when starting from still images.

My work is shaped by my interest in complexity, biological-based computing, and the relationship of my media to working directly on paper. My art integrates photography and digital manipulation of images with painting and drawing or virtual simulation of traditional media. I believe that the combination of media better allows me to capture the complexity and ambiguity of modern life. For better or worse, our perception of the world is colored by life in an interconnected technological society. By integrating a highly technological set of image manipulations with more traditional paint on paper and photography, I comment upon the way technology alters our perception of reality.

www.lesliesobel.com

Sarah- Dancing Reflections
15.12.2000, Original digital print, Epson 3000 with Lysonic E ink on Somerset Velvet enhanced paper, 23 inches x 29 inches

Akiko Tohma

Artist
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The representation of the human face is an endless motif for art. It continues to attract artists working on traditional paintings and sculptures, and those using today's digital technologies. The existing sophisticated skills for face representation can bring us a lot of suggestive information. Noh masks, wooden sculptures used in Japanese traditional Noh drama, can be considered as one example.

The masks used in Noh drama show diverse types of faces. However, a common impression given by Noh masks seems to be a "curious reality" – the coexistence of abstraction and deformation. This kind of realism could have never been achieved without an understanding of the anatomical essence of face shapes. Indeed, the observation of fine old masks, carved around the 14th century for example, suggests that the masters might well have understood the facial bone and muscle structures of the human face. Viewers are therefore able to project their memories of human faces onto the masks.

This digital image was created under the observation of a Noh mask's shape. The Noh mask appearing in the upper center of the image is a Ko-omote mask used for young female roles. In the middle, there is an image of the mask with facial muscles, which are imagined to be beneath the Ko-omote face. The imagined skull of the Ko-omote mask lies in the lower part. These three states, i.e., face, muscles, and bone, are arranged vertically, suggesting the aesthetic principles of traditional Japanese arts: TEN (Heaven-Space); CHI (Earth-Time); JIN (Man) also expressed in terms of SHIN (Formality); GYO (Semi-formality); and SO (Informality). The image also suggests the transition between life and death, or past and present, which are often described in Noh stories.

The Ko-omote mask was created using a 3D computer graphics technique.[1] The modeling process introduced a method of replicating a wooden Noh mask. Here, paper templates were created by measuring a wooden Ko-omote mask and then digitized as guide curves for NURBS surface modeling. The use of a 3D scanner was therefore unnecessary. The surface texture of the mask was created using paint-draw software. Curves of facial muscle fibers were traced from anatomical data and projected onto the mask's surface. The shape of the skull was modified to fit the Ko-omote mask.

References

1. Tohma, A., Shimohara, K., Tohkura, Y. and Yokoya, N. (2000). Creation of a Noh Mask Using a 3D Computer Graphics Technique. *Proc. IEEE International Conference on Information Visualization*, 407-412.

What Noh Masks Whisper to Us
January 2001, Ink jet print on Pictorico fancy paper, 45cm x 100cm

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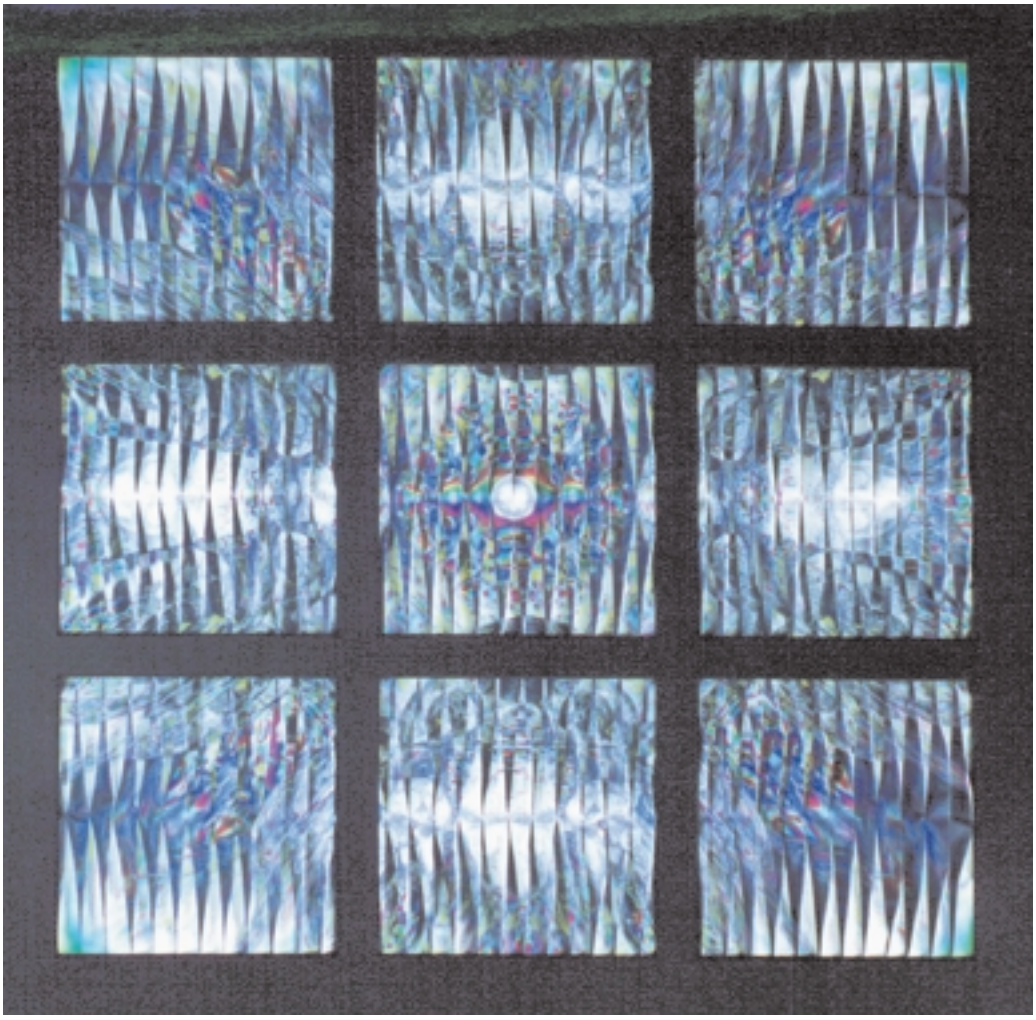
This work is one of my series of artworks that is created by transferring 3D rendered images. Digital images are easily duplicated with no degradation, thus threatening the uniqueness of the original work. I am pursuing the creation of digital image-based artworks in which only one original exists. I have chosen fabric as an output medium to transfer my digital images. Fabric is a soft and flexible medium that can be processed. I have manipulated the fabric to create 3D creases, thus the visual impression of this piece changes by the viewing position. I am also trying to express through my work the relationship between non-tactile virtual space and tactile physical space.



RT111
2000, Framed printed fabric, 81cm x 81cm

Anna Ursyn

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And again you commute
stable and roaming
sitting quietly while driving in a haste,
attentive yet unobservant.

So distinct in your glass case
yet immersed in milieus
urban and rural anew,
too familiar to disturb.

Composing tunes you whistle
listening to yourself
learning what you want for sure
enjoying the company of you.

Moon enters the city
Its converging structures belong to other town interiors
left behind with inattention
showing the way to new encounters.

Wooden moon soaks familiar sandboxes, parks, factories
well-retained in the memory.
A city, never visited before,
welcomes the guest.

Commuter's Tunes
2001, Vax, Fortran 77, Versatec, photosilkscreen, PC, 36 inches x 18 inches

Moonlit Manifestation
1999, Vax, Fortran 77, Versatec, photosilkscreen, PC,
32 inches x 32 inches

Yayoi Yokoyama

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Digital expression using the computer can create images that are not always intended. I have been creating artwork based on such incidents for some time.

I am like a flower and a plant from another era. I am interested not only in the lovely figures of flowers but also in the details – the colors, the petals, and the shapes. I create artwork of imaged flowers and plants using 3D computer graphics. I have made more than 100 electronic flowers and plants, but the impressions of these images resist the materiality present in the artwork. I felt it limited my artistic expression. Therefore, I thought it is necessary to make combinethem create to create an altogether different image.

I trimmed a part of the image of the first flower, and tried to create various effects. At this point, the real art-making begins. I tried to increase and decrease the amplitude of the trim angle, changing each by changing the parameters. The expression of the flower changed greatly, and began to look like a kaleidoscope. These changes were easy to make and after witnessing several successive changes it reminded me of watching a creature tirelessly morphing its own form.

The flowers, created with 3D computer graphics, were adjusted delicately so as not to alter the particular atmosphere and characteristics which allowed them to bloom realistically for each different image. When the crystals of the flower were collected and laid out, a "flower illustrated book" was completed.

The title, "Crystal Flower," arose because the electronic flower bloomed like the real thing, and realistically bloomed again, taking on the image of a crystal. Though the image is extracted from about 100 flowers, each flower crystal piece continues to grow.

Crystal Flower
2000, Three panels, 900mm x 700mm

Hye Jin Yoo

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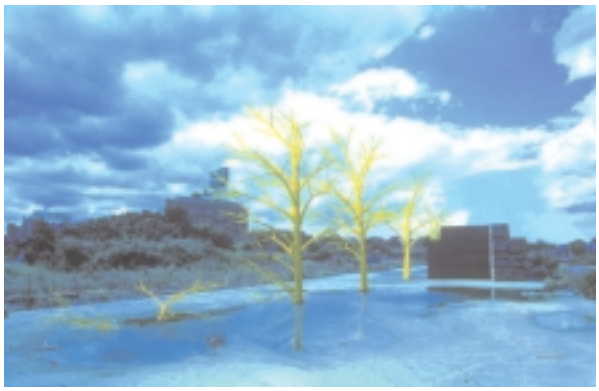
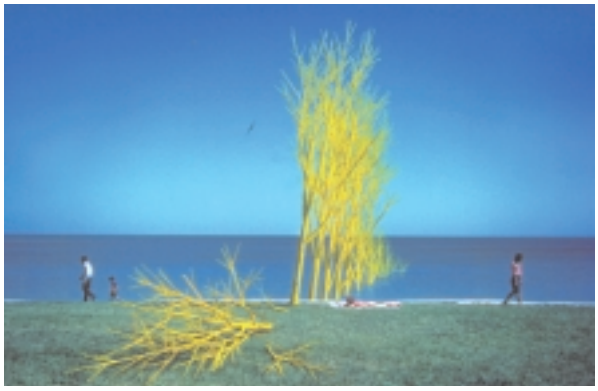
The way of approaching natural phenomena in the West is very different from the East in terms of how each group thinks about "things" in the world. I think that the main sense of nature in the East is of "universal events" which are too broad and ambiguous to define only one "thing" in the world, but do allow for the spontaneous awareness and abstractness of time and space. It can be interpreted by the Buddhist idea of transient moments from personal experience when we actually identify ourselves as a part of nature, which gives us a greater respect for nature and reveals ourselves to our own minds. To me, it was the moment when I picked up one yellow leaf and felt that this was no different from my own existence, living in this time and space but also going through the cycles of life; much like floating waves, an idea which is hard to grasp and form into a structure. The "thing" in Western ideology has a more dimensional quality, creating an identical and mechanistic sense of nature. For example, if I would say "one bright day of disaster," there should be some understood damage or physical destruction that follows. This type of "analyzed physicality" is a significant part of the Western sensibility.

In the "Overgrown Artificiality," I wanted to build up an ironical virtual assumption of futuristic views, which may speak to the negative side of natural disaster on a bright day in a new age that people might dream about. The yellow trees represent a sickened and altered nature as a metaphor for the human mind in some stage of purification. In the "Overgrown Artificiality," the Western idea of substance and physical matter which is transitory in time and space has combined with the Eastern sense of value that relies on the "thing as an event," but still encapsulates the Western physical value and perspective.



Overgrown Artificiality 9
2000, Large format inkjet printer, up to 36 inches x 48 inches



Overgrown Artificiality 10
2000, Large format inkjet printer, up to 36 inches x 48 inches

Overgrown Artificiality 11
2000, Large format inkjet printer, up to 36 inches x 48 inches

Overgrown Artificiality 12
2000, Large format inkjet printer, up to 36 inches x 48 inches

Andrzej Zarzycki

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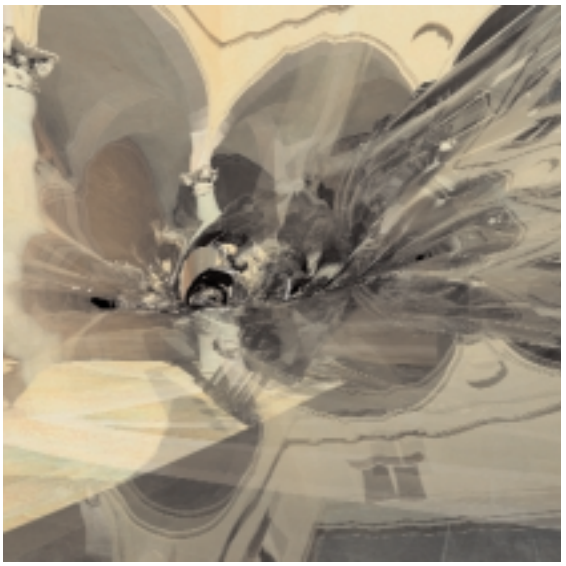
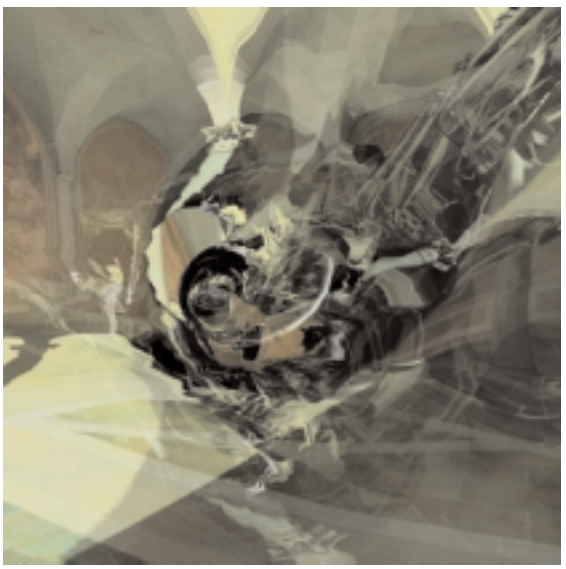
Andrzej Zarzycki is an artist and architect who employs computer graphic tools to create and visually experience environments. Andrzej's artistry is composed of two aspects: the sculptural – searching for excellence in form by computer simulated investigation of materials, light, and tectonics; and the imaginary – investigating the potential and desired representations of form. It is these two aspects that define Andrzej's unique style of bridging the art of sculpture and painting.

Andrzej believes that the most important aspect of his artistic process is exploration. The ability to work with materials, the interplay of light and form, creates opportunities which can best be captured through digital imagery.

Andrzej's environments explore the sculptural boundary of the possible with the impossible and utilize conventional architectural environments as a departure point. Frequently his creative approach leads him into imaginary worlds of pure exploration within the virtual environment. Using his ability to twist reality during the form-making process, Andrzej transforms conventional (as we know them now) into surrealistic spaces. The author strongly believes that once surrealistic spaces and virtual environments become more real to us, they will also affect our expectation of the surrounding environment.





Entering the Event Horizon
2000, Color posters, 20 inches x 20 inches

Jason Zimmerman

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This image is from a series that explores the deconstruction of the human body. The humans have been combined with mechanical parts to create beings that are a hybrid of man and machine. This particular image represents all that remains of a natural body. The body has been broken down and used for parts while the head remains locked away waiting for the time when it will also be taken and used in the creation of another being.

In my work, I merge objects that have been captured with a digital camera with objects that have been modeled three-dimensionally in the computer. This allows me to have greater control over the image and the environment I am creating. I am able to represent my ideas without restrictions or limitations.

Manufactured Existence: The Remains
2000, Iris Print

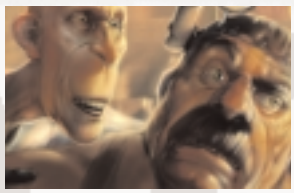
Computer Animation Festival

Chair

Sande Scoredos

Sony Pictures Imageworks Inc.

• Animation Theater
• Electronic Theater



Chair
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Sony Pictures Imageworks Inc.

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Industrial Light + Magic

Alternates
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Creative Technologies

Tim Skelly
Design Happy

"The screen is a magic medium. It has such power that it can retain interest as it conveys emotions and moods that no other art form can hope to tackle."
– *Stanley Kubrick*

2001: A Digital Odyssey

The Computer Animation Festival is the world's most prestigious film and video showcase of dazzling and innovative imagery created by current artists and scientists. As we enter the new century, we see that computer graphics has evolved and matured. We have advanced the technology to a state where anything is achievable and advancement is subtle. We now view computer graphics as another tool in the larger sense of moviemaking for visual story telling, entertainment, and explanation. The work selected for this year's Computer Animation Festival takes us on a remarkable journey that combines the talent and brilliance of current and future trends in art and science with the very best imagery depicting comedy, drama, romance, action, adventure, fantasy, science fiction, and science fact.

