Surrogate Self

by

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ABSTRACT

Everyday life in turn-of-the-Millennium America depends on information networks connecting people at remote locations for activities that were previously carried out in person, such as working, socializing and shopping. These information networks reflect a suburb/city model of urban planning that is itself decentralized and dependent on information networks for normal operation.

Peter Coppin is a product of the Dallas/Ft. Worth technosphere, a prime example of a decentralized city that requires mass use of information networks for its very existence. Peter's life and educational experiences within that decentralized technosphere included time periods both with and without television, as well as employment in the product development department of an interactive television company. These factors influenced Peter to create work that attempts to explore and resolve the isolation engendered by urban sprawl.

Graduate work in the School of Art at CMU consisted of six projects that attempted to create a system for remote interaction as a poetic resolution of this isolation. The culmination of this work, "Project Paradise," used principles of remote human interaction that were developed over the previous five projects.

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1. INTRODUCTION

Late 20th-century American life is shaped by technology concepts that allow people who are physically located in one place to use machines to experience something occurring in another, sometimes very distant place. Television, which allows viewers to see and hear events happening in other places and often–since most programs are recorded first and aired later–at other times, is one obvious example. In addition, telephone technologies allow a person in one place to carry on a conversation with someone in another place. A growing third example is hybrid computer/telecommunications technology such as e-mail, the World Wide Web, and many scientific and business applications we now use to perform activities at one location that either cause effects at another location or depend on information stored and organized at another location.

These technology concepts mediating activity between humans and machines correspond to a trend in which more and more experiences that were once conducted only in person, such as socializing, shopping and working, are replaced by machine-mediated remote experiences. In addition, mediation technology makes previously impossible experiences not only possible, but available on a mass scale.

The development of mediation technology both accompanies and reflects a pattern of growth in U.S. cities that results in decentralization. Cities designed before the widespread use of mediation technologies exhibit structures conducive to in-person experiences: offices, stores, restaurants, movie theaters and other central locations of

everyday life clustered in a "downtown" area small enough to visit on foot. Newer American cities are spread out, connected by highways; they feature large suburbs/ bedroom communities with no specific center or gathering place. These types of cities both depend on and perpetuate the use of mediation technologies.

I am a product of one of these decentralized suburban American cities. While a student in the School of Art at CMU I used art projects to address, explore, and comment on issues relating to decentralized life through the creation of projects that attempted to resolve isolation by allowing viewers to experience an event happening at a remote location through a combination of consumer-level information technology and telerobotics. During my course of study I helped form an art and robotics project team called the Centre for Metahuman Exploration, which focused on the creation of such experiences. We called this process of remote interaction *remote experience*. As we defined it, remote experience was the art of using widely available and accessible information technology to allow people to experience a real event taking place at a remote location.

The focus of my work in the M.F.A. program at CMU has been manufacturing scenarios and interaction concepts to create remote experiences that comment on social isolation. As the production team explored various modes of remote interaction, each experiment directed us towards resolving the viewer's isolation by creating a scenario of remote intimacy and emotional connection. We developed a method that allowed people to experience an emotional scenario at a remote location through the remote control of a

robotically augmented human actor. Our term for this actor was the Cyborg Surrogate Self (CSS).

My graduate work began with the creation of an interactive TV show that allowed viewers to remotely torture a living human in a TV studio by pushing buttons on their touch-tone telephones. Telephone button presses sent electric shocks into the arms and legs of the human subject. Six additional projects based on TV/telephone technologies and remotely controlled robots (telerobots) focused a growing understanding of remote interaction that culminated in a "remote paradise" thesis project called Project Paradise. This work is elaborated on in Section 3 of this paper, "Discussion of Work." The context for this graduate work encompasses current trends in academic media art, academic robotics research, and mass media culture. This context intersects with my own subjective reactions to growing up in a decentralized city in which everyday life depended on mediation technology.

Relevant Formative Experiences

TV or Not TV: My Childhood in Suburban America

On May 27, 1972, I was born in the suburban sprawl surrounding the Dallas/Ft. Worth Metroplex. Space exploration was a feature of the nightly news: the Soviet Lunakod explored the moon in 1973, and the Viking Probe landed on Mars in 1976. *Star Wars* hit the theaters in 1977. By the time I was old enough to be interested in television, shows like *Battlestar Galactica* and *Buck Rogers* were already re-runs. The suburban sprawl I emerged into was constructed in the late sixties/early seventies, so I grew up in a location that provided me with little sense of history. Instead, these recent remote events and mediated TV forms filled my imagination.

However, on a nameless summer day in the mid-1980s, the tube blew on the family television. This changed my life forever by jarring me out of the world of phosphorous simulation and into the world of "reality." I emerged from our house on 3213 Konet St. and into the hot concrete suburban sprawl. I saw that there was nowhere to go, nowhere to play, and most of all, nothing interesting to see. Houses, apartment complexes, warehouses and highways extended for miles, often without sidewalks. This made foot travel, and even bike travel, extremely difficult. Though it might seem strange, adapting to life without television in a concrete world not designed to be pleasurably experienced first- hand actually does make one think about society differently than those who still watch television. Without TV, you cannot participate in the mediated group realities that unite those who have access to that surrogate centralized arena of style,

music, news and fashion. Imagination, books and projects occupied my time until the age of sixteen. I remember reading science fiction books and books about space travel. I remember drawing pictures related to space travel and technology. I remember constructing simple projects, such as an alarm system I made for my room out of a broken toy known as a "space walkie-talkie." Without television, my formative years in the 1980s were a strange hybrid of the self-directed and locally-based premodern childhood, and the futuristic, technology-oriented childhood of most other members of my generation.

This orientation caused me to pursue dual trajectories of both science and art in high school. Educationally, Texas public schools are some of the worst in this country. However, the need for knowledgeable technicians and engineers for the Dallas/Ft. Worth Aerospace industry—such as the LTV factory that manufactured F-4 Phantom fighter jets behind my house–resulted in a superb high school science education. In physics, we covered basic principles that I now apply to art and technology projects. We created mechanical design/engineering projects that instilled styles of thinking essential to my current work. My art teacher, in defiance of all stereotypes, was a crusty ex-Marine airplane mechanic, train engineer, salvage diver and pilot. His approach to production was a healthy complement to science-engineering methods learned in physics.

To fill gaps in my education I studied humanities at the University of Dallas in 1990, but in 1993 switched to art and then sculpture in order to continue the project-oriented approach I had begun years earlier. Though the sculptural emphasis at the University of Dallas at that time was post-formalism, sculpture professor Cam Shoep encouraged me to pursue machine-oriented projects after seeing some of my experiments

in the shop (see fig. 1, 2 and 3). My creations of that period were not a critique or deconstruction of the technological world. Instead, they were unconscious explorations of the technology-based world within which I lived. Making a machine in that environment was as intuitive as Abe Lincoln's whittling a stick in the 1850s.

Fig. 1: Kinetic sculptures from my senior thesis exhibition.

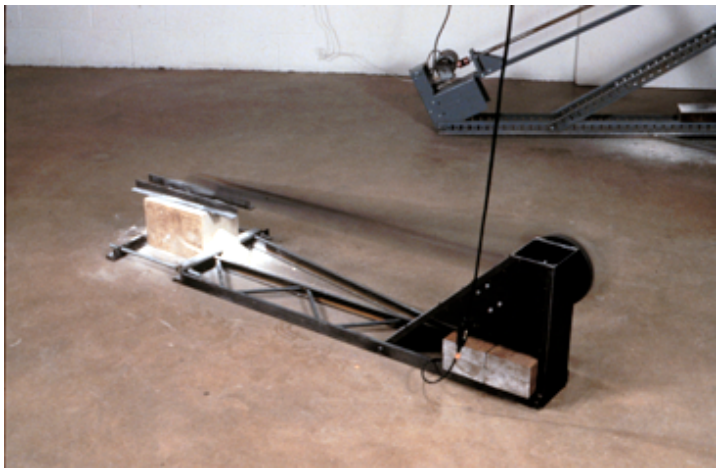

Fig. 2

Fig. 3

The Manipulation of Desire in the Corporate World

After graduation I worked in product development at a Dallas-based interactive cable company, Source Media. There I participated first-hand in content creation for the next generation of the televised distribution systems that had created the phosphorus dream world of my early childhood (see fig. 4). I saw how isolation in a decentralized sprawl led people to seek mediated experiences through television. I then saw how the limited and calculated options available on TV caused people to make inevitable choices among the options presented in television's prefabricated reality. Within the sprawl, the most entertaining experiences tend to be mediated/remote experiences. To "have fun," we explore the limited options offered by TV. This limited option shows us our other limited options. We live, purchase and seek pleasure within the constructed world of limited options.

