7 Transforming Mirrors: Subjectivity and Control in Interactive Media

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A technology is interactive to the degree that it reflects the consequences of our actions or decisions back to us. It follows that an interactive technology is a medium through which we communicate with ourselves—a mirror. The medium not only reflects back, but also *refracts* what it is given; what is returned is ourselves, transformed and processed. To the degree that the technology reflects ourselves back recognizably, it provides us with a self-image, a sense of self. To the degree that the technology transforms our image in the act of reflection, it provides us with a sense of the relation between this self and the experienced world. This is analogous to our relationship with the universe. Newton's First Law, stating that "For every action there is an equal and opposite reaction," implies that everything is a mirror. We discover our "selves" in the mirror of the universe.

The purpose of this text is to explore the implications of interactive media through the lens provided by interactive artists and their work. Interactive artworks are revealing because the artists creating them have taken literally McLuhan's oft-repeated dictum, "The medium is the message." The mirror is used as a technique of expression. While engineers strive to maintain the illusion of transparency in the design and refinement of media technologies, artists explore the meaning of the interface itself, using the various transformations of the media as their palette.

The expressive power of the interface, in conjunction with the increasing "apparent" transparency of interface technologies, raises complicated ethical issues regarding subjectivity and control. Interactive artists are in a position to take the lead in generating a

discussion of these concerns, but are also in danger of becoming apologists for industrial, corporate, and institutional uses of these technologies. An awareness of the contradictions inherent in mediated interactivity is essential if we, as a society, are to move into the future with our eyes open.

Interaction in the context of art

Although the focus in interactive artwork is usually on work that incorporates technology, the implied transformation of the relationship between art and audience can be traced back to roots that predate the existence of interactive technologies.

Itsuo Sakane, the Japanese journalist and curator, suggests that interactive art is simply art that involves the participation of the viewer. He goes on to remark, "All arts can be called interactive in a deep sense if we consider viewing and interpreting a work of art as a kind of participation,"[1] an echo of Marcel Duchamp's famous declaration, "The spectator makes the picture."[2]

While all artworks are to some degree open to multiple interpretations, some artists work to discourage subjective readings and others work to encourage them. An early example of work that encourages subjective readings is Laurence Sterne's novel, *The Life and Opinions of Tristram Shandy,* finished in 1766. Throughout the book, the reader's expectations and assumptions are variously addressed in a surprisingly postmodern manner. Here are some passages from chapters 37 and 38 of volume 6.

> Let love therefore be what it will,—my uncle Toby fell into it.
>
> —And possible, gentle reader, with such a temptation—so wouldst thou: For never did thy eyes behold, or thy concupiscence covet any thing in this world, more concupiscible than widow Wadman.
>
> To conceive this right,—call for pen and ink—here's paper ready to your hand.—Sit down, Sir, paint her to your own mind—as like your mistress as you can—as unlike your wife as your conscience will let you—'tis all one to me—please but your own fancy in it.[3]

After leaving a blank page, he continues:

> —Was ever any thing in Nature so sweet!—so exquisite!
> —Then, dear Sir, how could my uncle Toby resist it?
> Thrice happy book! thou wilt have one page, at least, within thy covers, which Malice will not blacken and which Ignorance cannot misrepresent.[4]

Sterne may be accused of excessive cleverness, but he actively addresses issues that are central to interactive work. His novel is intended to be physically modified by the reader, making literal and visible the implicit inscription of the reader's subjectivity into the body of the book. In fact, there has always been a strong interactive character to the process of reading; the reader takes the role of universal renderer, using his or her imagination to construct a subjective world upon the skeleton of the text. For a brief moment, Sterne clarifies the mirror provided by the text, showing us ourselves staring into the page.

Marcel Duchamp expresses the idea of the artwork as a mirror in his work *The Bride Stripped Bare by Her Bachelors, Even*. In his discussion of this work, Octavio Paz notes:

> Duchamp's painting is a transparent glass; as a genuine monument it is inseparable from the place it occupies and the space that surrounds it; it is an incomplete painting that is perpetually completing itself. Because it is an image that reflects the image of whoever contemplates it, we are never able to look at it without seeing ourselves.[5]

The work is mirror, image, and window combined. The spectator's reflection mingles with the images inscribed on the glass, and with the gallery space, the viewing context, seen through the glass.