A record-breaking number of pieces were submitted, processed, and carefully reviewed by a distinguished jury of industry experts. The outstanding quality of the 679 superb submissions presented the jury with a difficult, yet pleasurable assignment. With only a limited number of screening hours available at the festival, the jury worked very hard to view every submission and selected the finest 118 pieces that personify all the elements of the Computer Animation Festival criteria. Each submission was carefully viewed and rigorously examined for technical excellence, innovation, artistic achievement, content, creativity, originality, narrative quality, design, entertainment value, production values, cultural diversity, and a contribution to the computer graphics industry.

With so much wonderful work to jury, every piece in all four festival theaters represents the finest work produced by the best animators, artists, scientific visionaries, and visual effects magicians in the world. My colleagues and I hope you are enormously entertained and inspired by the extraordinary selections presented in this year's festival.

Acknowledgements
A festival of this size and complexity is not the work of one person. It is produced by a large team of collaborating visionaries. A dedicated team of volunteers stepped forward to help plan and implement all the phases of assembling the SIGGRAPH 2001 festival. The festival teams generated a wealth of wonderful ideas and carried them out with precision and a unified vision. I am proud to have worked with this great group of talented individuals: Jill Smolin, Jane Stephan, Pam Hogarth, Paul Debevec, Mark Hall, Ladd McPartland, Nick Bali, Rob Engle, G.G. Heitman, Robert Minsk, Jessica Westbrook, Tim Skelly, Jacki Morie, Cat Thelia, Alan Botvinick, and Teddy Kim.

The Computer Animation Festival would be nothing without the extraordinary work and accomplishments of the submitters, and I congratulate all who sent in their work. The arduous task of processing all the submissions was accomplished by the dedication, patience, and energy of Eric Withee, our Festival Coordinator, and his team of committee members and student volunteers from The Art Institute of Los Angeles and Gnomon School of Visual Effects.

I commend and congratulate the prestigious jury panel for having the diligence and aesthetic and technical sensibilities to select this amazing body of work worthy of the prestige the Computer Animation Festival: Brian Blau, Jeremy Cantor, Richard Chuang, Paul Debevec, Andrew Glassner, Steve Goldberg, Thomas Hollier, Ladd McPartland, Jacquelyn Ford Morie, and Tim Skelly. My gratitude and thanks goes to The Art Institute of Los Angeles Culinary Arts Program for their delicious gourmet creations and for keeping everyone well fed and content throughout the jury meeting. Also to Jacquie Barnbrook, our Electronic Theater Producer, for her extraordinary energy, expert production skills, and sense of humor. Jacquie's ability to keep us all on track, on time, on budget, and laughing was the key to our success, and I am forever grateful. I am in awe of the gifted artists who volunteered their time and talent to create the beautiful designs for the production: Sheena Duggal, Theo Vandernoot, Rachel Nicoll, Michael Scheffe and the team of artists and effects animators at Sony Pictures Imageworks Inc.

Every Computer Animation Festival begins with an extraordinary piece of creativity. This year, Jerome Chen and Blur Studios collaborated to produce a brillant piece of fun, beauty, and revelation to open the festival. It is destined to be an instant classic.

My deepest gratitude and thanks to the outstanding people at Sony Pictures Imageworks Inc. for their support, generosity, and contribution of talented artists, editors, and state-of-the-art facilities: Tim Sarnoff, Tom Hershey, Jenny Fulle, Debbie Denise, Stan Szymanski, Don Levy, John Nicolard, and Barry Weiss.

To my husband, John, who was always there lending his support, technical expertise, and love throughout the 18 months that I spent every moment of my spare time working on the Computer Animation Festival, I am thankful to have you by my side.

And to all the individuals who volunteered their time, energy, and enthusiasm: Without you, we could not have created this wonderful festival for our peers, friends, and community.

Sande Scoredos
Computer Animation Festival Chair

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Marry Borlik
Alan Botvinick
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John Bunt
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Ian Wayne
Jeff Weisend
Barry Weiss
Jessica Westbrook
Chris Wilson
Ray Wong
Jeff Wolverton
Steve Wright
Bill Zahn
Dan Zeigler

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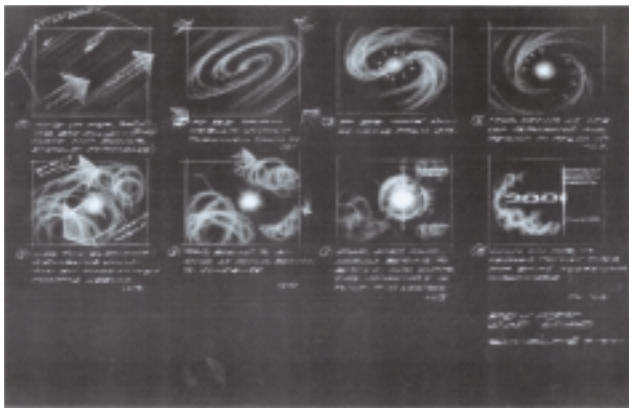
Sony Pictures Imageworks Inc.
and
Art Institute of Los Angeles
Cinesite
Industrial Light + Magic
Rhythm & Hues Studios

Electronic Theater Opening Sequence
2001: A Digital Odyssey
2:15

Director
Jerome Chen

Produced by
Blur Studio

The two-minute opening to the 2001 edition of the Electronic Theater is an homage to Stanley Kubrick's masterpiece with a slight SIGGRAPH twist.



Co-Director
David Stinnett

Producer
Al Shier
Blur Studio

Lead Animator
Richard Bluff

Animators
Richard Bluff
Brandon Davis
Tom Dillon
Juan Granja
Jon Jordan
Noel McGinn
Kirby Miller
Marlon Nowe
Derron Ross
Jeff Weisend
Bill Zahn

Music by:
David Norland

Sound design by:
Gary Zacuto
Jay Redd

Motion capture
John Bunt

System Administrator
Duane Powell

Systems support
Daemeon Nicolaou

Processors donated by:
Intel Corporation

Storyboard Artist
Vladimir Todurov

Logo sequence
Sony Pictures
Imageworks Inc.

Logo design and supervision
Sheena Duggal

Logo design
Michael Scheffe

Particle design and animation
Theo Vandernoot
Sirling Duguid

Executive Producer
Jacquie Barnbrook

Coordinator
Eric Withee

Logo typographic layout
Rachel T. Nicoll

Logo concept art
Marzette Bonar

Logo created on:
HP LINUX Workstations,
provided by Hewlett
Packard Company

Logo created in:
Houdini, donated by
SideEffects Software.

Buzz Lightyear courtesy of:
Pixar Animation
Studios/Disney

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tim@blur.com

Title Sequences: 4D Painting with Light

6:04

Producer
Jacquie Barnbrook
Sony Pictures Imageworks Inc.

Title Design and Supervision
Sheena Duggal
Sony Pictures Imageworks Inc.

I wanted to create an environment with infinite depth, and to use this depth to represent the bounds of possibility. Usually the visual information for title design happens in one image plane. Infinite depth represents infinite possibility and with computer animation anything is possible.

The richness of color balanced with black negative space is key to the design, as is the typographic layout and the animation style.

Using particle animation to reveal the typographic elements was an obvious choice. The particle system, written by Theo Vandernoot, allowed all our animators to manipulate the motion of the particles in simple, complex, elegant, and varied ways.

In creating these titles we were free from the usual constraints of 3D feature film production. And while we still had our own in-house production deadlines to meet, as well as the deadlines for the Computer Animation Festival, it was a great opportunity for us to express ourselves creatively.

Title Sequence Design courtesy of
Sony Pictures Imageworks Inc.,
Culver City, California

Concept Artist
Marzette Bonar

Title design
Michael Sheffe

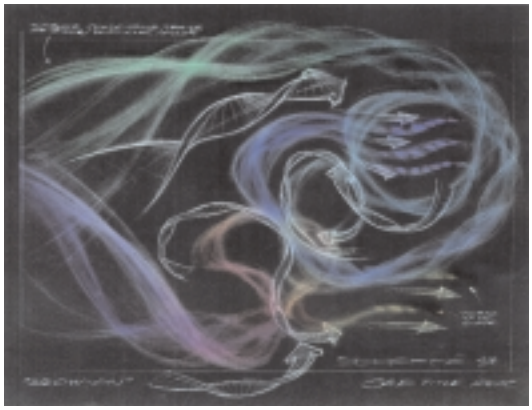
Titles and credits typographic layout
Rachel T. Nicoll

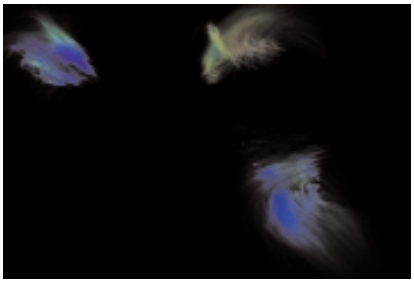
Particle Design
Theo Vandernoot

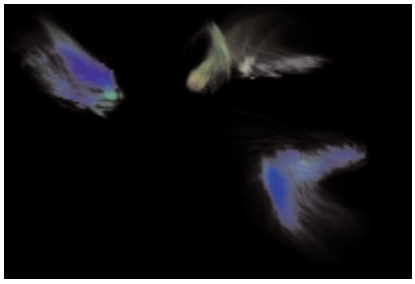
Particle animation
Stirling Duguid
Michael Edland
Zsolt Krajasik
Steve Lavietes
Danielle Plantec
Jeff Wolverton
Dan Ziegler

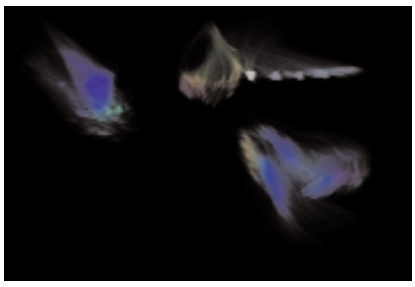
Inferno artists
Sheena Duggal
Doug Forrest
David Takayama

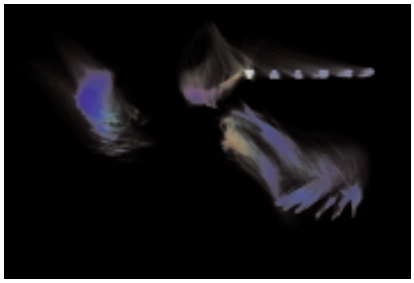
Technical support
Ted Alexandre
Nathan Eriksen
Creola Jones
Eric Withee

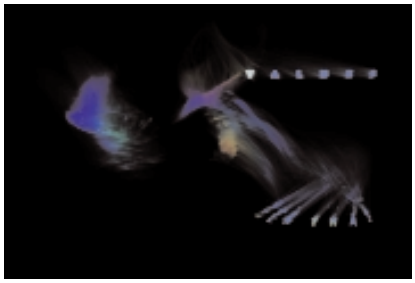












102 Dalmatians

2:04

Director
Kevin Lima

Producer
Edward S. Feldman
The Secret Lab

She's back! This time, Cruella's evil scheme is undone by Oddball, the little heroine of "102 Dalmatians." The spotless Dalmatian was produced by Disney's The Secret Lab, whose original strategy was to digitally remove spots from live action puppies and create a CG character for challenging stunt shots. However, daunting spot removal required a totally believable CG puppy for extreme close ups. Painstaking attention was paid to Oddball's face and expressive eyes. Muscle and skin techniques derived from "Dinosaur" attached muscle to bone and skin for realistic motion, and a proprietary new shader was used to finesse the puppy's fur.

Visual Effects Supervisor
Jim Rygiel

Co-Visual Effects Supervisor
Dan DeLeeuw

Visual Effects Producer
Liz Ralston

Digital Compositing Supervisor
Brian Leach

Digital Effects Supervisor
Wallace Colvard

Supervising CG Animator
Rob Dressel

Animation Supervisor
Matt O'Callaghan

Lead Animator
Atsushi Sato

Facial animation setup/IK
Patrick Taylor

Muscle and Skin Supervisor
David Oliver

Muscle and Skin TD
John Murrah

Lighting TD
Adolph Lusinsky

Groomer/Texture Painter
Colin Eckart

Lead Modeler
Ardie Johnson

Artics and Paint Supervisor
Sandy Houston

3D Technical Manager
Hank Driskill

Fur Systems Developer
Patrick Dalton

Contact
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Airheads

0:42

Director and Producer
Mike Wheeler
Ringling School
of Art and Design

"Airheads" depicts a relationship between creatures who are interconnected in an absurdist manner.

Student Work: Ringling School of Art and Design

Contact
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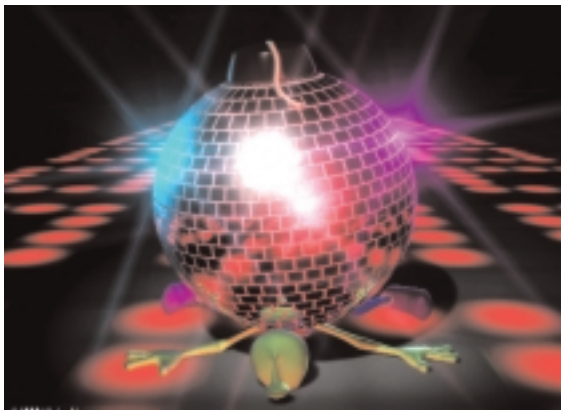
mwheeler@rsad.edu

Alien Song
1:00

Director and Producer
Victor Navone
Pixar Animation Studios

This animation originated as a personal hobby but has since attained global Internet celebrity. It features the original alien character Blit Wizbok lip-synching to Gloria Gaynor's disco anthem, "I Will Survive," before meeting a sudden and ironic demise. It was created on PC and Macintosh computers using off-the-shelf software and traditional animation techniques.



Contributors
Jamey Scott
Gloria Gaynor

Contact
Victor Navone
c/o Pixar Animation Studios
1200 Park Avenue
Emeryville, California 94608 USA
navone@navone.corg

Anjyu
2:00

Director
Yasuo Ohba

Producer
Yasuo Ohba
Namco Ltd.

"Anjyu" refers to composited layers of calmness. It reflects its producer's feelings and emotions during creation.

Software
Original

Hardware
SGI Octane

Music
Tomoko Tatsuta

Video Engineer
Naohiro Saito

Contact
Yasuo Ohba
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ohba@rd.namco.co.jp
www.pluto.dti.ne.jp/~ohba/

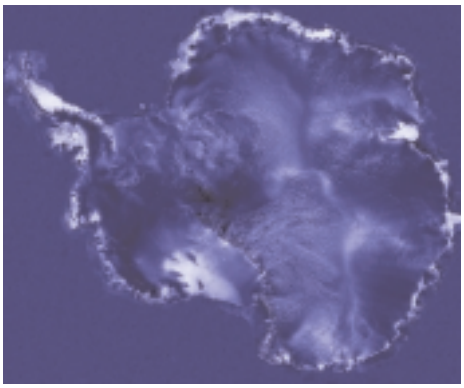
Antarctica: A Flying Tour of the Frozen Continent

4:59

Director
Alex Kekesi

Producer
NASA/GSFC - Scientific Visualization Studio

For 18 days during the southern hemisphere spring of 1997, a NASA-launched Canadian satellite called RADARSAT collected pieces of a puzzle that will help scientists study the most remote and inaccessible area on earth: Antarctica. Scientists have now put the puzzle pieces together to form the first high-resolution radar map of the mysterious frozen continent. This new map has answered scientist's questions about Antarctica and raised new questions about strange and fascinating features never seen before. For additional information: svs.gsfc.nasa.gov/imagewall/antarctica.html



Contributors
Ken Jezek, Marte Newcombe, Stu Snodgrass, Wade Sisler, Michael Starobin, Horace Mitchell

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+1.301.286.1634 fax
Alex.Kekesi@gsfc.nasa.gov

AP 2000

8:11

Directors
Loic Bail, Aurelien Delpoux, Sabastien Ebzant, Benjamin Lauwick

Producer
SUPINFOCOM

What can happen on the back of a dog?

Student Work: SUPINFOCOM

Contact
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supinfocom@compuserve.com

The Big One That Got Away

2:50

Director
James Torrens

Producer
Vancouver Film School

A short story of a sailor dreaming of himself underwater. He discovers a kissing mermaid.

Student Work: Vancouver Film School

Sound
Brett Anthony

Editor
Rina Gallo

Contact
James Torrens
Vancouver Film School
420 Homer Street
Vancouver, British Columbia V6B 2V5 Canada
+1.604.685.6331 x 109
+1.604.685.6317 fax
arnault@vfs.com

Body Story

2:00

Directors
Daniel Percival
Leanne Klein

Producer
Dan Gluckman
The Moving Picture Company

Commissioned by Wall To Wall Television for Channel 4, the Discovery Channel, and ITEL, "Body Story" is a series that takes the audience on six thrilling journeys inside the human body. The Moving Picture Company created 48 minutes of computer animation for six episodes (350 shots in 12 months). In-house software was written to effect an efficient method of rendering such vast amounts of geometry. Other software used: Maya, RenderMan, Shake, propietary software, Inferno, Fire.