As an art student trained to communicate by manipulating/manufacturin g an environment for the viewer, I was intrigued by the media control systems I observed at Source Media. This process of immersing a viewer within a world of limited options would become a characteristic of my later work in graduate school (elaborated on in Section Four, "Discussion of Work"), and was already evident in my transitional work during this time (described below).

Fig. 4: One of the online products that I helped create at Source Media Company.

Mobile Throne: An Early Collaborative Art Project

After graduation and before entering CMU, my work process underwent some major transitions. Far from the resources and influence of an art department, inspired by the group-working model of the corporate world, I decided to join with art school colleagues Doug Easterly and Kent Decardenas in forming a collaborative art group called ASDF. Our goal was to create an art installation that reflected the consumer's process of entrapment in searching for happiness.

In 1995 ASDF created and exhibited *Mobile Throne* (see fig. 5) at the Forest Park Art Space in Ft. Worth, Texas. *Mobile Throne* consisted of a live lab rat running along the floor inside a motorized bronze cage that was affixed to a large steel armature hinged on an axis in the middle of the room. At either end of the cage were tunnels leading to freedom. When the rat attempted to run towards the tunnels, however, sensors caused the motorized cage to move with it. No matter how fast the rat ran, it could not outrun the sensor-induced movements of the cage. The tunnels provided an illusion of possible freedom for the rat that induced it to keep running within the arc dictated by the axis of the machine. The rat's race for freedom caused a machine to enact a process that perpetuated the rat's imprisonment. The system created an illusion that caused the rat to seek freedom, but the rat's response to this illusion was the very thing that caused the sculpture to move according to our design, imprisoning the rat. *Mobile Throne* was a

conscious image of the workaday world I had experienced, especially during my time at Source Media, expressing the universal need to seek freedom—or, where freedom is impossible, to pursue illusory representations of freedom.

Fig. 5: Mobile throne.

Paradigm Shift

Working in product development at Source Media taught me the difference between making art pieces that are analogies reflecting the forces of society, such as images conveyed through sculpture and paintings, and actually becoming part of a creative force that shapes society through the creation, promotion and use of mediation technology (TV shows, etc.) At CMU I planned to depart from image-making by using actual telecommunications systems to develop a means by which the public would experience something they would not experience otherwise.

In the same way the rat became part of our system by following its natural urge to seek freedom, happiness, and a way out of the system, I would make people part of a system of mediated experiences using commonly accessible consumer information technology. To induce people to interact, the experience would have to be interesting, believable, and a stimulus to natural human urges. Where the rat sought to get out of a maze and therefore played into the overall plan of the piece, humans would seek freedom within a technological maze of limited options.

Undergraduate Art Education: Truth to Materials

My undergraduate art education in the early 1990s took place in a department that was segmented into "traditional" studio areas, such as painting, printmaking, ceramics, and sculpture. Among these disciplines, only sculpture provided a truly open-ended approach to education by using no set materials or processes by which to create an art object. This created an openness to materials that allowed for the use of machines, video,

electronics and elements of time that would not ordinarily have been used in the other areas of art. My colleagues and I were then able to experiment with the use of machines, chronology, electronics and human interaction within an art setting.

Our teachers had been educated in the 1980s, 1970s, or even the 1960s, which suggests that they were trained in a formalist mode. The overarching characteristic of this formalist and post-formalist education thrust was the idea of "integrity of materials" or "truth to materials." Simply put, truth to materials is creating content by intentionally choosing materials and processes that affect the meaning of an artwork. For example, aluminum could convey a feeling of slickness or high technology, while choosing leather or wood might suggest the opposite. Assembling an object with extreme precision conveys the idea of mass production, even producing an "assembly line" look. Crudely welding an axle motor to a piece of steel, however, implies another meaning entirely. This emphasis on truth to materials provided students with the freedom to explore many new materials and concepts, including time-based work, machines, electricity, concepts of remote control, and organic materials, because this openness to material choice brought new technologies and objects such as TV, video, computers and electronics into the studio. These new mediums reflected social messages inherent to them, which artists could contemplate, explore and manipulate.

Historical and Theoretical Influences

Post-Formalist Sculpture: Horn and Hirst

My use of remote experience as an art form is possible because of the artists and technologists who created important precedents in the 1980s and early 1990s. Popular artists represented in art journals, such as Rebecca Horn and Damien Hirst, created work that articulated the arena of real physical space in a gallery installation, yet used elements of time and organic materials that were a break from the typical gallery tradition. Such work provided a pathway to work created by the Survival Research Laboratories (SRL) that was completely separate from the gallery venue, and integrated organic materials, elements of time, but most importantly, concepts of robotics and violence that were a clear departure from gallery traditions.

For example, Rebecca Horn's important 1993 exhibition at the Guggenheim popularized formalist work incorporating machines as aesthetic elements (see fig.6). Unlike some kinetic sculpture, in which moving components are powered by a visible motor, the gears and levers of Horn's machines were themselves the aesthetic components of the work. Though the history books are full of other artists who have used machines in their work, Horn's devotion to craftsmanship and her use of machinic elements as the aesthetic subject matter of her work melded well with these conservative formalist sensibilities that preached "truth to materials." This acted as a pathway toward non-formalist work using machines that did not adhere to these formalist principals.

Fig. 6: The work of Rebecca Horn.

Also in 1993, Damien Hirst created the work "Two Cows," (see fig. 7) which featured a cow sliced into several sections. Once again the predominant effect of the piece was not the articulation of the material, but the choice of material (a dead cow) and its manner of presentation (severed and placed between plates of glass). This use of a cow as both material and subject matter was perhaps an extreme example of post-formalism and integrity of materials. The machinic/time-based work of Horn and the grisly subject matter of Hirst acted as pathways from the popular gallery art world to slightly more specialized, non-gallery work that not only was often articulated in non-gallery venues but engaged in critiques that did not involve these post-formalist modes of thought. A prime example of this is San Francisco-based Survival Research Laboratories (SRL).

Robotics in Performance Art: Survival Research Laboratories

SRL produced remotely controlled robots (telerobots) for use in public performances as early as 1978, and their work grew increasingly popular in the late 1980s and early 1990s. SRL provided a refreshing contrast to common art conventions in two important ways. First, they used nontraditional processes, materials and concepts for their productions, including telerobots and animals. Second, they created performances geared for mass non-art populations, as opposed to gallery art audiences. Very few of these works used the post-formalist conventions described above to any significant degree: instead, machines were constructed using crude mechanical techniques for purposes of engaging in a performative action (see fig. 8)—often destructive action, such as the machines designed to destroy each other and props in *Illusions of Shameless Abundance,*[1] a typical example of SRL's approach. Instead of conveying meaning through

craftsmanship and juxtaposition of materials, it was conveyed over time through this choreography of mass destruction.

Fig. 7: The work of Damien Hirst.

Fig. 8: SRL's Guncam.

Telerobotics in the Engineering World

1992 news headlines showed a spindly-legged robotic walker crawling into a volcanic crater on Mt. Spurr, Alaska. This legged Walker, Dante II (see fig. 9), was the latest in a long line of mobile robots created at Carnegie Mellon University's Robotics Institute (RI). Remotely controlled robots like the Remote Reconnaissance Vehicle (RRV) and the Remote Work Vehicle (RWV, nicknamed "Workhorse", see fig. 10) were used to explore and decommission the Three Mile Island nuclear plant after the reactor's meltdown in the 1980s. Meanwhile, the Ambler project (see fig. 11) created a prototype for possible robotic exploration of Mars. Other robots, such as Houdini and the Boa robots, cleaned toxic sludge from tanks or asbestos from pipes. All these projects continued Carnegie Mellon's rich tradition of creating robots for both purely academic research and research with immediate industrial applications.

Interdisciplinary Exploration: Telerobotics as an Art Form

From 1984 to 1989, Eduardo Kac and Ed Bennet began creating real situations that could be experienced from a distance. They accomplished this by using internet and telephone technologies to allow an audience to remotely control a mobile robot called *Ornitorrinco* (see fig. 12). In several performances, audiences navigated a room filled with archaic electronics equipment; in another, they navigated a garden. This work was a breakthrough: it created situations that extended the experience of the viewer to remote sites, rather than containing the experience within a gallery scenario as Hirst and Horn had done, or within a performance scenario like that created by SRL.

Fig.9: Dante II at Mt. Spurr in Alaska.

Fig. 10: The Remote Work Vehicle, nicknamed Workhorse.

Fig. 11: The Ambler robotic walker.

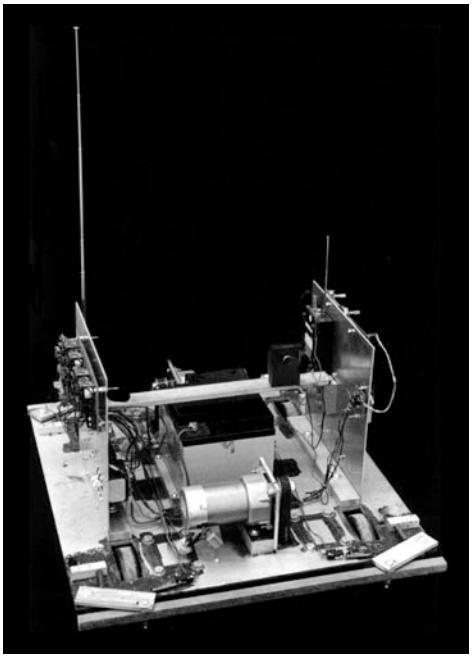

Fig. 12: The Ornitorrinco telerobot and interface.

Meanwhile, SRL's cowboy engineering/shadetree mechanic approach [2] to art and performance creation resulted in an influential use of remotely controlled telerobots for artists. In academia, Kac and Bennet's more controlled approach to robotics reflected a growing trend towards art and technology practice within academic art circles. It was only a matter of time before academic art-robotics began to merge with academic research in engineering-robotics. With its strength in both art and technology, Carnegie Mellon University was a natural locus for this merging: the school's electronic artists created interdisciplinary links with researchers in highly technical robotics and engineering projects. Such cross-fertilization resulted in collaborative efforts by artists and roboticists. Electronic artists Bryan Rogers and Simon Penny, both of whom created kinetic sculpture and robotics (see fig. 13 and 14) in the late 1980s and early 1990s, continued their work at Carnegie Mellon University and, in the process, contributed to such interdisciplinary collaboration. In 1996, for example, I helped form the Centre for Metahuman Exploration after meeting Robotics Ph.D. candidate Martin C. Martin and architecture student Michael Parris in Simon Penny's Robotic Art Studio class[3].

Professor Ken Goldberg, a CMU Robotics Ph.D. graduate and a product of the university's cross-fertilization between art and technology, joined the Computer Science department at the University of California at Berkeley in the early 1990s. In 1995, Goldberg and his collaborators created *Telegarden* (see fig. 15), a real garden in which the general public could sow and care for plants with an industrial robot arm they controlled via the internet .

Fig. 13: The work of Bryan Rogers.

Fig. 14: Petit Mal by Simon Penny.

Fig. 15: Telegarden.

This work built upon the remote experience work of Kac and Bennet, adding the components of responsibility and accountability to the remote experience by making people care for living plants whose survival depended on their ongoing participation. These new components provided an impetus for internet-mediated remote experience to become part of the participants' everyday lives, since avoiding this experience meant neglecting the plants.

During this same period, Robotics Ph.D. student and SRL member Eric Paulos and his advisor Professor John Canny were also working at Berkeley. Together they began creating robotic carts and blimps that could be controlled over the internet. They call these devices Personal Roving Presences (ProPs, see fig. 16). Their goal was and is to make robots that will allow individuals to engage in individual exploration with other people. This would be a step beyond teleconferencing: not only could ordinary citizens view a remote location by logging into a mobile robot instead of traveling there in person, they could also interact with people at the location via their robotic surrogates. [4] Other experiments in remote control of surrogates—in this case, human surrogates—included the 1996 Centre for Metahuman Exploration Interactive Television project, which allowed the public to engage in real remote torture on live television. This led to other projects related to remote human control, all of which will be elaborated on in Section 4, "Discussion of Work."

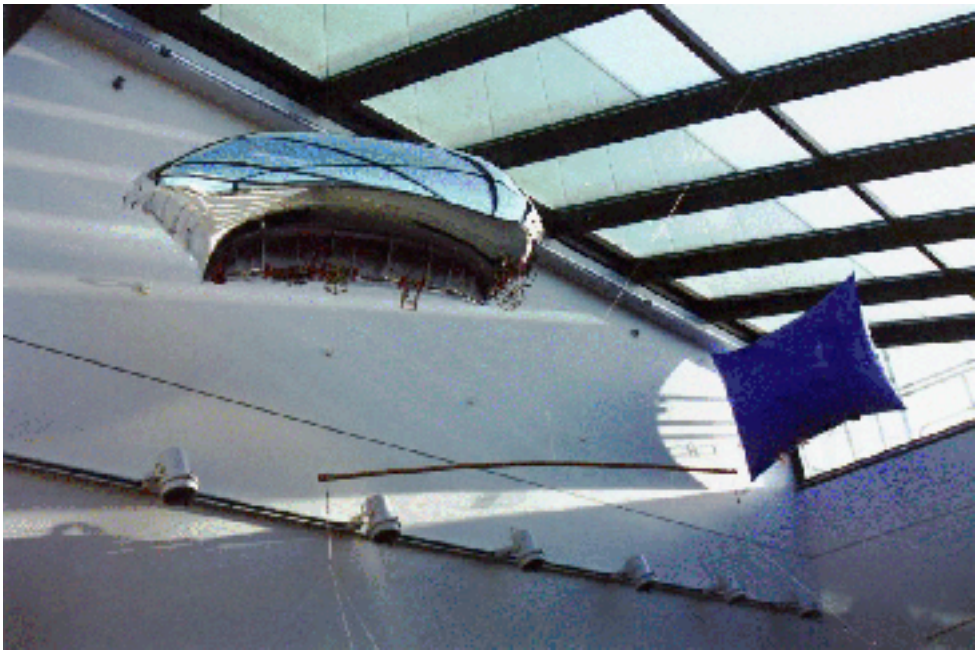

Fig 16: ProP's.

Public Remote Experience in the Robotics Research Community: The Lunar Rover Initiative

Artists are not alone in working to bring remote robotic experience to the public. The CMU team responsible for the Dante II robotic walker, led by scientist William "Red" Whittaker, spent the mid-1990s engaged in such efforts. Funded by NASA and promoted by a new company called LunaCorp, this team's Lunar Rover Initiative (LRI) project has as its ultimate goal the deployment of two robotic rovers on the surface of the moon and the unveiling of a system that will allow the general public to remotely control the rovers from a theme park in the year 2000. The benchmark for 1997 was to deploy a robotic rover called Nomad in the Atacama Desert of Northern Chile (see fig. 17), with a public interface at Pittsburgh's Carnegie Science Center. This public interface would allow the general public to control a rover located 5000 miles away. This research intersected with art production when the Centre for Metahuman Exploration produced Rover TV as part of the public interface for the Atacama Desert Trek. This will also be elaborated on in the next section.

Fig. 17: The Nomad rover during the *Atacama Desert Trek*.