Post production
The Moving Picture Company

CG Supervisors
Richard Morris, Chas Jarrett, Jim Radford

Animators
Glen Swetez, Lars Johansson, John Leonti, Jon Attenborough, Russell Appleford, Adam Lucas, Tony Thorne, Kevin Modeste, Rory Marks, Martin Heigan, Ben Sheperd

Programming
Jonathan Stroud, Peter Grecian, William Geiger

Computer systems
James Pearson, Stewart Anderson

Compositing
Paul O'Shea, Greg Slater, Yelena Stojanvoic, Danny Etherington, Mark Stannard, Marcus Moffat

Design
Robin Shaw, Richard Morris

Art Direction
Robin Shaw, Sean Schur

Production
Asher Edwards, Gilbert James

Contact
Dominic Buttimore
The Moving Picture Company
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London W1F 0NL
United Kingdom
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+44.0.207.437.2641 fax
dominic-b@moving-picture.com

The Book of Pooh

5:00

Director
Mitchell Kriegman

Producer
Robin Seidon
Shadow Digital LLC

"The Book of Pooh" incorporates the mesmerizing look of Bunraku, a form of Japanese puppetry that dates back 300 years, combined with real-time CG virtual sets of the entire Hundred Acre Woods.

Contributors
Paul Lacombe, Cabot McMullen, Chris Renaud, Bob Taylor, Jens Scott, Vlad Bina, Blake Holland, Dan Klem, Lawrence Littleton, Jim Spieler, Hans Anderson, Mark Rhodes, Erica Levin, Eli Rarey, Josh Crane, David Vanen, Peter Dufault, Thomas Weber, Dale Aman, Dave O'Neil, Sharon Braaten, Alex Lampila, Brendon Taylor, Curran Gidden, Alexander Souri, Stephen Grob

Contact
Paul Lacombe
Shadow Digital LLC
1375 Boardman Street
Sheffield, Massachusetts 01257 USA
+1.413.229.7880
placombe@shadowdigital.com

Budweiser "Come Home"

1:08

Director
Rick Schultze

Producer
Paul Hill
Industrial Light + Magic

For the Budweiser alien "whassup" commercial, ILM's CG Commercials Department accepted the challenge of generating a CG stadium crowded with aliens and making it look real without the aid of practical references. Particles placed in the seats of the stadium were replaced by animation cycles of the aliens. Other important challenges were the high level of subtlety in the aliens' performances and the unusual design of the aliens. The proportions of their hands and the backwards articulation of their legs made it particularly tricky to create a fluid animation.

Production Supervisor
David Lambert

Art Director
Randy Gaul

Animation Director
Paul Griffin

Post Supervisor
Diane Caliva

Lead Technical Director
Leandro Estebecorena

Technical Directors
Mary Beth Haggerty, Doug Sutton, Peter Chesloff, Hans Uhlig, Melva Young, Tripp Brown, Cedrick Chan, Marcus Stokes, Grue, Marc Cooper, Alan Trombla, Brian Gee

Technical Director/Viewpainter
Dean Foster

Animators
Linda Bel, Colin Brady, Marie-Laure Laffitte, Jonathan Lyons, Tim Stevenson, Kevin Scott, Andrew Grant

Modelers
Ismail Acar, Larry Tan, Stewart Lew, Neil Lim Sang, Steve McGrath, Steve Aplin, Simon Cheung

Animatic Artist
Jamy Wheless

Enveloper/Chainer
Todd Krish

Lead Matchmover
Luc Longin

Matchmover
Ingrid Overgard

Viewpainter/Rotoscoper
Drew Klausner

Viewpainters
Richard Moore, Rebecca Heskes, Tony Hudson

Assistant Technical Director
Michael Muir

Senior Compositor
Mark Casey

Compositors
Carole Johnson, Kristen Millette, Scott Younkin

Online Editor
Mary Serafini

Editor
Nick Seuser

Technical Coordinator
Michael Parkinson

CG Resource Assistants
Michael Balog, Amy Trevor

Video Technical Assistant
Jerome Backum

VP/Executive Producer
Marcie Malooly

Head of Commercial Productions
Paul Grimshaw

Head of CG Commercials
John RA Benson

Head of Commercial Editorial
Mark Tellegen

CGC Production Manager
Justin Harwood

CGC Project Manager
Eric Schroeder

CGC Production Coordinator
David Mammola

CGC Production Assistant
Yvette Memory

Contact
Yves Metraux
Industrial Light + Magic
3155 Kerner Boulevard
San Rafael, California
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+1.415.448.9000
+1.415.448.3468 fax
yves@ilm.com

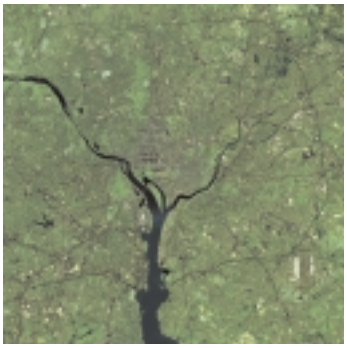
Capitol Zoom

1:45

Director
Gregory W. Shirah

Producer
NASA/GSFC - Scientific Visualization Studio

"Capitol Zoom" is a seamless, cloudless, zoom from a global view to the nation's capitol. It is composed entirely of real earth-observing satellite data: IKONOS one-meter data, Landsat7 15/30-meter data, Terra/MODIS 250-meter data, and Terra/MODIS eight-kilometer data. The visualization first zooms in seamlessly, then zooms out showing where the dataset layers reside. This vizualization was created using Maya for motion control, RenderMan for rendering, IDL for pre-processing of the data, Imagine for image registration, and Photoshop for color matching.



Contributors
Gregory W. Shirah, Horace G. Mitchell, Marte Newcombe, Michael Mangos, James W. Williams, Alex Kekesi, Stuart Snodgrass

Contact
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NASA-Goddard Space Flight Center
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Greenbelt, Maryland 20771 USA
+1.301.286.7903
+1.301.286.1776 fax
greg.shirah@gsfc.nasa.gov

Cartoon Network's "Quick Draw El Kabong"

1:57

Director
George Evelyn

Producer
Liz Gazzano
Wild Brain, Inc.

Quick Draw McGraw becomes El Kabong the Hero and fights El Bad Guy with his steel guitar. El Kabong and Babalooie ride into a garishly colored small town in Mexico that is inhabited by Day of the Dead skeleton townfolk. El Bad Guy and his cohorts are generally out to get the townfolk. El Kabong saves them and heroine Linda Neigh from certain disaster at the end of the piece, and El Bad Guy gets his just desserts. Hand-painted characters and backgrounds were scanned into the Mac and animated in AfterEffects. Music by: Calexico

Production Company
Wild Brain, Inc.

Executive Producer
Jeff Fino

Executive Producer/Commercials
Paul Golden

Animation Director
Jance Allen

Production Designer
Dave Gordon

Agency
Cartoon Network

Agency Creative Director
Michael Ouweleen

Agency CD/Writer
Dave Berg

Agency Producer
Lynn Slowinski

Contact
Sharon Redding
Wild Brain, Inc.
2650 18th Street
San Francisco, California 94110
USA
+1.415.216.2026
+1.415.553.8009 fax
sharonr@wildbrain.com

Cast Away

1:59

Visual Effects Supervisor
Ken Ralston

Executive Producer
Debbie Denise
Sony Pictures Imageworks Inc.

To strand Tom Hanks on a deserted island, "Cast Away" begins with a visceral plane crash sequence incorporating CG water and waves, live action and miniature photography, and numerous subtle digital effects. On the island, Hanks surveys the landscape, a combination of live-action photography filmed in a parking lot in Malibu and a completely CG-created environment.

Senior Visual Effects Supervisor (Main Titles)
Ken Ralston

Visual Effects Consultant (End Credits)
Rob Legato

Visual effects
Sony Pictures Imageworks Inc.
Culver City, California

Co-Visual Effects Supervisor
Carey Grant Villegas

Visual Effects Executive Producer
Debbie Denise

Visual Effects Producer
Crys Forsyth-Smith
Cari Thomas

Visual Effects Production Manager
Lauren Ann Littleton

Visual Effects Digital Production Manager
Lindsay Burnett

CG Supervisors
David Burton, Bart Giovannetti, Layne Friedman

VFX TDs
Steve Blakey, Doug Creel, R. Stirling Duguid, Curtis "NZ" Edwards, Harry Gundersen, Eric Hanson, Matt Hausman, Garman Herigstad, Dan Kaufman, Raji Kodja, Zsolt Krajcsik, Daniel La Chapelle, David C. Lawson, Tom Lynnes, Todd Pilger, Sam Richards, Allen Ruilova, Jeff Willette, Jonathan Wood, Douglas Yoshida

Interactive Compositing Artists
Brian Battles, Christian Boudman, Lisa Deaner, Tony Diep, Jennifer German, Mark Alan Loso, Jeff Olm, Rick Shick, Dave Takayama

Bonsai Compositors
Virginia Bowman, Bonjin Byun, Clint Colver, Colin Drobnis, Michael "Ffish" Hemschoot, Jep Hill, Tim Llewellyn, Ethan A. Ormsby, Bob Peitzman, Aaron Smith

Whale animation
David Schaub

Lead Match Move Artists
Jeff W. Smith, Joseph Thomas

Match Mover Artists
Joanie Karnowski, Rachel T. Nicoll

Matte Painter
David Bleich

Additional paintings
Digital Backlot

Texture Painters
Donna Tracy, John McGee

Rotoscope Lead Artist
Maura N. Alvarez

Rotoscope Artists
Lea Lambert, Lanelle Mason, Loree Perrett, John Shourt, James Valentine

Visual Effects Digital Coordinators
Jennifer Juen, Skye Lyons, Eric Scott

Visual Effects Production Assistant
Timothy Michael Cairns

Visual Effects Editor
Guy T. Wiedmann

Visual Effects Avid Editor
John Berri

Negative line-up
Dee Storm

Lead Technical Assistant
Jeff Dillinger

Technical Assistants
Rosendo Salazar, Todd Hara, Garrick McLaughlin, Marco Vidaurre, Kendrick Sutherland

Director of Interactive Compositing
Dawn Guinta

HSC Production Manager
Thomas F. Ford IV

Visual Effects Accountant
Robb Miller

Digital Color Timer
John Nicolard

Assistant Digital Color Timer
Anthony Harris

Systems Engineering Department Manager
Alberto Velez

Senior Systems Engineer
Dean Miya

Senior Video/ Hardware Engineer
Michael Trujillo

System Engineer
Nick Bali

Video Engineer
Olin Kimberly

Director of Software
Amit Agrawal

Lead Software Engineer
Manson Jones

Software engineers
Brian Hall, Bruce Navsky

Senior VFX Video Editor
Ron Vargas

Input-Output Supervsior
Dennis Webb

Lead Film Recordist
Derrick Quarles

Lead Scanning Technician
Christopher Arreola

VP of Technical Operations
Bill Villarreal

VP of Digital Productions
Stan Szymanski

Executive VP and General Manager
Tim Sarnoff

Additional visual effects
Travelling Pictures: Chris Winters, Amy Garback, Sam Marrocco, John Willette, Sheena Duggal

Contact
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Chameleon

0:25

Director
Pablo Bach
SZM Studios, GmbH

In this character animation, the challenge was to simulate the specific motion of a chameleon and create a realistic rain-forest environment.

Creature development and design
Sebastian Faber

Character animation
Juan-Pablo Brockhaus

Animation
Sebastian Weidner

Background design and animation, storyboarding
Rüdiger Kaltenhüser

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Coca Cola "Clay Dolls"

0:39

Director
Frankie Chung

Producer
Chu Chu Cheng
Centro Digital Pictures Ltd

This commercial, for greater Chinese market, utilised both CGI and miniature models set in a festive Chinese environment. The goal was an Asian version of the Polar Bear, but with a distinctive Chinese feel. The miniature city was shot by motion control. The CGI magical clay dolls were given a stop-motion look and feel. The whole production, including CGI, miniatures, and motion control, required four weeks of production time.

CGI software: LightWave, AfterEffects

Contributors
Leung Yiu Fung, Kith Ng, Miles Cheng, Marvin Chung, Alan Yeung, Roger Wong, Sonya Chu, Andrew Chen, Lau Wing Suen, Anna Wan, Anson Lam, Mike Mak, Ng Man Lung, Jane Wong, Vincent Chan, Ronald To, Tse King Ho, Wong Ching Yee, Tsang Man Tsun, Paul Duggan, Cecil Cheng, Franco Lam

Client
Coca Cola

Agency
McCann-Erickson Guang Ming, Shanghai

Contact
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Centro Digital Pictures Ltd
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lui@centro.com.hk

Comics Trip
6:04

Directors
Christophe Barnouin
Nathalie Bonnin
Luc Degardin

Producer
SUPINFOCOM

A little boy goes to a birthday party…with his imagination!

Student Work: SUPINFOCOM

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Bruno Follet
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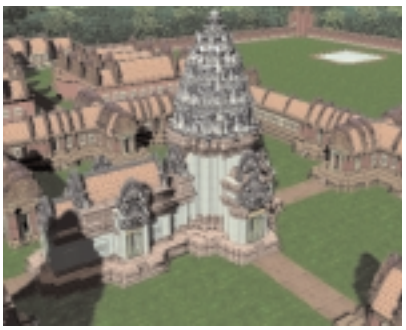
Computer Reconstruction: Temple Site at Phimai
3:22

Director and Producer
Richard M. Levy
University of Calgary

Phimai, one of the most important Khmer monuments in Thailand, is a walled complex of reconstructed temples, libraries, and ancillary structures. Reconstruction of this United Nations World Heritage site highlights the potential of computer visualization as a tool in heritage resource management. Virtual worlds offer archaeologists, historians, and museum curators a non-evasive environment for testing reconstruction scenarios, and they allow the public to learn about important historic monuments without contributing to their deterioration.



Animation and video
Richard M. Levy

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Considering an Exotic Pet?

0:40

A predatory reptile makes a cute pet when it's young, but can it be fun to eat from a can instead of catching food on the hoof? And what if the owner gives up trying to care for it properly? Only really well-prepared people can take care of an adult exotic pet well enough to give it a pleasant life.

Student Work: Ringling School of Art and Design

Director and Producer
Skye Carlson
Ringling School
of Art and Design

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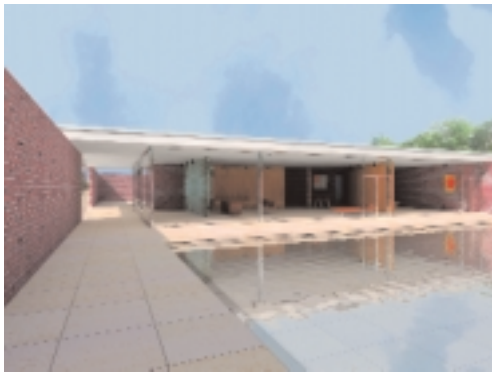
afn20039@afn.org

Courthouse With Curved Elements

3:04

This prototype is one of a series of courthouse designs created by Mies van der Rohe in the 1930s. The computer graphics production team began with the original schematic design from a plan drawing, achieved a derivative version by adding components similar to those found in other projects designed and built by the architect, and used radiosity-based software to develop a visualization. The camera moves between and around the uniquely shaped elemental walls and reveals the pleasure of scenes full of material colors and the ambiance of sunlight.



Director and Producer
Takehiko Nagakura
Massachusetts Institue
of Technology

Computer graphics
Stephen Duck

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Crimson Rivers

1:07

Director
Mathieu Kassovitz

Producer
Legend
Entreprises/Gaumont

This two-part sequence was entirely post-produced in 3D in order to create an avalanche with maximum realism. The avalanche is first seen from the outside and then from the inside, when the actors are buried. The sequence was composed from digital images composited with two stock-film shots.

SFX production
Christian Guillon
L'E.S.T.

SFX post production
Krao
Nicolas Rey, Jean-Baptiste Lere
Mikros Image

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The Crossing Guard

0:58

Director
Joshua West

Producer
Ringling School
of Art and Design

The hero is entrusted with just one unyielding duty: to protect and preserve the lives of children. He must battle three things while endlessly fighting to perform his calling. One, he's only a crossing guard. Two, the traffic is heavy. Three, he's an armadillo.

Hardware: HP Visualize workstations
Software: Alias|Wavefront Maya 3.0, DeepPaint, Premiere

Student Work: Ringling School of Art and Design

Faculty Advisor
Jim McCampbell

Contributors
Victory FX Animation, Alex Whitney, Gaston Ugarte, Alex Wang, Jennifer Woodbury, Jerry Brown, Steve Cady, Jamie Deruyter, Joe Spadaro, Heather Thomson, Phil Chiocchio, Claudia Cumbie-Jones, Deborah Healy

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DAB: Interactive Haptic Painting with 3D Virtual Brushes

5:38

Director and Producer
Vincent Scheib
University of North Carolina
at Chapel Hill

This video presents the system described in the SIGGRAPH 2001 paper by the same name. It uses the traditional tools of a painter to capture the sight, touch, and feeling of the artistic painting. This allows anyone to control a virtual brush as if it were a real brush. To achieve this, we have designed a physically based, deformable, 3D brush model and bi-directional, two-layer paint model, which allow the user to intuitively produce complex brush strokes. The haptic feedback enhances the sense of realism and provides critical tactile cues.