4. DISCUSSION OF WORK

Overview: Developing Principles for Remote Experience

The goal of my graduate work at CMU was to create a system for remote human interaction that sought to resolve the isolation of suburban sprawl. The project team created six projects, each of which contributed to the development of principles for remote human interaction. Our interpretation of audience response directed us to create a process called the Cyborg Surrogate Self (CSS), a human-machine emotional sensor/affector[5] that allows users to be involved in a scenario of remote intimacy. The CSS is a robotically augmented human actor that can be controlled by a remote user, who throughout the process experiences the scenario from a simulation of that actor's first-person perspective. The remote user maintains this illusory first-person perspective through carefully placed cameras that simulate the viewpoint of the actor and feed what he/she sees to the user via video images presented on television monitors. We used the ubiquitous and user-friendly interface of the standard touch-tone telephone so that we could prototype systems for gallery installation, yet also deploy these same systems to the public over public access television/telephone networks.

The principles for remote human interaction that we evolved were the result of experiments created over the three years preceding the deployment of *Project Paradise*, the best and final CMU-based implementation of the CSS system. These principles of remote human interaction are:

1. ***People want to focus on other people.***

Given the choice of focusing on a human or on anything else, they will choose to focus on a human.

To respond effectively to this principle, a scenario must either make humans the object of focus or leave them out of the subject matter entirely.

2. ***Unless distracted by something more interesting, people will subvert a scenario to satisfy their skeptical inquiry.***

We found that people performed incredibly sadistic and subversive acts in our remote reality situations.[6] Perhaps this response is a form of reality testing: when confronted with a remote reality, participants use violence and destruction to explore whether or not the remote situation is real. In a simulated world, such as a computer game, it is impossible to break the "reality": nothing the participant does truly matters. In the real world, however, it is possible to wreck cars and hurt people. Perhaps the viewers assume that if they can wreck a machine or hurt someone, the situation is real. If it is impossible for them to inflict pain or destroy some component of the system, they may assume it is fake: not a computer-based reality, but a computer game.

The key to resolving this tendency is to either make violence and destruction part of the theme of a piece, create an object of focus that is more interesting than the pleasure that would be gained through trying to determin if the system is real, or convince the audience that the piece is real, so that they do not manifest questions through subversive actions.

3. ***The audience must already want it.***

To interest people in our remote experiences, the system must provide something that satisfies desires most people already have.

This is accomplished by articulating a cultural/biological need or lust, a need for intimacy, or a sadistic impulse.[7] In fact, the audience response to a piece can be examined in order to determine what it was that the audience wanted—and subsequent pieces can be created that attempt to resolve that desire.

Project Descriptions: Artwork and Techniques for Remote Experience

The principles described above were developed over a period of three years and were based on our analysis and interpretation of audience response to each new art installation our team created. These installations will be described below in chronological order. Each subsection describes an art project, including a project description, results and audience response. Where appropriate, subsections may also include questions raised by the audience response, conclusions, or a detailed thematic analysis.

The Interactive Television Show

When I arrived at CMU in the fall of 1995, I did not have a clear understanding of remote interaction. However, I already wanted to create a contrast to the simulated world of television by providing an instance of *reality* through television. I joined with like-minded collaborators[8] to create an instance of *reality* by providing live imagery from a scenario of remote violence that took place in a television studio.

To confirm this reality to the audience, we needed an interactive loop between the viewers and the remote site. We accomplished this by adapting a "call-in talk show" format, where viewers can call and speak to show participants over the air, by giving audience members the additional possibility of physically affecting what happened on television by pressing buttons on their touch-tone telephones to trigger actual, though controlled, violence in the TV studio. We called this project The Interactive Television Show (see fig. 18).

Fig. 18: The Interactive Television Show.

I-TV Project Description

A human subject was suspended in a television studio. Electrodes were placed on various muscle groups in the subject's arms and legs. The electrodes interfaced with a four-line telephone system. This system allowed the TV audience to remotely control the muscle system of the human subject by using their touch-tone phones to send mild electrical shocks. Callers could speak to a hostess who greeted them and explained how the system worked.

I-TV Results and Audience Response

On the day of the television show, the four-line telephone system at PCTV Channel 21 was jammed with excited callers. Though interactive television was a new concept for Pittsburgh viewers and the show was barely publicized, channel surfers apparently wanted nothing more than to inflict as much pain as possible on the human they saw on their screen.

Unresolved Questions Leading to Principles 1 and 2

The success of interactivity in this project raised two major questions that became clues leading to Principles #1 (focus on a human) and 2 (sadism as a form of skeptical inquiry by users). The questions I-TV inspired were:

- Why was torturing a human so interesting for participants?
- Was it the realism that was most seductive, or the violence?

The project team chose to explore these questions by creating another television show with similar subject matter but different overtones. This would require the creation of new technology for a new interactive system.

Inverse Human, Absentee Ballot: New Technology for Remote Experience

Direct muscle stimulation was suitable for the Interactive Television Show, but it inherently contained the overtones of torture and sadism. We wanted to explore a non-violent interactive scenario in order to shed light on the results of I-TV by providing a non-violent contrast.[9] Furthermore, the limited amount of control that the audience could exert on the human subject always made the human *the subject*. Instead, we wanted to create a system where remote viewers could control a human in order to engage in a *directed task*.

Over the next few months we[10] began construction of a robotic exoskeleton, a remotely controllable machine designed to surround the right arm of a human being (see fig. 19). We named this device *Inverse Human*.[11] Designed for both closed circuit and remote control, we could interface Inverse Human to a data-glove-like hand controller or a conventional touch-tone telephone system. Though we had created a system and broad concept of distributed control for remote experience, we wanted a specific task towards which audiences could direct the remotely controlled human. For the fall of 1996 the project team[12] chose to focus on the 1996 American political election through an interactive television show called *Absentee Ballot* (see fig. 20).

Fig. 19: Inverse Human.

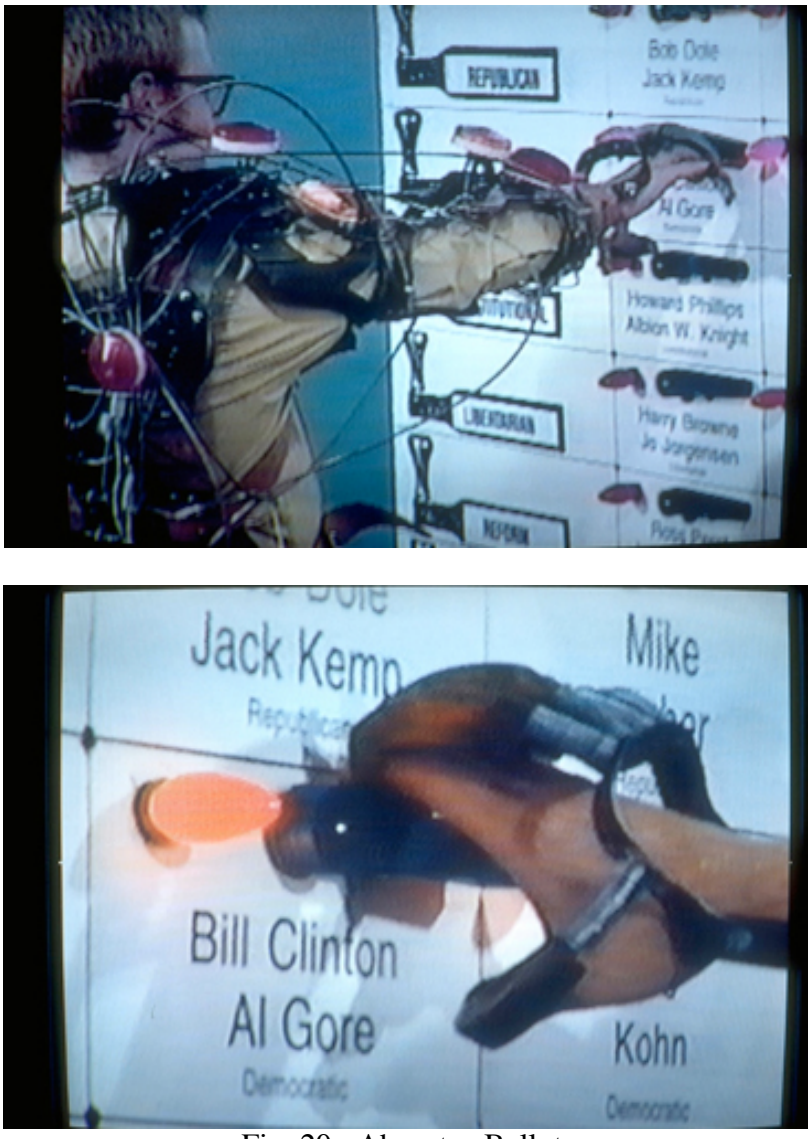

Fig. 20: Absentee Ballot.

Absentee Ballot Project Description

Absentee Ballot combined the call-in format we had developed with I-TV and a human actor wearing the Inverse Human exoskeleton. On their TV screens, standing in front of the ballot, viewers saw the Inverse Human-wearing American voter they could control via telephone. In this way, TV watchers could participate in the voting process through the remote control of the American Voter. Viewers saw the effects of their control on a real voter for the purposes of casting a ballot in an election where they had no visible effect. Commentators and a host provided background information about candidates and explained how the interactive voting system worked (fig. 21).

Absentee Ballot Results and Audience Response

Absentee Ballot did not turn out as we expected. In addition to various technical problems[13] we experienced, it soon became clear that users enjoyed bashing the robotically augmented voter more than the process of game show voting. Considering the results of both *The Interactive Television Show* and *Absentee Ballot* together led to important insights regarding our remote experience projects.

Conclusions from both Absentee Ballot and I-TV

In both *I-TV* and *Absentee Ballot,* viewers focused on the human presented on their television sets. This resulted in problems for *Absentee Ballot* and success for *I-TV*.

In the case of *I-TV,* people responded to the show as an outlet for sadism.

Fig. 21: Hosts provided background information in Absentee Ballot.

In contrast, the audience seemed unable to relate to the more esoteric interactive voting scenario of *Absentee Ballot*. Their response was to revert to sadism once again through the misdirection of activity towards the augmented voter.

This information points to the following conclusions:

- Principle #1, that when given a choice to affect a machine or a human, an audience will chose to affect a human. For example, in the case of *Absentee Ballot* the audience attempted to inflict harm on the machine- augmented voter rather than on the voting machine.

- Principle #2, that if an audience is given control of a *real* situation when they are accustomed to a *simulation,* they will test the reality by pushing the system to the limits. In the case of I-TV this meant that they tried to kill, hurt, or maim the human subject on TV. With *Absentee Ballot,* they also tried to hurt the robotically augmented human.

- Clues to Principle #3 were found by observing the success of *I-TV* in contrast to the failure of *Absentee Ballot*. An artist must give people a reason to interact by articulating cultural needs that the audience already has. In the case of *I-TV,* people related to the show as an outlet for their existing sadistic impulses. In contrast, the audience failed to identify with the more mundane interactive voting scenario of *Absentee Ballot*, and they reverted to sadism and reality testing.

Boundary Link: **Focus on Human Communication**

We next decided to try a non-TV related scenario, focusing instead on interpersonal communication. Our basic materials were the ubiquitous, familiar and intuitive technology of the standard telephone system. Further investigating Principle #1, we hypothesized that people would be drawn by curiosity to the experience of communicating with people they would not ordinarily meet. To create this experience, we chose to link two widely divergent communication sites: an arts festival at Carnegie Mellon University, and the very different scenario of a maximum-security youth prison.

Participants at both sites would therefore be of similar age, but probably very different backgrounds. Because we were creating a link between two distinct groups separated by spatial and social boundaries, we called the project *Boundary Link* (see fig. 22).

Boundary Link Project Description

The installation at the 1997 Wats:on? Festival consisted of four architecturally modified telephone booths placed in the College of Fine Arts at Carnegie Mellon University, the festival's host. Inside of each phone booth were images of preselected detainees at the New Castle, Pennsylvania Youth Development Center , and telephones that allowed festival goers to speak with them.

At the beginning of the performance, festival attendees heard telephones ringing inside each booth. When they answered the telephones, they engaged in conversations with residents at the detention facility, a contact that would be unlikely to occur in other settings. *Boundary Link* was presented again at the Three Rivers Arts festival in the summer of 1997.

Boundary Link Results and Audience Response

Audience members responded well to the ringing booth system, entering booths when they heard the telephones ring. We relied on basic curiosity on the part of the viewers to interest them in speaking to the remote convicts (Principle #3). We also relied on the fact that the object of focus was a real human being to stimulate interest (Principle #1). Because both the convicts and the festival visitors were real people, with no roles mediated by actors, the scenario was very convincing (Principle #2).

Fig. 22: Boundary Link.

These factors worked together to attract many viewers to the piece and hold their interest for over two hours.

Rover TV: Exploring a Desert 5000 Miles Away

In the spring of 1996, the Centre for Metahuman Exploration project team heard strange rumors about a project going on in the mysterious and often secretive world of the Robotics Institute at CMU. Researchers were working with a company called LunaCorp to make a remote theme park ride to the moon. The goal was to create a system where theme park attendees would sit down at a theme park style "telepresence" console, which would provide them with a direct satellite link to a robotic rover on the moon. Through this rover, the user could remotely explore the lunar surface.

Planetary exploration research is a multi-year process. At that stage, the RI/LunaCorp project was primarily a NASA demonstration of future robotic technologies. The 1997 project goal was simply to deploy a robot in the Northern Chile's Atacama Desert, whose terrain is similar to that of the moon. To further our goals of bringing remote experience to the general public, the Centre for Metahuman Exploration submitted a proposal to the Robotics Institute for a remote-experience TV show that would allow viewers to explore the Atacama Desert by interfacing the capabilities of the rover with a live interactive television show.[14]

Rover TV Project Description

Two episodes of *Rover TV* (see fig. 23) were aired on PCTV Channel 21. The episodes allowed viewers to see imagery transmitted live by the rover from Chile's Atacama Desert, and also to control the rover's movements by dialing a number on their touch-tone telephones. Telephone button presses controlled both camera movements and steering of the rover.

Rover TV Results and Audience Response

During both episodes of *Rover TV*, callers were interested enough in what they saw that roughly thirty of them called in to drive the rover and speak to the on-air host. According to on-air comments by viewers, the similarity to planetary exploration and the massive publicity surrounding the NASA trek whetted their innate curiosity, spurring them to participate (Principle #3). During testing before the official episodes were broadcast, viewers saw scientists in the distance. They immediately steered away from their previous objective and headed toward those scientists, clearly indicating that other people were more interesting to them than the barren desert terrain (Principle #1). The placement of the camera on the rover provided a "first-person view" [15]of the remote terrain. This, in addition to the fact that the system responded to their button presses, convinced many of the participants that the scenario was indeed real. However, the time delay between button presses and rover movements that resulted from the satellite relay system between Pittsburgh and the Atacama, in conjunction with the slow turning speed of the rover, made some drivers feel that the scenario was fake. Some users responded by attempting to drive the rover into obstacles or ditches (Principle #2).

Fig. 23: Rover TV.

One viewer refused to even push buttons, insisting that they thought the scenario was fake. Possibly viewers were so used to a world of simulation that they could not believe that normal citizens would be placed in control of a NASA rover.

Though *Rover TV* was a conceptual departure from our other human-control projects, it still provided the important lessons described above, which we used to validate our theories of remote human interaction. One concept we took with us to future projects was how crucial it was to incorporate careful camera placement simulating the perspective a viewer would have if they were at the remote environment. This is a fundamental technique used in telepresence that we had not explored until that time[16].

Petting Zoo: Cyborg Research at ISEA 1997

By this time, we had a clear understanding of our three principles of remote human interaction. We began to start planning our thesis show. To be completely successful, it would need to provide interaction with other humans as the principal subject matter (Principle #1), be convincingly real as a result of careful camera placement and believable subject matter (Principle #2), and hold participants' interest by responding to needs or desires they already had (Principle #3). Fusing principles #1 and #3, we considered making it erotic in nature.

Because our pending thesis exhibition was to be presented in a gallery, we needed to figure out a way to present this interactive TV work in a closed-circuit gallery scenario. We decided to use a booth system similar to that of *Boundary Link*: a ringing

telephone inside a booth would draw viewers away from other areas of the gallery and into the isolation of the booth, which simulated the isolation of suburban sprawl[16].