Student Work: University of North Carolina at Chapel Hill

Contributors
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Ming Lin
Dinesh Manocha

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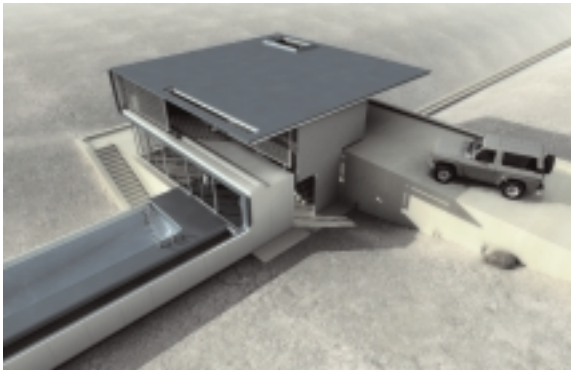
Desert H_2Ouse

1:58

Director
Joseph Kosinski

Producer
k+d.lab

Conceived as a critique of traditional architectural "flythroughs" and perhaps a glimpse into the future of online environments, this short film documents the investigation of an abandoned house from multiple points of view. The "handheld" camera movement was accomplished through four layers of motion-capture data via the mouse. The house was designed and modeled in form•Z, animated in 3D Studio Max, and rendered in Mental Ray. AfterEffects and Combustion were used for compositing and graphics.



Design and animation
Joseph Kosinski

Titles and graphics
Dean DiSimone

Sound design
Jeff Kosinski

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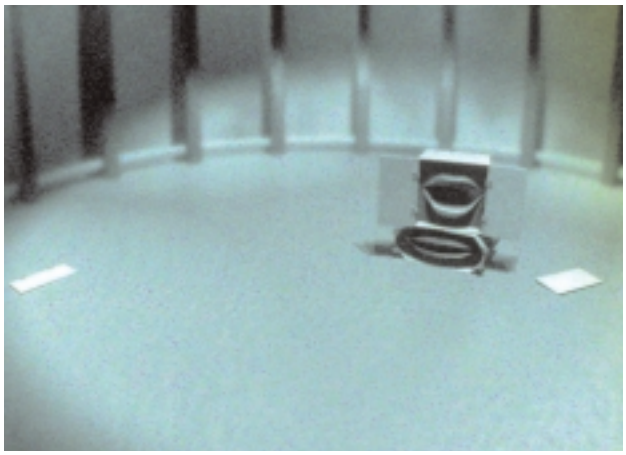
Distrust of Romantica

1:28

Images of an old circus.



Director and Producer
Hitoshi Suenaga
Taiyo Kikaku Co., Ltd

Contributors
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Dr. Seuss' How the Grinch Stole Christmas

2:09

The highly stylized "Seussian" world created for director Ron Howard's "Dr. Seuss' How The Grinch Stole Christmas" is testament to the huge strides CG has taken over the last few years. Although the film was shot entirely on stage, the winter wonderland created for the film was generated at Digital Domain. The film's visual effects challenged all the assumptions of marrying 3D CG with 2D work. This look behind the production scenes features the CG landscape and atmospherics of the film, from the opening credits to the top of Mt. Crumpit and the film's sleigh-ride finale, all created in CG.

Computer Graphics Supervisor
Matthew Butler

Compositing Supervisor
Bryan Grill

Character Animation Supervisor
Randall J. Rosa

Digital Set Extension Supervisor
Vernon R. Wilbert Jr.

Digital Production Manager
Suzanne Buirgy

3D Effects Animators
James Battersby
John Michael Courte
Brian C. Davis
Sean Andrew Faden
Swen Gilberg
Rusty Ippolito
Nikos Kalaitzidis
Mike O'Neal
Danielle Plantec
David Prescott
Ryo Sakaguchi
Juan-Luis Sanchez
Rob Stauffer
Zachary Tucker
Alfred Urrutia
Chris Y.Yang

Digital Sleigh Sequence Lead
Markus Kurtz

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Dan Fowler
Andrew Hall
Keith Huggins
Giancarlo Lari
David Mclean

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Melanie Okamura

3D Integration Lead
Robert Andrew David Frick

3D Integration Artists
Duncan Blackman
Brian Cantwell
Anne Hermes
Kerry Lee
Eric Roth
Neil Rubenstein
Messrob Torikian

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Howie Muzika
Gaku Tada
Andrew Waisler
Dustin Zachary

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Dan Lemmon

Digital Shader Lead
Johnny Gibson

Technical Developers
Greg Duda
Darren Hendler
Charlotte Manning

Lead Digital Compositors
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David Lauer
Donovan A. Scott

Digital Compositors
Brian Begun
Kevin Bouchez
Randy Brown
Rafael Colon
Jodi Campanaro
Filippo Costanzo
Betsy Cox
Sean Devereaux
Feliciano Di Giorgio
Christina Drahos
Rachel Wyn Dunn
Jerry Hall
Claas Henke
Mary S. Lietz
Christine Lo
Dave Lockwood
Anthony Mabin
Brandon Mcnaughton
Davy Nethercutt
Lou Pecora
Kelly Port
Brennan Prevatt
Mark Dominic Rienzo
John Sasaki
Dave Stern

Digital Paint Lead
Shannan Burkley

Creative Paint Lead
Martha Snow Mack

Digital Matte Painters
Laurent Ben-Mimoun
Ronnie Bushaw
Carlin Kmetz
Brian F. Ripley

Digital Rotoscope/Paint Lead
Byron Werner

Digital Rotoscope/Paint Artists
Loring Doyle
Gregory Elwood
Hilery Johnson
Sophia Lo
Michael Maloney
Stacie Manning
Bill Schaeffer
Tonia Young-Bilderbeck

Digital Imaging Supervisor
Jeffrey Kalmus

Visual Effects Production Coordinator
Mary Loibl-Sobel

Digital Effects 2D Coordinator
Michelle Reiner

Digital Effects 3D Coordinator
Karen N. Sickles

Digital Effects Coordinators
Tom Clary
Siouxsie Stewart

Walk-Through Coordinator
Bernardo Jauregui

Visual Effects Editor
Debra Wolff

Visual Effects Avid Editor
Rob Doolittle

Assistant Visual Effects Editor
Val Keller

Visual Effects Accountant
Cindy LeJeune

Visual Effects Production Assistants
Riccardo Anderson
Mariana Sanchez
John Casey Vanover

Visual Effects Executive Producer
Nancy Bernstein

Visual Effects Supervisor
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Visual Effects Producer
Julian Levi
Digital Domain

Early Light
7:35

Director and Producer
John S. Banks
Artek Images

Early Light is part two of a three-part series dealing with times of day and seasons. The idea is to create a living manuscript of the impressions and memories of different seasons and how they unfold. The work, which progresses from the end of winter through spring, was inspired by experiences of landscape as sensed internally and spiritually. These are interpretations of nature's emerging and shifting consciousness. The source scenes are constructed from multiple photographs and video footage. The stills are animated through mattes of generated light, wind, and noise.

Original soundtrack
Fritz Heede

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Elmo's World: Digital Puppetry on Sesame Street

2:49

Director and Producer
Emre Yilmaz
SMA Video

This piece illustrates the real-time digital puppetry process that brought five furniture creatures to life for Sesame Street, and how this process fit into the production.

Contributors
SMA Video, Protozoa, Sesame Workshop

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Enemy At The Gates

1:59

Director and Producer
Jean-Jacques Annaud
Double Negative

Perhaps the greatest challenge that "Enemy at the Gates" presented to Double Negative was how to serve the film's narrative flow whilst staying as faithful as possible to history. For the opening sequence, digital matte paintings depicting Stalingrad's war-torn skyline were derived from an exhaustively researched 3D architectural library. Detailed surveys of surviving Stuka aircraft ensured an accurate portrayal of the dive-bomber attack. In the air-raid sequence, the 3D library was taken to its logical conclusion with a digital recreation of the entire ruined cityscape. Through extensive previsualisation, all visual effects work was tightly integrated with the film's dramatic structure.

Contributors
Matthew Plummer, Antony Bluff, Matthew Holben, Rudi Holzapfel, Jesper Kjolsrud, Richard Bain, Charlie Noble, Frazer Churchill, Paddy Eaton, Richard Briscoe, Adrian Banton, John Hardwick, Paul Riddle, Sarah Soulsby, John Moffatt, Jody Johnson, Chris Panton, Julian Mann, Elie Jamaa, Martin Preston, Pete Bebb, Paul Franklin, Sheila Dunn, Fredrik Sundqvist, Jake Mengers, Asa Svedberg, Annick Hartnel-Tournier, Martin Hill, Mikael Hakansson, Giuliano Vigano, Mike Ellis, Jim Bowers, Dimitri Delacovias, Ciaran Crowley, Claire Tinsley, Hannah Cassell, Dale Lewis, John Seymour, Ian Chisholm, Steve Macpherson, Simon Burley, Pete Hanson, Neil Miller, Nigel Arnold, Claire Mitchell, Kerrie Grant, Mike Pope, Mikael Hakansson

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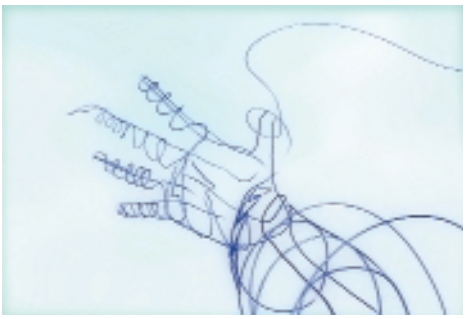
Ericsson "Lines"

0:43

Director
Alain Gourrier

Visual Effects Producer
Stephanie Gilgar
Digital Domain

Beginning with a simple animated line drawing, this commercial progresses into a full human animation for Ericsson and its agency, Young & Rubicam. The spot was created principally in Maya, but the lines were rendered in Lightwave. Compositing was created in Flame.



Visual Effects Supervisor
Eric Barba

Visual Effects Coordinator
Mark Allen Kurtz

Lead Character Animator
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Modelers
Eliot Cail-Sirota
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Character Animators
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Daniel Loeb
Keith Smith

Color and lighting
Tom Williamson

FX Animator
Brad Herman

Technical Director
Matthew Fairclough

Data Integration
Tim Conway

Matte Painter
John Hart

Roto
Laura Ormsby

Lead Compositor
Jean Luc Azzis

Compositors
Gavin Miljkovich
Kevin Moseley
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Rob Trent

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Eve Solal

1:15

Director
Marc Miance

Producer
Attitude Studio

An interview with a young French virtual personality. Eve Solal has worked for French fashion magazines, as a leading model, and as a radio DJ. Animated with motioncapture (vicon). All the 3D work was done on Maya. Proprietary software was used for skinning and facial animation.

Motion Capture Director
Rémi Brun

Infographie Director
Bruce Tajtelbom
Philippe Fournier

Development Director
Laurent Martin

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EVENTIM.DE "Mouse/Concerts"

0:22

Director
Peter Spans

Producer
Martinique Spans
Spans & Partner GmbH

This gentle and dancing mouse, a 3D-generated character in a photorealistic look, presents the most popular styles of music and explains the "around-the-ticket service" of EVENTIM.DE.

Software: Softimage (3D), Phoenix Tools (Geo Fur), Discreet (Flame).
Hardware: SGI, Compaq, Supermicro.

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Evolution of the Universe: Large-scale Structure and Galaxy Formation

1:06

Directors
Donna Cox, Stuart Levy, Robert Patterson

Producers
Tom Lucas (NOVA)
Donna Cox (visualization)

A visual excerpt from the PBS HDTV production: "Runaway Universe", courtesy NOVA/WGBH, PBS, and Tom Lucas Productions. The adaptive mesh refinement simulation grid automatically refines into subgrids to develop small-scale features, generating over half a terabyte of data. We see gravitation forming nested hierarchies that vary by many orders of magnitude. Tiny fluctuations in the density of the early universe are amplified into a network of interconnected filaments. Condensing gas clouds give birth to new stars and merge into whirling galaxies that congregate, collide, and interact in a fiery cosmic dance.

Cosmological adaptive mesh refinement simulation
Michael Norman, Brian O'Shea, Greg Bryan
(Grand Challenge Cosmology Consortium)

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Exit

1:51

Director
Mike White

Producer
Vancouver Film School

A boy is set free by confronting his greatest obstacle: himself.

Student Work: Vancouver Film School

Sound
Brett Anthony

Editor
Rina Gallo

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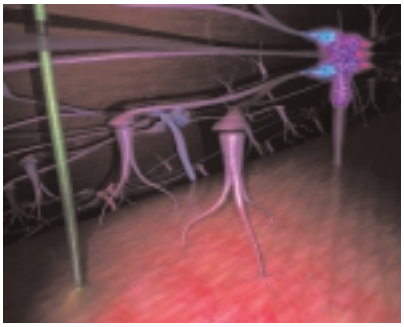
Exploring Serotonin in the GI Tract

2:53

Director
Eric Rosemann

Producer
Peter Korian
IOMedia

IOMedia, in collaboration with Intermed Media Inc, created this interactive presentation for Novartis. The presentation, geared toward physicians, explores the relationship among serotonin, an enzyme, its receptors in the gut, and irritable bowel syndrome (IBS). The purpose of the presentation is to visually convey this complex yet fundamental mechanism, in hopes of creating new therapies for treatment of IBS. Extensive knowledge of the workings of the gastrointestinal system and its neural network was required in order to accurately depict the abstracted, microscopic spaces. All visual design, animation, compositing, editing, and interactive design were performed at IOMedia.



Contributors
Gregory Amos, Dan Burt, Eugene Carroll, Ildar Istarki, Steven Korian, Benjamin Kou, Marc Lafontant, Michael Lasker, Benjamin Pirt, Allan Quinn, Allyson Rieger, Kris Rivel, Junya Sekai, Nemu Shinzawa, Sandor Toledo, Gregory Wallach, Steven Wood, Cindy Yang, Manchiu Yeung, Peipei Yuan

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f8

Jury Honors

12:50 Animation Theater
3:43 Electronic Theater

Director and Producer
Jason Wen
Crystalline Lens

In the distant future, an unstoppable alien power has genetically altered the entire population of a planet to serve as a labor force. The workers are bred to believe that their sole reason for being is the complete infrastructure buildup for an (as of yet) intangible supreme being. Amidst this scenario, one individual manages to break into a face vault to steal a particular identity and attempt a daring escape.

Software: Lightwave 5.6, Project: Messiah, AfterEffects, Premiere, Photoshop, Nuendo.
Hardware: 1 PIII 550, 1 PIII 600, 2 AMD Athlon 800s, KRK V8 speakers plus S12 subwoofer, Sennheiser K6 shotgun microphone, Sennheiser headphones, Tascam portable DAT recorder.

Screenplay
Howard Wen

Concept Artist
Andrew Jones

Music
Casey Hess, Don Relyea

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Final Fantasy: The Spirits Within

2:58

Director
Hironobu Sakaguchi

Producer
Jun Aida
Square USA, Inc.

Square Pictures' "Final Fantasy: The Spirits Within" defines the current state of the art in fully synthetic moviemaking. It breaks new ground by presenting a fully computer-rendered world populated not by insects, robots, or toys, but by realistic human characters who can act and directly involve the audience. Ambitious use of new modeling and procedural-animation methods, high-quality rendering, and new forms of special effects were combined with traditional character animation and innovative motion-capture technology to create a theater experience unlike anything movie audiences have seen before.

Co-Director
Motonori Sakakibara

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Freeware

6:56

Director
Alex Orrelle

Producer
Mike Kaczmarek
Academy of Art

Visually stunning and action packed, "Freeware" is a 3D, CG-animated thrill ride through a futuristic world. This sci-fi short follows three cyborgs on a daring race to rescue Maia, an assistant at a powerful IT company, from the grips of its evil CEO. All animation was created using Alias|Wavefronts Maya.

Student Work: Academy of Art

Supervising Technical Director
Andres Martinez

Art Director
Jed Diffenderfer

Shading Supervisor
Tadao Mihashi
David Lipton

Animation Supervisor
Kate Cole

Lighting Supervisors
Erik Smitt
Maria Yershova

Visual Effects Supervisors
Brian McClure
Mark Manfrey

Compositing Supervisor
Dan Cayer

Sound Supervisor
Genevieve Freckelton

Music
Andrew Leung

Voice of Porter
John Rothman

Voice of Angela and Maia
Sabrina Schlumberger

Voices of corp soldiers
Mike Kantor

Animation Supervisor
Gabriel Schlumberger

Editor
Bryan Poon

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Fruits of Labor

1:18

Director
Rudy Poat

Producer
Candice Alger
Giant Studios

This quirky tale centers around a small creature, Guy, and his misadventures with an apple. The action takes place in a gorgeous, park-like setting, infused with luminous tones and rich detail. Our unfortunate little star trips on a grape and lands heads-first in an apple that is on a picnic table. His ensuing struggles and the results make for a Charlie Chaplin-like comedic sketch.