To subvert the violence and destructive impulses that accompany skeptical inquiry (Principle #2), we decided to carefully place cameras so that viewers could not see the faces of the people they were controlling. Instead, they would see "first-person views" of the actor's hands and arms, much as in a computer game like *Doom* or *Quake*[17]. This would be in contrast to *Absentee Ballot*, where participants saw the human they controlled as separate from themselves. We hoped that by placing the camera in such a way, we would trigger users to see the robot-wearing human actor as an extension of themselves. Our hope was that this would deter the types of audience subversions of *Absentee Ballot*, drawing participants' attention away from the possibility of inflicting real harm and towards accomplishing a task. We developed this idea from participants' response to the first-person camera placement in *Rover TV*.

Since we did not want any controversies to stop us from deploying the thesis show that was nine months away, for the ISEA experience we chose to focus on something tamer than erotic interaction with a human. Instead, we designed a presentation that allowed viewers to pet a little bunny rabbit. Though not an erotic scenario, empathy and the desire to nurture fellow living creatures is still a powerful drive (Principle #3) that people often express as affection towards pets and children. At this time, we created a name for this notion of using a robotically augmented human to transmit both human will and emotion to subjects in remote environments: the Cyborg Surrogate Self.

Petting Zoo Project Description

Gallery attendees heard the sound of a ringing telephone coming from the interior of an aluminum isolation booth (see fig. 24). Participants entered the booth and answered the ringing telephone (see fig. 25 and 26). A TV monitor in the booth switched between two views. A long view showed a robotically encased human arm: users found that by pushing the buttons on the telephone, they were able to move the arm. The monitor also switched to a more intimate, "first-person" view that revealed a living, breathing rabbit on a field of grass. By pushing buttons on the telephone, participants were able to move the joints of the human arm in order to direct the arm towards the rabbit. Using this technique, they could successfully pet the bunny rabbit. By speaking into the phone, they could even speak to it. In addition, we used a hidden control room to adapt the decentralized interactive TV scenario to the centralized gallery scenario. The rabbit existed in a separate environment in a hidden part of the gallery (see fig. 27).

Petting Zoo Results and Audience Response

As in *Boundary Link,* the ringing booth system successfully triggered viewers to separate themselves from the rest of the gallery. During the course of performances at ISEA, hundreds of viewers interacted with the piece. Interviews showed that users found the piece enjoyable; many users returned several times to re-experience *Petting Zoo*. Interestingly, only one viewer tried to harm the rabbit or Cyborg Surrogate Self.

Fig. 24: Petting Zoo isolation booth.

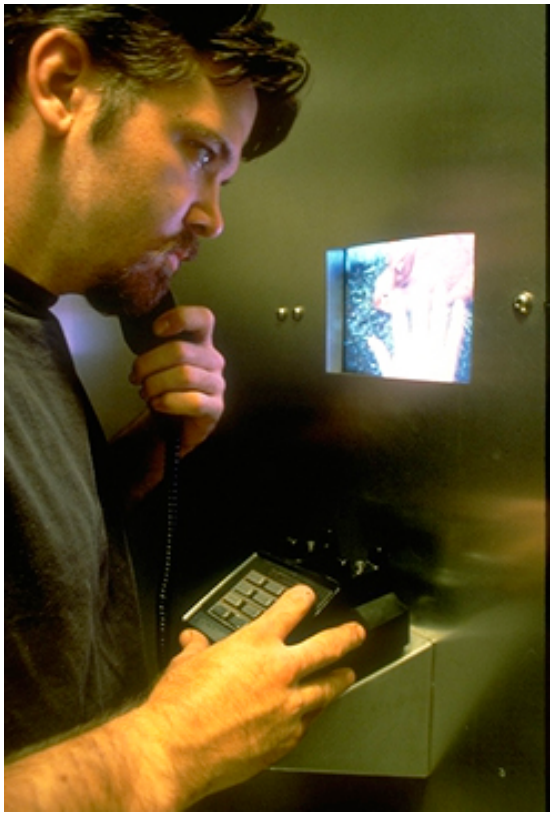

Fig. 25: Users enter booth and answer the telephone.

Fig 26: Petting Zoo user interface.

Fig. 27: The rabbits environment, the “cyborg” and the control room.

How Petting Zoo Articulated Principles #2 and 3

According to viewers, they experienced the Cyborg hand as an extension of themselves[18] (Principle #2). In addition, the rabbit behaved like a flesh-and-blood rabbit: a living thing that visibly responded to the caresses of users. Viewers stated that this both emotionally validated their experience and convinced them that the scenario was real (Principles #2 and 3). A rabbit responds well to being petted by a human, but not by a machine; extending the viewers' will via a living Cyborg hand was thus necessary to make the rabbit respond positively to the caresses in Petting Zoo. In that way, the use of the Cyborg Surrogate Self made possible the creation of a convincing scenario.

This system of extending the will of a viewer through robotic augmentation of a human actor, using the actor to transmit human emotion and affection, is the essence of the Cyborg Surrogate Self concept: a machine alone cannot transmit and receive human emotion. Creating a character through whom the viewer can relate to the remote site is not a new concept: it is an extension of traditional literary concepts found in fiction, movies and other cultural processes.[18] One novel element of our work is the linking of viewers to a real person/actor who is placed in a real remote scenario instead of a fictional one: this creates a space for genuine interactivity.

Project Paradise: **The Wire Through Which Happiness Flows**

As previously explained, the overarching goal of my graduate work was to present increasingly better pre-packaged experiences to viewers by creating scenarios that respond to their suburban isolation. The CSS seemed to resolve the physical

isolation of the suburban void by providing a surrogate who could transmit participants' emotions and their desire to overcome loneliness to a remote location—one to which they did not otherwise have access—in which they could attempt to confront and transform this isolation.

After the research we conducted through the series of projects described above, the obvious response to this isolation was the creation of a "remote paradise," or a wire through which happiness flowed. Our goal was to pre-package "paradise" much as corporate manufacturers pre-package other consumables, presenting them as ideal responses to people's needs: a tube of toothpaste to provide you with what you need to clean your teeth and join the hallowed ranks of the young and attractive, for example. Unlike many consumer products, however, *Project Paradise* was not presented as a means of obtaining those personal qualities that are supposed to bring happiness; it was designed as a direct line to happiness itself, bridging the gap between reality and that which people desire by bringing a remote erotic experience directly to participants.

Project Paradise Installation Description

Instead of a single isolation booth as in *Petting Zoo,* we used two aluminum isolation booths and a cylindrical chamber connected by video and telephone cabling (see fig. 27). Each isolation booth contained the interface to *Paradise* in the form of a television and a telephone (see fig. 28). The ringing telephone beckoned exhibit patrons to enter the booth; after answering the telephone, participants received a brief introduction and instructions. They then entered "Paradise," the cylindrical aluminum chamber located elsewhere in the installation, which contained a lush, plant-filled

"garden of Eden" and two robotically-augmented but otherwise nude people: the Cyborg Adam and Eve (see fig. 29). This "Paradise" could only be experienced through telepresence via the robotically augented human actors. Through these Cyborg Surrogate Selves, participants could touch the grass, the flowers, and the flesh.

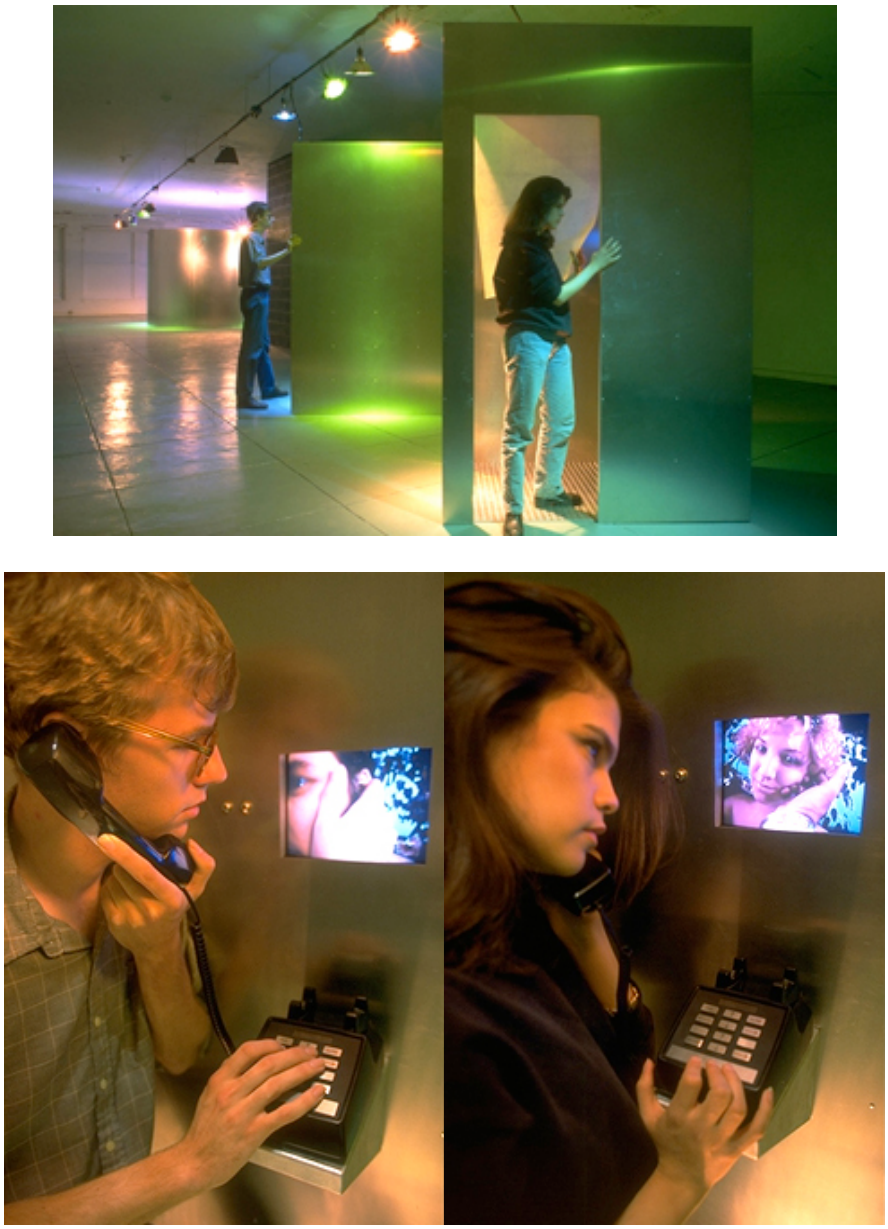

Fig. 28: Project Paradise installation view.

Fig. 29.

Fig. 30: The tank.

Project Paradise Results

Paradise was the most successful implementation of our interaction principles and CSS system. As stated earlier, no users attempted to subvert the piece by harming actors or damaging machines. Few users attempted to engage in acts of skeptical inquiry by trying to find "holes in the system." The piece was extremely popular: we had many repeat customers, and we were invited to show the piece in many venues in both the United States and Europe. In the summer of 1998, Project Paradise was shown at Siggraph in Florida; this exposure led to an invitation to appear at the fall 1998 Ars Electronica in Linz, Austria, which we eagerly accepted. Another invitation brought it to the December 1999 Mir: Art in Space show in Bolzano, Italy. An appearance in Copenhagen is planned for spring of 2000.

Eroticism and Project Paradise: Merging Principles #1, 2 and 3

Project Paradise, which used eroticism as the arena of articulation, was the culmination of the interactivity principles we developed over the course of our three-year collaboration. *Paradise* allowed users to erotically interact with other human beings via Cyborg Surrogate Selves. This represents one possible distillation of principles #1 and 3 within the framework of the Cyborg Surrogate Self, since the erotic is both inherently focused on other people and innately desired by human beings. Other common human desires such as love, money and power can be conceptualized as related to, or in some cases rooted in, eroticism; TV, movies, commercials, and now computer games all manipulate this fact. Eroticism also resolved Principle #2 (unless distracted by something

more interesting, people will subvert the piece) in two different ways: by stimulating the participants' desire to explore and satisfy their erotic feelings, it outweighed any urge to test the reality of the system through acts of subversion; and by employing the first-person perspective of the CSS, it created a convincing remote reality.

In addition, *Paradise* employed conventional techniques derived from movies and broadcast television to enhance believability. For example, when a user "touched" Eve's breast via the cyborg Adam, the user saw Eve's lusty smile of pleasure straight into the camera[19]. The effect successfully conveyed the reality of the erotic situation and also provided a pleasure that, for most users, was greater than the pleasure of reality testing, so that users felt no need to hurt actors or break machines. Furthermore, because *Paradise* was essentially designed as an interactive TV show to be shown in a gallery scenario, we employed an isolation booth system for each remote user and a containment vessel that hid the cyborgs and their environment from the view of those outside the isolation booths. By manufacturing a specific environment for the user and only presenting them with mediated views of the garden paradise, the illusion conveyed through the television remained intact. In this way, we used TV/Hollywood artifice and manipulation of viewers' emotions and lusts for an unusual purpose: not to suspend viewers' disbelief in a fictional scenario, but to confirm the authenticity of a real scenario.

Discussion of the Goals of my Graduate Work

The artistic content of this work is not best understood on a piece by piece basis; it was an evolving body of work. The decisions regarding the scenarios used in each piece were not necessarily poetic, since the structure of each individual scenario integrated basic principles found to be effective in earlier pieces with common modes of consumerism. For me, the poetry is to be found in the system we devised for resolving a viewer's isolation by creating a scenario of remote intimacy and emotional connection. This was a poetic response to the isolation of suburban sprawl and the mediated/simulated realities[20] that accompany it. The "art" was the macroscopic form created through the willing participation of users in a machinic system that capitalized on basic human needs, creating planned actions through the presentation of limited options.

On a basic level, this work was a human-focused instantiation of the rat interaction in *Mobile Throne*. In that piece, the more the rat tried to be free, the more the sculpture would unfold according to our design. Likewise, the more people try to escape the isolation created for them within the sprawl, the more they depend on an interactive system provided for their happiness and their harvest. In this way they play into the goal of the information networks' creators. Our satire with *I-TV* and *Paradise* allowed people to freely choose *only* what *we* wanted, as is usually the case in marketing. As in *Mobile Throne,* we depended on the free will of the participants to control what they did. In other words, we used our growing knowledge of the ways people were likely to direct their free will as a paradoxical means for controlling what they did.

The Satire of Decentralized Pleasure Control

In many ways, this work was a satire of modern utopia as informed by the principles of consumerism/freedom. People are sold a means to attain the image of freedom/happiness: products, lifestyles, government systems, ideologies and fashions are among the things marketed as means of attaining that freedom. Various images of freedom/happiness are conveyed via soap/beer/product commercials, political speeches and manifestos, all of which imply that certain predetermined choices must be made if one is to experience happiness. Like the *Mobile Throne* rat heading for the freedom tunnel, people consume products as a means of pursuing this ever-elusive state. Sometimes the image of freedom/happiness is a bikini-clad lass on a Saturday afternoon beer commercial, or an SUV bouncing adventurously through a scene of great natural beauty. Sometimes, more simply and more subtly, it is the promise of security and a suitable human breeding sanctuary in a suburb that can only be reached through the choice of certain professions and lifestyles.

Exploiting Desire: Where Art Meets Marketing

Concretely, the basic principle of consumerism is that people will choose the one option among many that seems likely to make them the "happiest/freest." Furthermore, different people will usually make similar decisions if they are placed in similar situations. Perhaps, on a macro scale, a human placed within an isolated machinic system of limited options will behave just as predictably as a machine. Thus, in the same way that electrical current can be exploited for an engineer's design, human quests for "paradise" can by exploited for an artist's or marketer's design.

In our case, we discovered the factors that make people enjoy a system of remote interaction. In our final project, we employed these factors to make "a wire though which happiness flowed," "a coloring book that could be crawled into," "a renaissance painting that was alive." Choosing a classic theme that depicted a time before complication, isolation, sin and technology, we decided to create a prepackaged "Garden of Eden" for the consumer.[21] However, unlike the classic myth, our garden does not contain any complicated choices about the future of humanity: ours is garden of Eden made safe for the consumer. Like a shopping mall, video game or Disney, there is no real danger, no real choice, and most of all, no chance to fall.