Writer
Rudy Poat

CG Supervisor
Sean Pollack

Technical Director
Blake Holland

Compositing and editing
Rich Suchevits

Animation and modeling
Anwar Al-asmi, Kurt Judson, Santosh Kale, Michael Kennedy, Dave Peng, Mark Therrell

Lighting and shading
Rudy Poat

Texturing
Dave Peng, Anwar Al-asmi

Pre-vis layout
Dave Peng

Systems administration
Jeff Askew, Alex Nicassio

Producer
Kathleen Fitch

Marketing and PR
Rand Cabus

Audio
Dave Henshaw

Special thanks
Avid, Softimage XSI, Therese Bruno, Ludovick Michaud, Boxx Nothing's Real Shake

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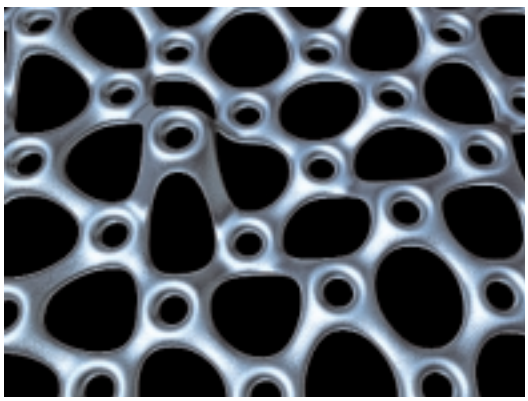
Garden of the Metal

2:00

Directors and Producers
Hitoshi Akayama
Katsuyuki Kamei
Japan Electronics College

The inorganic objects in this desolate space appear to move of their own volition. All motions are controlled by MEL (Maya Embedded Language) and Expression. This work was awarded an excellence prize in the non-interactive division of the 2000 4th. Agency for Cultural Affairs Media Arts Festival.

Software: Maya



Music
Koichi Nishi

Special thanks
Japan Electronics College

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Grandma
4:12

Director and Producer
Sungyeon Joh
The School of the
Art Institute of Chicago

This fairy tale is based on my grandmother's experience of surviving World War II, when Japan occupied Korea. She remembers that she had to learn the Japanese language and culture, and she even had to use a Japanese name. It was like having your own body without your own spirit inside.

Software: Softimage, Media100, SGI

Student Work: The School of the Art Institute of Chicago

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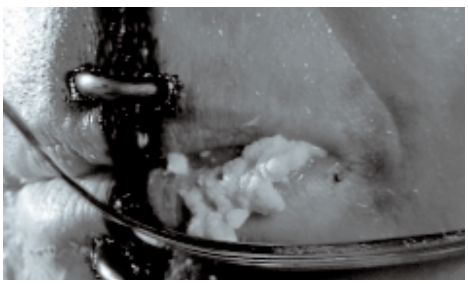
Harvey
9:32

Director
Peter McDonald

Producers
Priscilla Collins
Rachel Roberts
Australian Film, Television and
Radio School

"Harvey" combines cutting-edge digital compositing and animation techniques with a poetic metaphorical tale of loneliness and incompleteness. The main character, Harvey, has been cut brutally in half from head to groin, down the centre of his body, yet he remains very much alive. The film follows the macabre results of his obsessive relationship with his mysterious neighbour. Actors were shot with blue chroma make-up and combined with heavy Inferno matte work and 3D geometry to create fantastically surreal and macabrely horrifying images.

Student Work: Australian Film Television and Radio School



Contributors
A team of rotoscopers, 3D trackers, and compositors from Australia, New Zealand, and Canada.

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Hessi James

3:06

Director
Johannes Weiland

Producer
Martin Burkert
Filmakademie Baden-Württemberg

In the desert of Arizona, two cowboys meet for a most unusual duel.

Software: Maya
Hardware: Dual 600-MHz Intergraph workstation
Production time: eight months

Student Work: Filmakademie Baden-Württemberg

Story
Badesalz

Animation
Johannes Weiland

Score
Thomas Mehlhorn

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Hollow Man

3:22

Director
Scott E. Anderson

Producers
Susan MacLeod
Brian Keeney
Sony Pictures Imageworks Inc.

"Hollow Man" was an ambitious and unusual project founded on creation of a detailed and functioning digital human. We examined this human from the inside out. Our challenge was simple in description: create a synthetic digital human capable of sharing the screen and replicating the performance of his human counterpart, actor Kevin Bacon. Creating a digital Sebastian would require our synthetic human to do everything Kevin could as well as stand in during actions that were physically impossible for Kevin (like ripping off his skin) but maintaining full interaction and performance within the film.

Contributors
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Horses On Mars

6:56

Director and Producer
Eric Anderson
University of Southern California

3.6 billion years ago, a microbe blasts off its home planet propelled by a meteor impact and embarks on a journey through the inner solar system. After spending time on other worlds, it decides home is best and tries to return, only to head in the wrong direction by mistake. Unable to ever return again, it has a one last vision of home and what lies ahead for it. The imagery mimicks the look of electron microscope imagery.

Created on a Dell workstation donated by Intel. Maya and Maya Composer donated by Alias|Wavefront. RenderMan courtesy of Pixar.

Student Work: University of Southern California

Contributors
Brett Rutland, Anuj Majumdar,
Chris Lexington, Ishu Patel

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Hubert's Brain

1:15

Director
Phil Robinson

Producer
Nina Rappaport
Wild Brain, Inc.

Cornered by a bully on a class trip to the natural history museum, Hubert Stinkler gets locked into a laboratory where he literally stumbles onto a talking brain in a jar and gets mixed up in a bizarre tale of vivisection and mayhem. "Hubert's Brain" is a twisted buddy movie about a boy and a brain. Each goes to great lengths to prove the values of friendship. The story gives new meaning to the phrase "everybody needs some...body." "Hubert's Brain" was modeled, animated, and rendered in Maya by Alias|Wavefront and composited using Shake by Nothing Real.

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Ice Age

3:10

Director
Chris Wedge

Producers
Lori Forte
John Donkin
Blue Sky Studios

"Ice Age" is a fully CGI-animated feature film from Blue Sky Studios and 20th Century Fox. Set against the onslaught of the Ice Age, the story revolves around three characters: a woolly mammoth, a sabre-tooth tiger, and a giant sloth. Together, this unlikely group of characters take an unexpected passenger, an abandoned human baby, on a journey home. Blue Sky's proprietary renderer, CGIstudio, is featured. Rendering is done on Compaq Alpha render servers. Alias|Wavefront's Maya was used for modeling and animation. Nothing Real's Shake software was used for compositing.

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Images of Seasons

1:48

Director
Jyunichi Fujita

Producer
Kouichi Kai
Video Station Q Co., Ltd

A dog, a frog, fishes, and a crow sing "wonderful world." This piece was created using Maya and Media Illusion.

Planner
Seiko Nakamura

VFX
Kenichiro Tanaka
Kazuhisa Watanabe
Hiroshi Yanai

Camera
Takahiro Matsunaga

Lighting
Kazuyoshi Yamaguchi

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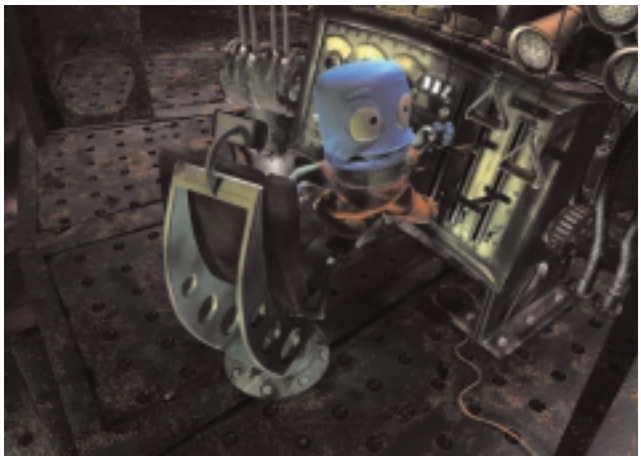
In the Body
1:26

Director and Producer
Savage Frog!

Based on an original concept and a few rough sketches by Seth Kearsley, this short piece depicts a "body factory worker" dealing with a potential crisis. All of the modeling, animation, and rendering was done using NewTek's Lightwave 3D.



Storyboards, set modeling, texturing, lighting, camera work
Ken Sullivan

Character modeling and animation
Paul Davies

Audio
Eric Freeman

Original concept and designs
Seth Kearsley

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Savage Frog!
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Industrial Light + Magic: Research and Development 2001
2:58

Produced and edited by
Colum Slevin
Brent Bowers
Industrial Light + Magic

This presentation illustrates the ILM Digital Technology Group's latest groundbreaking developments. The in-house tools were used by ILM's many digital artists in the four major summer releases of 2001: "Pearl Harbor," "The Mummy Returns," "AI," and "Jurassic Park III." The tools include: rigid body dynamics for plane crashes and advanced smoke simulation ("Pearl Harbor"); advancements in motion capture technology ("The Mummy Returns," "Pearl Harbor"); new advances in flesh simulation and creature dynamics ("Jurassic Park III"); and virtual set technology developed for real-time, on-set visualization ("AI").

R&D Department
John Anderson, David Benson, Rod Bogart, David Bullock, Brice Criswell, Joel Davis, Tim Fortenberry, John Horn, Jim Hourihan, Philip Hubbard, Zoran Kacic-Alesic, Florian Kainz, Sebastian Marino, Marcus Nordenstam, Tony Pelle, Philip Peterson, Cary Phillips, Nicolas Popravka, Vishwa Ranjan, Ari Rapkin, Eric Schafer, Steve Sullivan, Corina Wang, Jeffrey Yost

A very special thank you to all the ILM digital artists and the ILM visual effects production team for their work on: "Pearl Harbor," "The Mummy Returns," "AI," and "Jurassic Park III."

Motion capture department
Seth Rosenthal, Michael Sanders, Doug Griffin, Ann McColgan

Systems R&D department
Tom Dilligan, Andy Hendrickson

Music
George Sakellariou

Also for their great help and support:
Cliff Plumer, Yves Metraux, Vicki Dobbs Beck, Kevin Barnhill, Alan Rosenfeld, Josh Pines, and Christi Carota

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The Instant-Animator Machine

1:38

Director and Animator
Rick May

A SIGGRAPH conference attendee stumbles across the next big use of motion capture technology.

Sound Design
Marc Schaelgen
Amir Soltani

Audio and video recording
Roberto Ziche
Discreet

Contact
Rick May
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Iomega "Pool"

0:44

Director
Traktor

Visual Effects Producer
Richard Bjorlin
Digital Domain

This humorous spot, directed by the world-renowned Traktor (Mats Lindberg and Ulf Johansson) for Publicis and Hal Riney, features a CG animation of a pesky squid and live action of a typical American backyard summer. Compositing was done in Flame. The spot was modeled and animated in Maya, and rendered and lit in Lightwave.

Visual Effects Supervisor
André Bustanoby

Visual Effects Coordinator
Jay Worth

Lead Character Animator
Piotr Karwas

Modeler
Melanie Okamura

Character Animator
Doug Wolf

Character Designer
David Hodgins

Texture Artist
Mark Wilson

Fx animation, color and lighting
David Lo

Roto
George Oliver

Data integration
Nancy Adams

Lead Compositor
Katie Nook

Compositer
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Kami
6:37

Directors
Lionel Catry, Julien Charles, Nicolas Launay, Olivier Pautot

Producer
SUPINFOCOM

A piece of paper is looking for friends…

Student Work: SUPINFOCOM

Music
Patrick Ghienne

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Kent - Tout Est La
2:57

Director
Francois Vogel

Producer
Entropie

After directing the winning "Faux Plafond - Cosmic Promenade," Francois Vogel created his first music video. For Kent's "Tout Est La," he gives us a fantastic journey in the north of France. The production team used AfterEffects and Photoshop to create the set and the characters, cars, and other animations.

Post production
Mikros Image

Digital artists
Francois Vogel, Francois Colou

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Knitwear Rendering

2:47

Director
Baining Guo

Producer
Heung-Yeung Shum
Microsoft Research China

Rendering knitwear presents a significant challenge because of the many detailed characteristics of the material, such as the microstructure of yarn fibers, variations in stitch patterns, and shape irregularities. In our SIGGRAPH 2001 paper, we address this rendering problem by introducing a modeling primitive called the lumislice, which represents a yarn cross-section. By propagating a lumislice over a knitwear skeleton and adding soft shadow effects, we are able to synthesize realistic images of knitwear over various levels of detail while capitalizing on transparency-blending hardware. The results of our technique are exhibited in this video and compared with real footage.

Contributors
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L'Autre Temps

6:30

Directors
Thomas Delcloy, Vanessa Lamblet, Céline Lardet

Producer
SUPINFOCOM

It is always difficult to write a love letter.

Student Work: SUPINFOCOM

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Le Processus

7:51

Directors
Xavier de l'Hermuziere,
Philippe Grammaticopoulos

Producer
SUPINFOCOM

In this strange city, don't lose your hat…

Student Work: SUPINFOCOM

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L'Enfant de la Haute Mer

7:00

Directors
Laetitia Gabrielli, Pierre Marteel, Mathieu Renoux, Max Tourret

Producer
SUPINFOCOM

As she does every morning, a little girl living in the open sea opens the windows of the town.

Student Work: SUPINFOCOM

Music
René Aubry

Voice-over
Anne Frédérique Fer

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Little Miss Spider

2:07

Directors
Diana Walczak
Jeff Kleiser

Producers
Molly Windover
Jeremy Ross
Kleiser-Walczak

"Little Miss Spider" is a computer-animated short based on the best-selling book by artist and author David Kirk. For Little Miss Spider's debut as an animated character, artists at Kleiser-Walczak transformed Kirk's vibrant 2D oil paintings into a stylized 3D world. The result is a storybook brought to life by warm and inviting 3D computer-generated imagery of Kirk's magical characters. Maya was used for character and scene modeling, animation, and rendering. Composer and AfterEffects were used for compositing. This project was produced for Callaway & Kirk.

Written and created by
David Kirk

Executive Producer
Nicholas Callaway

Narrator
Susan Sarandon

Little Miss Spider
Marichal MacDonald

Betty Beetle
Judith McSpadden

Spiderus
Fred Newman

Goldfinch
Judith McSpadden

Sound Design
Robert Kessler

Music
Robert Kessler
and Ethan Neuburg

Animation
Kleiser-Walczak

Executive Producer
Alison Brown

Animation Supervisor
Michael Clausen

Lighting Supervisor
Leonardo Quiles

Facial Animation Supervisor
Derald Hunt

Scene Modeling Supervisor
Stephen Mann

Avid Editor
Slavica Pandzic

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Arman Matin
Kody Sabourin
Natalia Saenko

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Jeffery A. Williams

Senior Systems Administrator
Joe Hall

Art Department Assistant
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Graphic Artist
Varick Nevins

New York Coordinator
Bennett Lieber

Business Affairs
James Stokes Hatch

Administrative Assistant
Marie Trudeau

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Sound Seller Productions
Bong + Dern

Audio
Kessler Media Productions,
Ltd.

Sound Mixer
Scott Cresswell

Callaway & Kirk Company

Author and Artist
David Kirk

President
Nicholas Callaway

Director of New Technology
Jeremy Ross

Senior Editor
Antoinette White

Designer
Toshiya Masuda

Production Director
George Gould

Associate Publisher
Paula Litzky

Director of Contracts
Laurie Feigenbaum

Personal Assistant
to Mr. Kirk
Debbie Geri

Art Assistant
Raphael Shea

With special thanks to:
Michael Peyser of Mike's Movies; Jean Feiwel, Barbara Marcus, and Jennifer Braunstein at Scholastic Press; Donna Bascom and Sony King.

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Lunch
1:25

Director
Marion Gothier

Producer
Martin McNamara
De Anza College

The way to a man's heart leads through his stomach, but it can be paved with formidable roadblocks, as "Lunch"'s hero discovers to his dismay.

Software: SoftImage 3D
Hardware: Dell Dimension PC 866Mhz
Editing Station: Macintosh G4 with Final Cut Pro
Awards: Ed>Net Media Arts Award (First Prize, Computer Animation)

Student Work: De Anza College

Direction, animation, script, design, editing, sound
Marion Gothier

Music
Eric McFadden

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Lunch
3:14

Director
Keith Lango

Producer
Keith Lango
Keith Lango Animation

This energetic, comical, modern-day animated parable chronicles the lunchtime adventures of a man, who is on a tragic quest for ever-tastier treats, and his dog. It features a stylized look that mixes color and greyscale tones with a strong emphasis on simplicity. Animated in Alias|Wavefront Maya, "Lunch" is the fifth animated short film created by Keith Lango Animation.

Contributors
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ManHang (Ephemeral Epiphany)

4:56

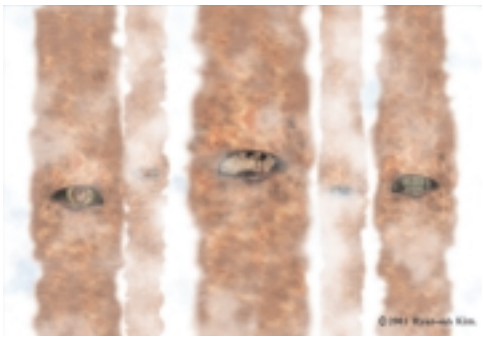
Director
Hyunsuk Kim

Producer
Hyunjee Kim
School of Visual Arts

I tried to depict my own realization of the circle of life in this animation: the suffering after birth, the paralyzed salvation after death, and the void of meaning. The only way to escape from the circle of life is to see it and to realize it, although the realization evaporates in a moment. I wanted to see it to show it. In Chinese, the title means the way to reach true knowledge.