4.CONCLUSION

My graduate work with the Centre for Metahuman Exploration provided a direction for my artistic process, which is now becoming formal university research and may not, at first, seem to be directly related to art. As a starting point, Centre for Metahuman Exploration team members Alexi Morrissey and myself gained outside funding for a 1998 CMU Robotics Institute initiative called Big Signal. As artists, we use the artistic process and the principles of human interaction we discovered during graduate study to develop telerobotics projects that allow the public to remotely experience places they could not otherwise visit. The public accesses these places via easy-to-use interfaces that Big Signal designs to function with consumer-level internet browsers. Currently, these interfaces provide a visual link to a NASA telerobot at a remote location. While the applications of Big Signal's projects are currently educational and scientific, the research conducted for each project addresses important issues of human interaction that need to be investigated in order for remote experience to become a widely available mode of exploration/expression. Like movies and television before it, this artistic exploration will eventually give rise to an industry.

Overall, my CMU graduate work was suitable ground upon which to gain an understanding of the principles of remote human interaction, to deploy that work within information networks that many people have access to, and to respond to the concerns of that population. This was a starting point towards a life as a creative individual within modern Western society. However esoteric or "strange" my projects may seem to the layman, I take comfort in the fact that many fields and industries we now take for

granted—TV, the internet, and so on—were once the domain of a few individuals whose passion turned idiosyncratic research into vast industries. When the TV and movie industries were young, for example, people used the nebulous territory of art or an equivalent experimental forum to test new ideas that became research, and ultimately industries. Interestingly, once a form of artistic exploration gives rise to an industry, or even begins to make a significant amount of money, people tend to stop calling it art. In TV and movies, for example, project managers are called producers, and artists are called actors, screenwriters or production designers. Such labels do not diminish the creativity of the activity or the artistic process involved. Throughout my career, I will always use the artistic process to create projects; however, often I will express myself within industries that are not generally considered part of the art world.

As I discovered early in life, modern U.S. cities are barely livable anymore unless one has access to information technology. For the most part, it is too late to change that fact: 99% of American households own televisions, and two thirds have cable TV.[22] As far back as 1993 Americans left each other 12 trillion voice mail messages,[23] and trends suggest that by 2002, 90 million Americans—more than one adult in 2—will own cell phones.[24] Half of American households have computers,[25] and 78% of American schools are wired to the Internet;[26] life in this country is organized around this integration of technology into our everyday lives. However, the information technology that mediates the lives of most Americans is currently shaped by the forces of consumerism. It is these forces that much of my graduate work participated in and parodied. If the traditional role of the artist is to communicate with people and to facilitate communication between

people, then it seems that helping to create the new ways people will use information technology to live in the future is a natural and legitimate role for the artist, and one that will allow artists to create a more fruitful living environment than consumerism alone could ever produce. That is the role I will play.

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[1] Available from www.srl.org

[2] The term "shade tree mechanic" is slang referring to mechanics who work at home on their "hot rods," adding customized components that augment the features of the automobile well beyond factory specifications. This statement refers to early SRL work, much of which consisted of drastically altered automobile technology. This is in contrast to the more academically or industry oriented robotics technology.

[3] Simon Penney's Robotic Art Studio resulted in extensive collaborative work between roboticists and artists. Not only did it lead to the initial Centre for Metahuman Exploration work, but the members of other student groups, such as the Institute for Applied Autonomy, all at one time or another took that class.

[4] This falls into the field of Personal Robotics, an emerging area of robotics research. Personal Robotics is the convergence of several areas which are currently rather different, but which are united by the essential role of the "human in the loop." (Canny)

[5] *Affector* is a robotics term referring to a device on a robot that can be used to affect the outside world.

[6] This refers to the sadism in the *Interactive Television Show*, the attempt by the audience to strangle the robot-wearing actor in *Absentee Ballot*, and the attempt by the drivers of the Nomad Rover in *Rover TV* to drive into ditches and towards scientists.

[7] In this way, we are joining other product creators in the world of consumerism that capitalize on an ability to provide a service for a given market.

[8] I formed a project team consisting of Visiting Professor Brent Scott, undergraduate Ryan Douglass and undergraduate Margaret Cox. This project was a perfect hybrid of the team's skills. I was interested in remote interaction upon human beings as an extension of the *Mobile Throne* piece, while Scott had previously experimented with electrode muscle stimulation of human beings. Douglass was a student and performance artist who created works where he was subjugated/humiliated himself in public. Margaret Cox, the hostess of the show, had spent the semester interviewing the public as part of a public art project called "The Post-Modern Cowgirl."

[9] In addition to resolving the questions raised by I-TV, we needed to deploy a non-violent project in order to exhibit nationally and internationally. We also wanted to pursue funded ventures, which would need to be more socially acceptable.

[10] At this point I began working with Martin C. Martin, a Robotics Insitute Ph.D. student, and Michael Parris, an Architecture student. We met in a class taught by Art/Robotics Professor Simon Penny, Robotic Art Studio.

[11] The machine's name, *Inverse Human,* reflects its subversion of the normal concept of human action, in which a person directs the movement of his or her own body parts. The exoskeleton did the inverse, by distributing control of an individual to a third party at a remote location.

[12] For this project, Art MFA student Alexi Goodrich (also called Alexi Morrissey) began working with the CME as a core member. Art MFA student Ricardo Mirando played the role of an on air host, while roboticist Jesse Easudes provided technical coordination and, once the bugs inherent in the TV studio's system became apparent, emergency troubleshooting.

[13]*Absentee Ballot* was finished at the last minute, which prevented staging of a test run prior to broadcast. The studio's telephone system was initially configured in such a way that signals from viewers' phones were at too low a voltage to trigger movement in the robot arm, and as a result the robot malfunctioned for nearly ten minutes on live television until the problem was finally identified and fixed. For me this was a painful but important lesson in project management. In addition, once Inverse Human was functional, viewers immediately subverted the scenario by attempting to strangle and otherwise maim the human actor. This was an important lesson in the psychology of interactive art.

[14] At this time I was already working in the robotics institute on a much less glamorous project known as the BOA asbestos removal robot. By the time the fall of 1997 rolled around I had switched to the Nomad project, and all of the Metahuman team somehow became involved.

[16] What we really gained from Rover TV was not a conceptual artistic leap, but a new way of working. For the first time we entered the world of formal proposals, budgets, and institutionally funded activity. Funding allowed me to spend a summer working on nothing but interactive art projects. This blissful and unusually sane experience was one factor that led us to form a funded research initiative.

[16] I feel that *remote* human interaction is only really necessary or even effective when viewers are in a state of physical isolation. A gallery situation is a centralized meeting ground for the public, so drawing individual visitors into the isolation of the booths was a necessary feature in the success of gallery-based deployment of this type of work.

[18] Audience response to this installation was gauged both in interviews and from statements people made into the phone, which are documented on our archived videos.

[18] The Cyborg Surrogate Self extends the literary/artistic notion of empathic identification into the realm of telepresence through the creation of an empathic avatar who act as a first-person emotional sensor/affector. This type of avatar, or surrogate self, exists in literature and drama in the form of the character the audience "roots for." Such avatars can even be found in science—for example, in the form of astronauts. There were few scientific reasons to send humans to the moon, but many cultural ones. When Neil Armstrong uttered the famous words "one small step for a man, one giant leap for mankind," he underscored the fact that he and his fellow astronauts were the avatars for all of humanity.

[19] This technique was an appropriation of standard media conventions used by people as varied as news anchors, weather reporters, the President of the United States, and porn stars.

[20] These mediated/simulated realities include television, movies, the telephone, and the Internet.

[21] The Biblical garden of Eden story has, of course, long been a classic theme in all fields of Western art.

[22] Michael L. Dertouzos, "What Will Be: How the New World of Information Will Change Our Lives," New York: HarperEdge, 1997, 47.

[23] Michael A. Braun, address to Multimedia 94, Sydney, Australia: 30 July 1994.

[24] Brad Stone, "The Great Cell Invasion," *Newsweek,* p. 91, 10 November 1997.

[25] Robert J. Samuelson, "The PC Boom—And Now Bust?" *Newsweek,* p. 52, 5 April 1999.

[26] "Wired to the World," *Newsweek,* p. 20, 18 December 1998.