Software: Adobe AfterEffects, Phototshop, Boris FX, Avid Xpress, Protools.
Hardware: IBM

Student Work: School of Visual Arts



Contributors
Rick Barry, Beth Warshafsky, Kim Lee, Don Ritter, Claudia Herbst, Doug Vitarelli, Ericka Beckman, Linda Lauro-Lazin, and my parents

Special thanks to all professors at Pratt Institute.

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Master Q

3:30

Directors
Eddy Wong
Herman Yau

Producer
Tsui Hark
Menfond Electronic Art and Computer Design Co. Ltd

Master Q is a legend in Chinese folk culture. Most Chinese have known this comic character since the 1960s. Now, Master Q is the subject of a 75-minute movie, the first 3D character animation in Chinese film history. The producer, Tsui Hark, said: "Master Q bought me a lot of happy and sweet memories, especially since there have been so many pressures and miseries in our society, and family problems. I would like to take this opportunity to introduce a peaceful and joyful world to the audience."

Contributors
China Star Entertainment Group, One Hundred Years of Film, Film Workshop Co. Ltd, Menfond Electronic Art and Computer Design Co. Ltd

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Metal Gear Solid 2 Sons of Liberty

10:07

Director and Producer
Hideo Kojima
Konami Computer
Entertainment Japan

This work was created by editing in-game demo scenes of Konami's new PlayStation 2 game. Almost all of the scenes consist of materials rendered in real time on a home game console instead of an expensive, high-spec computer. It is our attempt to create "CG footage that you can touch" instead of "CG footage you watch."

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Konami Computer Entertainment Japan

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Metropopular

4:30

Director
Jonah Hall

Producers
Jason Heapy, Laura Lockwood
PDI/DreamWorks

"Metropopular" is an animated short film about what the cities of America would say to one another if they could talk. Frantic about a popularity contest, they jockey for top position while arguing among themselves about why they should be "America's favorite city."

Executive Producer
Julie Haddon

Editing
Greg Snyder, John Dorst

Sound design
Colin O'Neill

Job TD
Marty Sixkiller

Film Technician
John Hanashiro

Marketing and publicity
Kelly Brown, Amy Krider

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Microsoft Xbox "Two to Tango"

1:36

Director
Tim Miller

Producers
Al Shier
Sherry Wallace
Blur Studio

Microsoft came to Blur Studio seeking a cutting-edge teaser that would add impact and energy to the unveiling of its Xbox gaming console. With the visceral and energetic "Two to Tango," we were able to convey the emotion, intensity, and visual splendor that video games on Xbox will possess in the very near future.

Animation team
Jeremy Cook, Tom Dillon,
Jeff Weisend, Bill Zahn

Music
David Norland

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Modeling & Animation Reel

1:58

Director
Scott Dossett

Producer
Vancouver Film School

Another version of how the pyramids were created.

Student Work: Vancouver Film School

Sound
Brett Anthony

Editor
Rina Gallo

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The Moving Pyramid

9:38

Director
Wolf-Rudiger Bloss

Producer
Camille Eden

"The Moving Pyramid" is a charming animated short that tells the story of corruption, power, and revolution. This short combines traditional, papercut, and computer animation and was completed in two years using Softimage software. The making of "The Moving Pyramid" would not have been possible without the assistance of Industrial Light + Magic and all the animators and technical directors who volunteered their valuable time.

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New Baiyun International Airport, Guangzhou City, China

4:56

Animation Director
Jeff Coleman
URS Corporation

In 1998, URS Corporation and Parsons Aviation created a joint venture to bid for the largest new airport in China: White Cloud Airport in Guangzhou (Canton). Located in the Pearl River delta and part of a special economic zone, Guangzhou grew to 20 million people in the past 10 years. As a result, the new airport will serve passenger volumes greater than Los Angeles International Airport. Eventually, it will seve 80 million passengers per year.

The design competition began with competitors from America, England, France, and China. The winning Parsons/URS design was judged uniquely functional and beautiful, with a roadway system unlike any other airport in the world. The building flows organically and dramatically into the rolling hills and lush vegetation of Canton. Chinese see the building as a gateway into China that is at once both classical and modern. The phase-one budget is 2.5 billion dollars.

We used computer modeling and imaging during the competition and after winning the bid. Illustrating the project helped the Chinese accept and understand the design. Computer modeling enabled description of the building geometry, which curves in 3D. URS's Columbus, Ohio office executed modeling and design completely in form•Z with technical support from Parsons and URS groups in Seattle and Tampa.

In 2000, the Chinese needed a public relations tool to promote this completely new airport to airline customers worldwide. Derong Liu, chief architect for Parsons, and Mark Molen, design director for URS, decided that an animation would be the best promotional tool. Mark created an initial animation of the building exterior, which the client loved. Derong quickly wrote scripts in Chinese and English for the project.

The animation staff then created 3DStudio interior models and used the Columbus exterior model. The resulting seven-minute video illustrates departing passengers at curbside and arriving passengers going through baggage claim. Models were created and rendered using five-dual 933 PCs. The animation and rendering of 10,800 frames took six weeks.

Storyboard
Derong Liu

Architect
Mark Molen

Architect
April Yang

Animation staff
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Curt Coleman
Chi Tran
Jim Winborg
Charles Parsons
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New World Computing Cinematic Team

6:33

Director
John Slowsky

Producer
Mark Caldwell
New World Computing

The New World Computing Cinematic Team is dedicated to the idea that, as a species, we are either inherent storytellers or we hunger to experience the rich tapestry woven by visual artisans. So prevalent is this drive that there is room for both the industrial entertainment machines and the village storytellers. We are only seven, but each of us brings to the table one exquisite spice to mix with our diligence and passion into a feast that we humbly lay before our families, friends, and neighbors.

Contributors
Brian DeMetz, John Gibson, Todd Luallen, Adam MaCarthy, Kurt McKeever, John Slowsky, Phelan Sykes

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Norfolk Southern "Chasm"

0:38

Director
David Dryer

Producer
Jim Shippee
Rhythm & Hues Studios

"Chasm" depicts two CG cities on either side of a rift: one represents the brick-and-mortar business world, and the other represents e-commerce, with Norfolk Southern trains effortlessly spanning the gap between. The detail and design of the worlds created a compelling hyper-realistic visual density unusual in commercial CGI, with some shots exceeding 2.5 million polygons. To aid in integrating live talent, the spot was choreographed prior to shooting and played back on set with overlaid blue-screened actors and extras.

Executive Producer
Carlton Ashley

CG Production
Rhythm & Hues Studios

CG Director
John-Mark Austin

Executive Producer
Michael Crapser

Head of CG Production
Ian Dawson

Producer
Deborah Austin

Digital Artists
Tim Everitt, Brad Hayes, Mike Johnson, Steven Rogers, Brian Tatosky, Andrew Weiler, Andy Wilkoff

City designs
Gary Montalbano

Modeling
Tex Kadanoga

Matte painting
Lopsie Chan Schwartz

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Nostalgia

1:12

Directors and Producers
Momoko Daigo
Takashi Yamaguchi
Namco Limited

One summer's day, she was visiting her old hometown, where she spent so much time as a child. The town was quiet. It was almost as if nothing had changed. Overcome by nostalgia, she began to recall fragments of her past.

The main character's facial expressions were animated and achieved with the aid of optical motion-capture technology. The background scenery, a street lined with shops and houses in a quiet country town, was created entirely using computer graphics.

Music
Minamo Takahashi
Junichi Nakatsuru

Motion capture and character setup support
Namco C-Team, Tetsuya Tat Wakao

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ymg@cg.namco.co.jp

O Brother, Where Art Thou?

1:56

Based on Homer's Odyssey and conceived as a humorous homage to film director Preston Sturges' "Sullivan's Travels," this cock-eyed American ode by the Coen brothers is a picaresque "convicts-on-the-run," character-driven comedy through the mid-1930s Mississippi Delta. This excerpt, entirely driven by visual effects, features a blend of live-action plates with CG water, as well as computer-generated animals, flooded landscapes, floating barns and trees, musical instruments, and multiple cans of Dapper Dan pomade.

Visual Effects Supevisor
Erik Nash

Visual Effects Producer
Julian Levi
Digital Domain

Digital Composting Supervisor
Claas Henke

Computer Graphics Superviso
David Prescott

Miniature Effects Supervisor
Alan Faucher

Digital Imaging Supervisor
Jeffrey Kalmus

Visual Effects Editor
Debra Wolff

Visual Effects Coordinators
Julie Goldberg

Creative Imaging Supervisor
Michael D. Kanfer

Visual Effects Executive Producer
Nancy Bernstein

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Rachel Dunn
Gregory Elwood
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Walter J. McLean
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Allan Randall
Brian Ripley
Brian Rogers
Scott Salsa
Chris Soja
George Stevens
Roy Stevens
Tamara Waters

Visual effects photography unit
Allan Bruce
Dan Brodhead
Tom Conway
Eric Donaldson
Jerry Giacalone
Paul Giacalone
Michael Karp
Bill Kennedy
Dwayne Lyon
John Maltbie
Bill Manning
Brian Mussetter
Brian Pass
Chad Pearce
Gregg Preston
A.J. "Juice" Raitano
Heather Rae Roberts
Luke Scully
Troy Steinmetz
Ron Veto
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Larry Williams

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Oblivious
0:47

Director
Alex Whitney

Producer
Ringling School of Art and Design

We are unaware of other worlds that exist and how our actions affect the inhabitants of those worlds. This piece was created using Maya, Deep Paint 3D, and Shake. Hardware: HP Visualize Workstation, SGI 320 Visual Workstation

Student Work: Ringling School of Art and Design

Contributors
Jim McCampbell, Karen Sullivan, Victory FX Animation Studios, Josh West, Matt Wilson, Luke Roman, Iva Lovell

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Oddworld: Munch's Oddysee
6:53

Director
Lorne Lanning

Producer, Exectutive Producer
Sherry McKenna
Oddworld Inhabitants

How would you feel if you broke your leg in a bear trap, were abducted by soul less scientists, had an alien device implanted in your skull, and found out your race had been hunted to extinction? Meet Munch, the hero of Oddworld's oddest opus yet! Captured by sadistic Vykker neurosurgeons, Munch and his fellow lab animals must escape Vykker's Labs Pharmaceutical Corporation before they are processed into a thousand tiny pain relievers. 3D models, animation, and rendering were created using Maya and composited using Shake. Water was created using Arete Nature F/X, and Paraform was used for scanned data.

Assistant Director
Chris Ulm

Producers
Shane Keller, Josh Heeren

Senior Production Designer
Farzad Varahramyan

Production design
Raymond Swanland, Gautam Babbar, Silvio Aebischer

Animators
Scott Easley, Mauricio Hoffman

Technical Directors
John Burk, Matt Aldridge, Ryan Ellis, Marke Pedersen, Iain Morton

Sound Designer/Composer
Michael Bross

Tech Ops
Eli Rodriguez, Randy Hicks, David Rothman, Erik Tweedie

Contact
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Ojo Por Ojo

2:24

Director
Alejandro Meludis

Producer
Lenin Leon
Arte y Parte

This tribute to the eye was made for the opening show of a national art festval in México. We used several kinds of eyes for which there are words in Spanish, such as the eye of a hurricane, or the eye of a needle, but not a human eye. Software: Adobe photoshop, Adobe Illustrator, Media 100. Hardware: Macintosh G4.

Contributors
Paco Zepeda, Tito Ramirez, Carlos Mendez, Lorena Rossete, David Valdez, Jesus Gonzalez

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Alejandro Meludis
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Our Lady Peace "In Repair"

4:17

Director
Oli Goldsmith

Producer
Nathon Gunn
Bitcasters Inc

By innovating new production techniques to specially treat the video's live-action scenes, Oli Goldsmith has combined film footage with animated characters from his paintings in a surrealistic 2.5-dimensional world. Based on Our Lady Peace's concepts for their album "Spiritual Machines," the video explores organic and mechanical narratives inspired by Ray Kurzweil's writings.

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Pasta for War

3:27

Director and Producer
Zach Schlappi

Dictator
Robert Prosky

"Pasta for War" satirizes a 1930s propaganda newsreel. It begins with fresh pasta marching towards the podium. There, the Great Dictator orates. A young recruit envisions formations of dive-bombing bow-ties flying above columns of ravioli tanks, while he wades through marinara sauce to battle against utensils at the bottom of the sink. The realization that he may die ends his fantasy, but his comrades march ever forward to their impending doom: a towering pot of boiling water.

Toni
Aaron McMasters

Rigatoni 1
Brian Garrigan

Rigatoni 2
Fleur Levitz

Rigatoni 3
Zach Schlappi

Sound
Stefan Prosky

Music performed by the Massed Bands of the British Army
Released on Beulah

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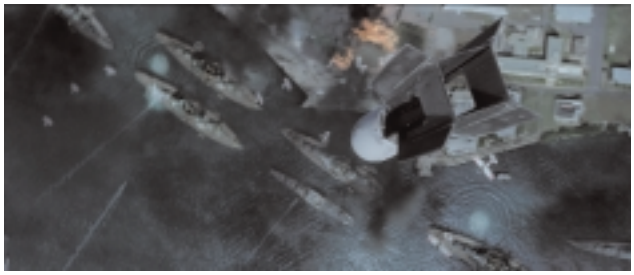
Pearl Harbor
2:10

Visual Effects Supervisor
Eric Brevig

Visual Effects Executive Producer
Ned Gorman
Industrial Light + Magic

For "Pearl Harbor," ILM created vistas of period battleships under attack and CG planes in combat. Simulation software was written for the huge billowing smoke from destroyed battleships, and new rigid-body software was developed for the destruction of planes and ships. Other developments included: new environmental lighting techniques to enhance the realism of rendered planes and ships; new crowd and sailor placement software using motion capture, including data from a daylight motion-capture solution; and new match-animation tools to deal with complex plates and set extension needs.



Visual Effects Co-Supervisor
Ed Hirsh

Visual Effects Associate Supervisor
Ben Snow

Visual Effects Producer
Janet Lewin

Computer Graphics Supervisor
Michael Bauer

Compositing Supervisor
Marshall Krasser

Visual Effects Art Director
Alex Jaeger

CG Sequence Supervisors
Joel Aron
Steve Braggs
Hayden Landis
David Horsley

Animation Leads
Scott Benza, Scott Wirtz

Physical Model Supervisor
Michael Lynch

Digital Artists
Mimi Abers, Shadi Almassizadeh, Al Bailey, Jeffrey Benedict, Aron Bonar, Pat Brennan, Cathy Burrow, Brian Connor, Ryan Cook, Kathy Davidson, Vince De Quattro, Emmet Doyle, Russell Earl, Raul Essig, Kelly Fischer, Jim Green, Craig Hammack, John Helms, Dorne Huebler, Peg Hunter, Samson Kao, Hilmar Koch, Mohen Leo, Mike Ludlam, Craig Lyn, Greg Maloney, Ken McGaugh, Hiromi Ono, Max Rocchetti, Kim Ross, Candice Scott, Jeff Sutherland, Blake Sweeney, Barbara Townsend, Susan Weeks, R.D. Wegener, David Weitzberg, Ronnie Williams, Jr., Rita Zimmerman

CG Animators
Maurice Bastian, Paul Kavanagh, Neil Michka, Chris Minos, Doug E. Smith, Mark Wilhite

Lead CG Viewpainter
Ron Woodall

Lead CG Modeler
Peter Bakic

CG Modelers
Bruce Holcomb
Simon Cheung
Paul Theren

CG Viewpainters
Scott Bonnenfant, Tony Summers

3D Matchmove Supervisor
Terry Chostner

Technical Lead Matchmover
Jeff Saltzman

Location Matchmover
Randy Jonsson

3D Matchmove Artists
Duncan Blackman, Wendy Hendrickson-Ellis, Pat Turner

Digital Paint and Roto Supervisor
Katharine Baird

Digital Paint and Roto Artists
Chris Bayz, Beth D'Amato, Nika Dunne, Dawn Gates, Cameron Griffin, Jiri Jacknowitz, Michelle Motta, Sam Stewart

Visual Effects Editor
Greg Hyman

Digital Timing Supervisor
Kenneth Smith

Visual Effects Coordinators
Lindsey Cline
David Gray
Susan Greenhow

Digital Matte Artists
Ronn Brown
David Saccheri
Bob Scifio

Visual Effects Directors of Photography
Kim Marks, Carl Miller, Marty Rosenberg, Ray Gilberti

Practical Effects Supervisor
Geoff Heron

Chief Model Makers
Bryan Dewe, Robert Edwars, Brian Gernand, Peggy Hrastar, Mitchel Romanowski

Production Supervisor
David Dranitzke

Model Makers
Barbara Affonso, Charlie Bailey, Don Bies, Phil Brotherton, Jeff Brewer, Fon Davis, Thomas Ehline, David Fogler, Mike Grivett, Aaron Haye, Michael Jobe, Scott McNamara, Wendy Norton, David Murphy, Randy Ottenberg, Alan Peterson, Tony Preciado, Christopher Reed, Kim Smith, Steve Walton

Foreman
Robert Clot

Pyro effects
Jason Brackett
Tom Sindicich
Frank Tarantino

Camera crew
John Gazdik, Rick McKay

Stage support
Bill Barr, Burnie Damalski, Craig Mohagen, Tim Morgan, Mike Olague

Software development
Jim Hourihan, Vishwa Ranjan, Steve Sullivan, Jeff Yost, Doug Sutton

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Alex Frazao, Neha Wickramasekara

Plate Coordinator
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Pam Knott

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Joshua Chapel
Michael Muir

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Nic Provenzano
Paul Vega

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ILM senior staff
Patty Blau, Gail Currey, Chrissie England, Jim Morris, Cliff Plumer

In memory of:
Earl Beyer

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Perestroika

2:22

Director and Producer
Alexandrovich Friderici
Evileye Animation

"Perestroika" (pur es troiku) was created as a representation of sudden change. Though its Russian political references are evident, in this piece, "perestroika," meaning restructuring, is represented in the more literal sense of the word. It is an individual's ability to change what he once believed to be something else. Aided by his aboriginal self, his actions threaten to alter the balance of current reality.

Software: Newtek Lightwave 6.5, Adobe Photoshop 6, Adobe AfterEffects 4.1, Sasquatch

Student Work: Evileye Animation

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Pipe Dream

3:30

Director and Producer
Wayne Lytle
Animusic

In this single from a video album, all instruments are played by steel balls shot out of PVC tubing. Two years in the making, the full video album is comprised of seven pieces, each generated by a completely different instrument configuration. Proprietary animation software analyzes the music and automatically drives the movement of the instruments for highly accurate and efficient animation. Essentially no traditional keyframing is used. The DVD version of this video album is scheduled for release in late summer 2001. The album was created by the producer of the original musical fountain in "More Bells and Whistles," SIGGRAPH 90.

Contributors
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David Crognale

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The Pit 2

1:21

Director
Tim Miller

Producer
Al Shier
Blur Studio

This second installment in the Pit series features an out-of-touch executive telling a clearly frustrated artist about how upper management would like to improve their product marketing.

Animation Team
Tom Dillon, Jon Jordan,
David Stinnett, Jeff Weisend,
Bill Zahn

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Platonic Chain

4:00

Director
Jun Asakawa

Producers
Hiroshi Kitahara
Nanae Fujisawa
Hiroyo Osawa
ACiD inc.

This series of futuristic stories, written by Kozy Watanabe, narrates the life of teenage Japanese girls with broadband mobile phones. We were able to produce Japanese-style animation by using a full 3D computer-graphics approach. We used various animation software, including 3D Studio Max, Ink'n Paint (courtesy of Blur Studio), Discreet combustion, and Adobe AfterEffects, running on dual Pentium3 PCs. Optical-based motion capture systems were used to animate the CG characters.

Contributors
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Takeshi Okazaki

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Puppet
2:25

Director
Raf Anzovin

Producer
Steve Anzovin
Anzovin Studio

A puppet-master struggles with a marionette who won't be jerked around. This short was originally conceived as a technical test for new character skeleton setup, nonlinear animation, a spinning light rig, and multipass rendering techniques in Hash's Animation: Master 2000 (v8.5) software.

Animators
Raf Anzovin
Dave Boutilier
Deb Osgood
Bill Young

Lighting
Bill Young

Music
"Funeral March of a Marionette," by Charles Gounod, performed by the Orchestra of the Royal Opera House, Covent Garden, conducted by Alexander Gibson. Courtesy UCG/UMG.

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Red Planet: AMEE

1:21

Director
Anthony Hoffman

Producer
Cinesite

AMEE is the attitude-rich, computer-generated villain and star of this film. Cinesite's artists modeled, animated, textured, lit, and composited AMEE into a menacing, taunting feline successor to HAL.

Visual effects and AMEE character animation
Cinesite

Visual Effects Supervisor
Thomas J. Smith

Visual Effects Producer
Scott Dougherty

Animation Director
Steve Markowski

CG Supervisor
Serge Sretschinky

Composite Supervisors
Mark Lewis, Jerry Sells

CG Tracking Supervisor
Jeff Baksinski

Paint Supervisor
Corinne Pooler

Rotoscope Supervisor
Erin Cullen

Visual Effects Editor
Kevin Clark

CG Character Modelers
John Hewitt, Jonathan Gerber

CG Character Animators
Chris Lentz, Derrick Carlin, Dave Feiten, Ethan Marak, Mike Makara, David Feiten, Tom Gurney, Jackie Gordon, Minhee Cho

CG Lighters
Wayne Vincenzi, Kate Choi, Quentin Frost, Olun Riley, Dan Kessler, Darren Kiner

CG Texture Artists
Brian Gardner, Scott Ballard, Ruth Caspary, John Wallace

CG Particle Animators
James Peterson
Oscar Castillo

CG terrain
Ram Sampath

CG Tracking Artists
Lynn Basas, Dan Wankett, Mike Ramirez, Anthony Serenil, Steve Bovaird, Chad Owen

Compositors
Marcel Martinez, Sarah Moore, Tom Zils, Karen Klein, Ken Sjogren

Digital Artits
Joe Dubs, Valerie McMahon

Rotoscope Artists
Krystine Kryttre, Serena Naramore

Concept Department
Lubo Hristov, Kino Scialabba

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Vince Lavares

3D Data Supervisor
Dante Quintana

3D Data Operators
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Data Management Supervisors
Tony Sgueglia, Pavel Dvorak

Data Operators
John Ceballos, Fred Jimenez, Ruth Vasque

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David Robinson, Carl Moore

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VP/Head of Production
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Executive Producer
Dennis Hoffman

Production Manager
Kristen Niederholzer

Office Manager
Karl Rumpf

Production Accountant
Carla Sierra

CTO
Dan Rosen

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Scanning and recording
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Research and development
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Video Operators
Kevin LaNeave, Dale Stelly

Projectionist
Curtis Lindersmith

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Rendering Translucent Materials

2:36

Director
Henrik Wann Jensen

Producer
Steve Marschner
Stanford University

Translucent materials, such as marble, milk, and skin have a soft and smooth appearance that cannot be simulated with standard lighting models. This animation demonstrates a new practical model for correctly rendering translucency and shows how it can eliminate the traditional hard computer graphics look. Our model is described in detail in the SIGGRAPH 2001 paper "A Practical Model for Subsurface Light Transport."

Contributors
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Steve Marschner
Marc Levoy, Pat Hanrahan

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Ricky Martin: "Private Emotion"

4:00

Director
Francis Lawrence

Producer
Heather Heller
Pixel Envy, Inc.

In this music video, the entire set is CG, but it looks so real that it is impossible to tell.

Artistic design
Colin Strause

Contact
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Robbie Williams: "Let Love Be Your Energy"

6:32

Director
Olly Reid

Producers
Ed Bignell
Cara Speller
Passion Pictures

In Robbie's first animated promo, we see him running through various landscapes from seashores to cities and, in what some might call art imitating life, "brief encounters" with glamorous women. Created with Lightwave 6.5 and Messiah 1.57, the promo was composited in AfterEffects. The Lightwave Cell Shader was applied to the 3D models to achieve a two-dimensional effect. Editing was done with Matrox Digisuite using In-Sync's Speed razor and AfterEffects.

Artiste
Robbie Williams

Record company
EMI

Music management
Tim Clark, David Enthoven, Carrie Sutton
IE Music

Executive Producer
Andrew Ruhemann

Technical Director
Mark Wilson

Animation and modelling
Mark Wilson, Phil Dale, Geoff Suttor, Tim Kirkby, Wesley Coman

Lighting and compositing
Stuart Hall, Tim Kirkby, Robin Konieczny, Matt Westrup

Editors
Kevan O'Brien, Nigel Karikari

Inferno
Ian Richardson
Glassworks

Contact
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Rule-Based Dynamic Simulation for "Wave of Death"

1:14

Director
Frederik Steiner

Producer
Jens Folger
CA Scanline Production GmbH

Production of this fully computer-generated dam-breaching sequence was achieved with a rule-based dynamic system, which differs significantly from conventional keyframe animation or pure dynamic simulation. Instead of separately animating each chunk, fragment, or element of dust, water, or mist, software was developed to combine all dynamic behavior, interactions, and dependencies in one big rule system. With rule-based dynamic simulation, control of the whole visual effect sequence was extremely simplified, which dramtically reduced the amount of work.

Contributors
Stephan Trojansky, Florian Hu, Roland Langschwert, Fritz Beck, Albrecht Steinmetz, Sebastian Küchenmeister, Edwin Braun

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munich@scanline.de

SAE (A BIRD)

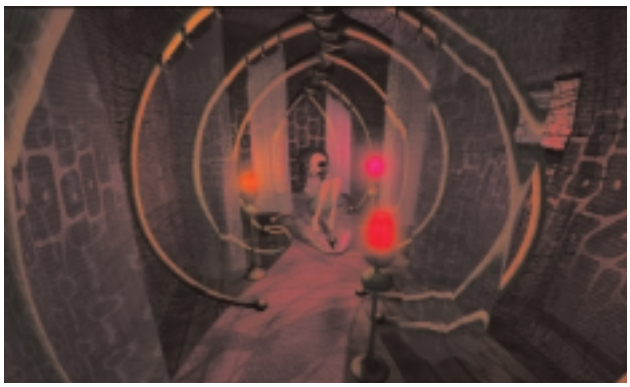
13:10

Director
Byung-Sue Kim

Producer
Korea National University of Arts

A 3D animation about two miserable pure souls who live in an old woman's belly. Software: Softimage, Photoshop, and Flame.

Student Work: Korea National University of Arts



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SAY CHEESE

1:35

Director
Derek Flood

Producer
Das Werk AG

In this story of greed, gluttony, and vanity, a mouse gets in trouble when he eats so much cheese that he can't move. When the cat appears, his troubles really begin. Software: Maya, Shake.

Animation and story
Derek Flood

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The Search for Infinity

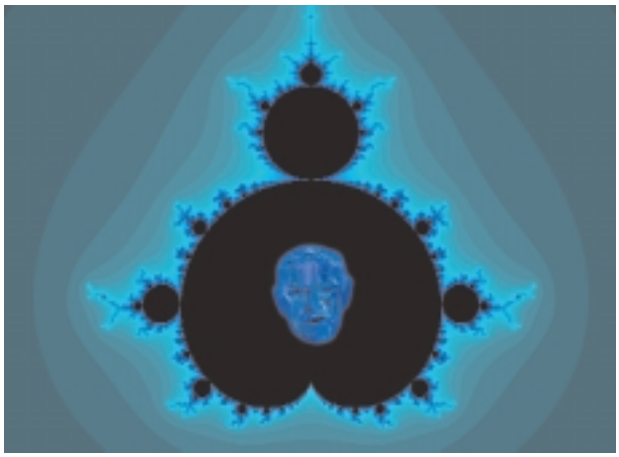
2:39

Director
Ron Fricke

Executive Producer
Jeffrey W. Kirsch

Producer
Camille Cellucci
Cinesite

Arthur C. Clarke narrates this extraordinary journey through a Mandelbrot set as he describes our quest for infinity. Originally produced as the opening for an Imax feature by the same name, this psychedelic voyage shows us that mathematics and art are synonymous and beautiful..



Art Director
Carlos Arguello

In-House Producer
Carole Cowley

Compositor
Timothy Gibbons

Software Engineer
Phil Graham

Digital Effects Supervisor and Compositor
Steve Wright

Composer
Michael Stearns

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Sequence from "Monsters, Inc."

3:29

Director
Pete Docter

Producer
Darla Anderson
Pixar Animation Studios

This sequence from Disney and Pixar's "Monsters, Inc." is a continuous progression starting with storyboards, through final lighting, showing our newest cloth and long fur technology. "Monsters, Inc." is the largest scare factory in the monster world. Sulley is one of its top Scarers and Mike is his Scare Assistant. Their job is to gather the kids' screams that power the monster world. When Sulley accidentally lets a little girl, Boo, into Monstropolis, life turns upside down. While trying to get Boo home, they make a discovery that changes the monster world forever.

Contact
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hart@pixar.com

Serenade

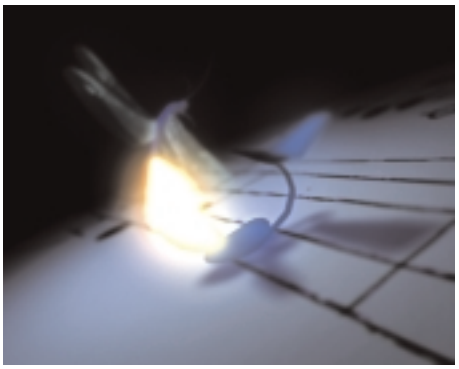
2:49

Directors
Jason Judy, Paul Downs,
Mike Berger

Producer
Ringling School
of Art and Design

Fireflies lead us into an enchanting forest, where a magnificant tree is hosting this evening's serenade. At the foot of the tree, a composer adds the final notes to his midnight symphony. Among the branches, a worker diligently carves an instrument from the wood around him. Under the moonlight, the piece intensifies as we join the conductor and his orchestra above the canopy of leaves.

Student Work: Ringling School of Art and Design



Music
Aram Khachaturian

Cello
Lauren Bair

Faculty Advisor
Jim McCampbell

Technical genius
Karissa Miller

Contact
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Paul Downs
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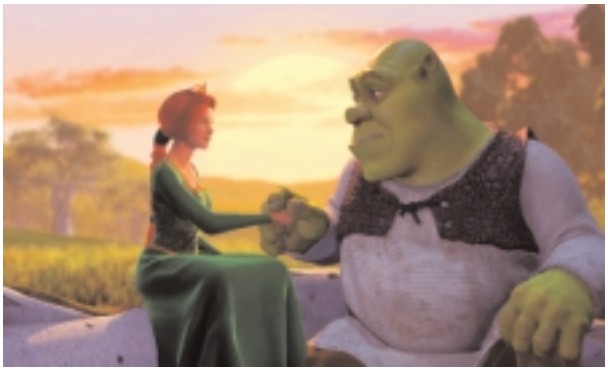
Shrek

3:30

Directors
Andrew Adamson
Vicky Jenson

Producers
Aron Warner
John H. Williams
Jeffrey Katzenberg
PDI/DreamWorks

One of the most visually rich and technically challenging computer-animated films to date, "Shrek" was created by more than 300 artists, computer animators, software developers, and engineers at PDI/DreamWorks who spent almost three years completing the film. "Shrek" features technical breakthroughs in the areas of realistic humans (facial animation, clothing, hair, and fur), natural environments (forests, trees, and foliage), and special effects (CG liquids such as water, mud, beer, and milk along with CG fire and lava).



Editor
Sim Evan-Jones

Production Designer
James Hegedus

Visual Effects Supervisor
Ken Bielenberg

Supervising Animator
Raman Hui

Associate Producer
Jane Hartwell

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Silhouette

3:03

Directors
Amber Rudolph
Tonya Noerr

Producer
Ringling School of Art and Design

"Silhouette" is about a toy ballerina who comes to life when her music box opens. As she continues to dance, her imagination runs wild. Is the shadow real, or just a figment of her imagination? This is the question that the ballerina has to ask herself.

Software: Alias|Wavefront Maya 3.0, Nothing Real Shake

Student Work: Ringling School of Art and Design

Music
Beethoven's 6th Symphony in F major, 4th movement.
Courtesy of Promusic.

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Steam Punk "Go Round"

1:00

Director
Hiroyuki Nakao

Producer
Hironori Terai
P.I.C.S.

A steam chef visits a sushi restaurant and tries to select a plate of his favorite tuna from a revolving table.

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Stop-Motion Versus CG

0:44

Director
Kyle Bell

Producer
Erik Vignau
Will Vinton Studios

Contrary to its title, "Stop-Motion Versus CG" employs harmony rather than conflict. It is a collaboration of diciplines and formats: stop-motion, CG, high-definition video, and live-action film brought together for laughs.

Software: Maya, AfterEffects, Jenoptic MF
Hardware: 35mm Mitchell stop-motion camera, Eyelike digital camera

Director and Animator
Kyle Bell

FX Supervisor and Compositor
Noah Klabunde

DP
Mark Ifort

Editor
George Shubin

Stage Manager
Toby Ethridge

Camera Operator
Charlie Rewalt

Motion control
Bret Crutcher

Camera Assistant
Audrey Moore

TD
Alex Inman

Electronic Imaging Engineer
Gary McRobert

Digital image guy
Dean Koenig

Model Builder
Bill Stall

Character setup
Derick Carlin

Contact
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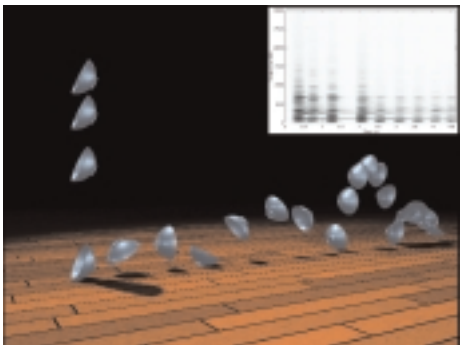
Synthesizing Sounds from Physically Based Motion

1:15

This video demonstrates our technique for approximating the sounds that are generated by the motions of solid objects. As the motions of the objects are computed, their surfaces are analyzed to determine how the motion will induce acoustic pressure waves in the surrounding medium. Our technique computes the propagation of those waves to the listener and then uses the results to generate sounds corresponding to the behavior of the simulated objects. Further details are provided in our paper in the *SIGGRAPH 2001 Proceedings*.



Contributors
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Tabasco Commercials

1:10

Director
Bodo Keller

Producer
UPSTART! Filmproduktion GmbH

Four commercials for Tabasco green pepper sauce produced in film resolution for cinema release in Europe. Character modeling and animation: 3D Studio Max with Character Studio. Compositing of various rendered layers: AfterEffects and Shake.

Contributors
UPSTART! Filmproduktion GmbH, Maria Boeckenhoff, Bodo Keller, Michael Koch, Arvid Landgraf, Frank Rueter

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Time Out

1:10

Director
John Wong

Producer
Vancouver Film School

A little boy has been given a "time out" in the corner, when he gets an idea to become a "SuperHero." He creates havoc around the house, unaware that he will encounter his greatest weakness.

Student Work: Vancouver Film School

Sound
Brett Anthony

Editor
Rina Gallo

Contact
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Trick or Treats

5:18

Directors
Candice Clemencet
Jean Dominique Fievet

Producer
SUPINFOCOM

It is Halloween night, and kids are looking for candies.

Student Work: SUPINFOCOM

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The Turing Test

5:27

Director and Producer
Mark Sagar
LifeFX Networks, Inc.

Artificial intelligence computer algorithms compete with each other in a game show setting where they attempt to pass the Turing test and gain acceptance as human. This work demonstrates new animation techniques. The 3D digital actors have been designed to perform and render in real time over the Internet and were recorded to video directly from the display of a standard PC. The characters' dialogue was created from text using text-to-speech engine or sychronized to real-voice audio clips. The digital actors were "directed" using a mark-up language to describe behaviors and expressions, with real-time interactive playback.

Software: LifeFX
Hardware: PC, graphics card

Contributors
Mark Sagar, Paul Charette, Greg DeCamp, Brad Kalinoski, John Wallace, Alexander Pouchkarev, Mayumi Shimokawa, Diana Lynn, Justine Sagar

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Unexpected Perspectives

1:14

Director
Scott Dickey

Producer
Ringling School of Art and Design

In a beautiful world of blue flowers, an organic character who is separated from the environment operates his harvesting machine. After an unexpected event, he must realize new insights about the outside world.

Student Work: Ringling School of Art and Design

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Until Wolfy Met Helga

1:25

Director
Mookie Weisbrod

Producer
Ringling School of Art and Design

Wolfgang and Helga are two figurines living in a brand new cuckoo clock. As the clock strikes the hour, it's time for them to meet. Both are very excited, until Wolfy meets Helga.

Student Work: Ringling School of Art and Design

Music and sound design
Mert Ihsan Balta

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Values

Best Animated Short

4:32

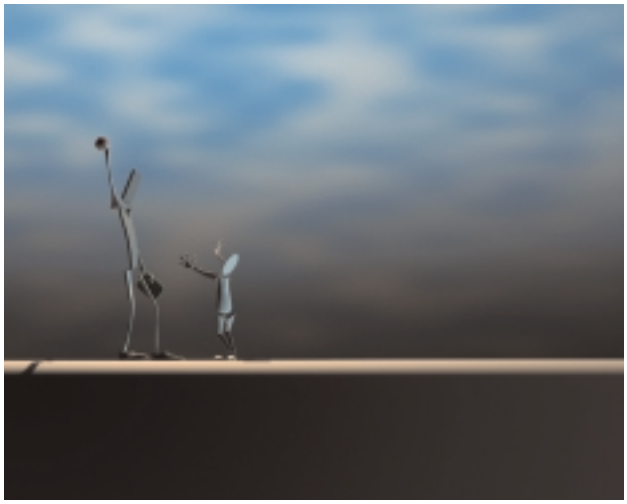
Director, Producer, and Animator
Van Phan
Cinema-Television School
University of Southern California

This animated film was inspired by the filmmaker's relationship with his late father. In a minimalist manner, using primitive shapes such as spheres, planes and cylinders, the filmmaker tells a story about parent-child relationships. By simplifying the character design and locking the camera to primarily a master shot, the filmmaker tells his story mainly through the acting and lighting. Because the elements are kept to the minimum, viewers can project more of their own experiences into the story. Less can sometimes be more.

Produced at the USC Cinema-Television School Division of Animation and Digital Arts, this thesis film was inspired by the filmmaker's relationship with his late father. In a minimalist manner, using primitive shapes made out of spheres, planes, and cylinders, "Values" tells a story about family relationships. Story elements are kept to a minimum. Characters are reduced to faceless icions. The camera is locked to primarily a master shot. And audio is limited to music only. It was hoped that this simple approach would draw the audience closer into the story. Less can sometimes be more.

The film was animated and modeled using Maya. Each frame was rendered using the Maya renderer at D1 resolution and resized to 2k for film exposure. Everything was textured procedurally within Maya. Alias|Wavefront Composer was used for compositing and editing. A Dell Intel Pentium III computer was used for rendering.

Student Work: University of Southern California



Composer
Michael Sean Colin

Production Manager
Mar Elepano

Special Thanks
My family and friends, Khanh Phan, Alias|Wavefront, Noel Goin, Mai Doan, Eastman Kodak, Kathy Smith, Mitch Cockerham, Intel, Adrian Iler, Lorette Bayle, SPI, Ishu Patel, Barry Weiss, Tom Sito, Christine Panushka, Brett Rutland, Lan Phan, Vibeke Sorensen, SGI, Eric Armstrong, Karen Knight, Richard Weinberg, Henry Anderson, Sergio Ramirez, Eric Furie, Pauline Ts'o

Dedicated to Nguyen Phan

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Vel Satis en Capitale

5:42

Director
Pierre Quatrefages

Producer
Olivier Boulanger
Renault

Integrating 3D virtual cars in a real environment is a powerful and essential tool for the everyday design process at Renault. Using similar techniques, this piece integrates the new Renault car, Vel Satis, into Paris. The city is lighted with a touch of magic. This animated short was produced using Lightware 5.6 and Adobe Photoshop. It was edited with Avid's MCXpress at TVI Community College in Alburquerque, New Mexico.

Contributors
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Walk

5:35

Director and Producer
Jeff Drew
Jeff Drew Pictures

Join Edgar, the man, and Gigi, the dog, on a walk through a wacky cut-and-paste world filled with drunk clowns, smoking grandmas, and sidewalk preachers. Who knows what may be down the next block, or what lies in store for Gigi at the end of the walk? This animated short was produced using Lightware 5.6 and Adobe Photoshop. It was edited with Avid's MCXpress at TVI Community College in Alburquerque, New Mexico.

Student Work: Jeff Drew Pictures

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The Wardrobe

2:02

Director and Producer
Maria Lee
Academy of Art College

"The Wardrobe" is a story about the meaning of love and sentiments in our post-modern world. Inspired by René Magritte's surrealistic approach to visual images, Mikhail Bakhtin's writings on Dialogism, and Jean Baudrillard's ideas on simulations, "The Wardrobe" evokes mysteries through poetic combination of ordinary objects. Its intent is to activate discussion of ideas and values of love by exploring these meanings on various levels. What is real love? "The Wardrobe" indicates that the meaning of love and sentiment is elusive and fabricated.

Student Work: Academy of Art College

Original music
Bruce Christian Bennett

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Where is Frank?

4:05

Director
Angela Jedek

Producer
Filmakademie Baden-Württemberg

Once upon a time from different perspectives, or a story of cool cowboys, a fly, and the ride of things. Hand-drawn textures (Indian ink): Maya 3.0, NT, Adobe Photoshop 4.0.

Student Work: Filmakademie Baden-Württemberg

DoP
Frank Wurster

Animators
Jens Hansen, Martin Breidt

Plug-in programing
Harald Grünbele

Music
Sebastian Müller

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Wild Jungle - Motion Ride

3:45

Director
Shinji Torigoe

Producer
Shingo Yasumaru
SEGA Corporation

A jungle tour filled with downhill bumps, cliff hangers, bridge-collapsing moments, the discovery of an ancient burial site, and an unpredictable ending turns this into one wacky adventure. "Wild Jungle" is a twelve-person motion ride with a 180-degree wrap-around screen seamlessly projected by three CRT projectors at 60 frames per second.

Contributors
Shinji Iei, Ryo Takahashi, Toshinori Takata, Kazue Tsukamoto, Yoshimi Saito, Takamasa Namiki, Yukiko Isobe, Youichi Iwata, Hiroki Morikawa, Masahito Honda, Masato Takazawa, Takako Ohbuchi, Syozi Okada, Kenichi Hasegawa, Ryo Matsubara, Ji-youn Song, Masaki Sakai, Makoto Fukushima, Kazuhiko Nagai

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Wing 2001

1:37

Director
Kei Yoshimizu

Producer
Yusaku Toyoshima
Digital Frontier Corporation

A TV commercial for a new brassiere. The charactor's name is "Tsubasa."

Contributors
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Woodrow Wilson Bridge Project

1:52

Animation and Video Director
Jeff Coleman
URS Corporation

The Federal Highway Administration, the Virginia Department of Transportation, the Maryland State Highway Administration, and the District of Columbia Department of Public Works are pursuing a $2.2 billion improvement of a 7.5-mile section of the east coast's busy I-95 corridor at the mid-point across the Potomac River, which includes the Woodrow Wilson Bridge. Potomac Crossing Consultants, a joint-venture of Parsons Brinkerhoff, URS, and RKK, LLP, is the general engineering consultant that is providing project management of design and construction for the project. The setting includes a highly populated, environmentally and culturally sensitive landscape, and the project affects many businesses, local residences, and travelers, so it requires extensive public involvement.

URS, Creative Imaging Group, Tampa, created a series of 3D computer simulations showing the new bridge and roadway design. The use of the rendering products began during a bridge-design competition in which CADD files and technical information were translated into still and animated visuals. These images were used by a citizen's advisory panel and a distinguished jury to determine the competition winner. Print and television news media received the materials, which they have continued to use to track stories of the largest public works project in the mid-Atlantic region.

Subsequently, renderings were used in still and animated forms for public hearings, town hall meetings, stakeholder panel meetings, b-roll for the media, and a variety of other formats. In November 2000, a Virginia Department of Transportation public hearing debuted a 12-minute video of a split-screen fly-through from a helicopter point of view, at an altitude of approximately 300 feet, of full construction of the Virginia portion of the project. A fly-through animation of the entire project was prepared to show traffic movements. This fly-through was available on a one-hour loop for five days at the annual Transportation Research Board (TRB) meeting in Washington D.C., where 7,000 attendees had the opportunity to view the video. That video has been reformatted into other formats for various purposes and will be available for broader distribution. These are very effective ways to show building removals and how new ramps will serve travelers, and they have been very well received by those who are unable to visualize engineering drawings.

Clients
Federal Highway Administration,
Virginia Department of Transportation,
Maryland State Highway Administration, and the D.C.
Department of Public Works

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Work In Progress

3:09

Director
Tom Bertino

Producer
Christian Kubsch
Industrial Light + Magic

In a fantastic workshop hidden deep in a world of natural wonders, two peculiar inventors squabble over their latest creation. What's more important: concept or implementation? A mysterious third party intervenes and provides the elusive, missing ingredient.

Story Supervisor
Anthony F. Stacchi

Visual Effects Supervisor
Erik Mattson

Co-Producer
Jill Brooks

Layout Supervisor
Scott Farrar

Executive Producers
Patricia Blau, Jim Morris

Cast
Tony Haygarth
Richard Wilson

Music
Jimmie Haskell

Production Designer
Erik Tiemens

Character Designer
Carlos Huante

Sound Designer
Tom Myers

Editor
Steve Bloom

Character Animation Supervisors
Chris Arnstrong, Sean Curran, Tim Harrington

Creature and Set Model Supervisor
Paul Giacoppo

Creature and Set Viewpaint Supervisor
Susan Ross

CG Sequence Supervisors
Joel Aron, Amelia Chenoweth, Patrick Conran, Indira Guerrieri, Gerald Guthschmidt

Story Artists
Jamie Baker, David Gosman, Bosco Ng, Brian O'Connell, Steve Purcell, Garret Sheldrew

CG Lead Development Artists
Barry Armour
Tommy Burnette
David Meny

CG Lead Environment Artist
Ken Wesley

Lead Creature Developer
Aaron Pfau

Key Conceptual Artist
Ryan Church

Production Manager
Barbara Dawson

Concept Artists
Robert Mackenzie, Larissa Martin, Claudia Mullaly

Character Animators
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Layout Artist
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Creature Developers
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Viewpainters
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Digital Matte Artists
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Compositors
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Paula Nederman

Production Suport
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First Assistant Editor
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Digital Timing Supervisor
Bruce Vecchitto

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Todd Mitchell

Negative Cutter
Angela Chou

"Vesti la Giubba: Aria"
Performed by
Todd Geer

Post production services
Skywalker Sound

Sound Design Assistant
Christopher Barrick

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Foley Mixer
Tony Eckert

Foley Recordist
Frank "Pepe" Merel

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X-Men "Morphology"

2:07

For director Bryan Singer's "X-Men," Digital Domain created a photoreal CG Senator Kelly as he convulsed into a liquid death. CG supervisor David Prescott and his team, led by technical developer Sean Cunningham, used passes of a reflection sphere to create a global illumination environment for the CG elements. Ninety percent of the final shot was CG, originating with a brief plate shot of actor Bruce Davison. This provided more freedom to manipulate and exaggerate his breathing and final gasps as he turned to water, essentially adding to and enhancing the actor's performance.

Visual Effects Producer
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Digital Domain

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Jonathan Egstad

Miniature Effects Supervisor
Alan Faucher

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Digital Production Manager
Lisa Harriman Scott

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Zachary Tucker
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Keiji Yamaguchi

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Babak Forutanpour
Matthew Lamb

Lead Digital Compositor
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Digital Compositors
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Betsy Cox
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Christina Drahos
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Mary S. Leitz
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Anthony Mabin
Joe Mandia
Brandon McNaughton
Robert Nederhorst
Davy Nethercutt
John Rauh
Cesar Romero
Andrea Sholer
Rob Trent

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John Hart
Carlin Kmetz

3D Track Artists
Nancy Adams
Jay Banks
Allen Blaisdell
Steven Bovaird
Tim Conway
Eric Gambini
Michael Karp
Mohannad Khamra
Jim Mclean

Digital Rotoscope Artists
Paul Carlos
Stacie Manning
George Edwin Oliver, Jr.
Robert Schultz
Tonia Young-Bilderbeck

Visual Effects Editors
Gus Duron
Rebecca Lilienfeld

Visual Effects Coordinator
Julie Goldberg

Digital Effects Coordinators
Tom Clary
Sean Devereaux
Margie Stubbs

Walk-Through Coordinator
Ricardo Anderson-Jaco

Visual Effects Accountant
Rebecca Misiorowski

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Bryan Rogers

Scanning and recording
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Christopher Holsey
Bopo

Projectionist
Jim Smith

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X-Men: Mystique Transformations

1:24

Director
Bryan Singer

Producers
Lauren Shuler Donner
Ralph Winter
Kleiser-Walczak

For "X-Men," Kleiser-Walczak artists developed a 3D-morphing technique for transforming various live-action characters into the evil metamorph: Mystique. CG keyframe animation and procedural animation formed the basis of visual effects that were integrated with Rebecca Romijn-Stamos" performance and Gordon Smith's practical make-up.

To produce Mystique's transformations, Kleiser-Walczak used polygonal 3D body scans by InSpeck and Cyber FX, 3D modeling software by Paraform, Alias|Wavefront's Maya for procedural animation, and 3D tracking solutions by Yannix Technology. Chalice was used for compositing, and WAM!NET provided rendering resources.

Kleiser-Walczak Visual Effects Team

Visual Effects Supervisor
Frank E. Vitz

Visual Effects Producer
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Lead Animators
Scott Palleiko
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Animators
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Beau Janzen
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Martha Small

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Scott Lord

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Joe Hall

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Special thanks to:
Bryan Singer
Lauren Shuler Donner
Ralph Winter
Rich Thorne
Michael Fink
Denise Davis
Twentieth Century Fox

Mystique "Making Of" by:
Beau Janzen

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Zoids

4:00

Director
Takao Kato

Producer
Toshihiro Nakazawa
Shogakukan Music & Digital Entertainment Co., Ltd.

The TV cartoon series "Zoids" was made with the toon shader 14of SoftImage 3D. 2D cel animations were blended without any oddness. First, each 3D CG model's basic actions (walking, running, jumping) were established. Then, using the "animation sequencer" function of SoftImage 3D, an autofilling "motion blend" was performed on the changing parts to produce many cuts. Finally, RETAS! PRO and AfterEffects were used for the cel drawings that combined 2D characters, hanging smoke, rock, and natural objects. These made it possible to fine-tune the arrangement, and any oddness between the two was eliminated.

Contributors
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cover image
Detail from Self Portrait: The Consturctor, El Lissitzky, 1924.

background image
Multiplying or Dividing Machine, Otto Steiger, Patent document, 1895.

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