A book or a painting appears capable only of passive response under the subjective gaze of the spectator. The artist may, however, have acted in anticipation of the spectator's interpretations by combining elements into the work so that their significance is transformed by the shifting perceptions of the viewer. Again commenting on Duchamp, Paz suggests: "A work is a machine for *producing meanings*. In this sense Duchamp's idea is not entirely false: the picture depends on the spectator because only he can set in motion the apparatus of signs that comprises the whole work."[6]

An examination of how "interactive" artists incorporate interaction into their work reveals a correspondence with Paz's view.

The reactive behavior of most interactive works is defined by a computer program that is written in advance by the artist, or by a programmer realizing the artist's wishes. This program is, in most cases, a static text that is *read* and *interpreted* by the computer. Each reading of the program by the computer depends on the activity of the spectator. Like the artist constructing an "apparatus of signs" that anticipates and supports subjective readings, the interactive artist, according to pioneer interactive artist Myron Krueger, "anticipates the participant's possible reactions and composes different relationships for each alternative."[7] Although, in both Duchamp's and Krueger's cases, the artist has made room for the spectator's subjective readings of the work, what this involves is a partial displacement of the machinery of interpretation from the mind of the spectator into the mechanism of the artwork, a *fracturing* of the spectator's subjectivity. The external machinery is partly, as McLuhan contends, an extension of the spectator, but the relationship between the spectator and this extension is externally defined.

As the role of the spectator is questioned and transformed, so is the role of the artist. Most artworks start as a set of possibilities: the blank canvas, the empty page, the block of marble, and so forth. The act of realizing a work is a process of progressively narrowing the range of possibilities by a series of creative choices until one of the possibilities has been manifested in the finished work. One might say that the interactive artist decides at some point in this process not to choose from among the remaining possibilities but to create some sort of audience-actuated choosing mechanism. The immediate precedent for this is found in John Cage's chance compositions. In each of these works, Cage defined a set of rules and then used the tossing of coins to choose a specific composition from the range of possibilities allowed by these rules. Cage's intent in reducing the control he had over the final result can be inferred from his suggestion that "the highest purpose is to have no purpose at all. This puts one in accord with nature in her manner of operations."[8] However, as the composer Henry Cowell commented in a discussion of these compositions:

> It is evident that much more remains to be done in this direction, for in spite of his best efforts to the contrary, Cage has not succeeded in eliminating his highly refined and individual taste from the music derived from the

> I Ching. Unfortunately, from the point of view of this group of composers, no order of tossings can give anything more than a variety of arrangements of the elements subjectively chosen to operate upon.[9]

In later works, Cage further removed himself from the compositional process through what he called "indeterminacy." In these works, the rules themselves were left intentionally ambiguous, leaving them open to subjective interpretation by the performers as well.

The structure of interactive artworks can be very similar to those used by Cage in his chance compositions. The primary difference is that the chance element is replaced by a complex, indeterminate, yet sentient, element: the spectator. Whereas Cage's intent is to mirror nature's manner of operation, the interactive artist holds up the mirror to the spectator. There is an additional and important difference that this creates. Unlike Cage's work, interactive work involves a dialogue between the interactor[10] and the system making up the artwork. The interactive system responds to the interactor, who in turn responds to that response. A feedback system is created in which the implications of an action are multiplied, much as we are reflected into infinity by the two facing mirrors in a barber shop.

Whatever the differences, interactive artists like Cage are looking for ways to give away some of the control over the final actualizations of their works. The extreme of this position, in some sense corresponding to Cage's notion of "indeterminacy," is found in the creation of learning and evolving systems. One might take the extreme position that a significant interaction between an artwork and a spectator cannot be said to have taken place unless both the spectator *and* the artwork are in some way permanently changed or enriched by the exchange. A work that satisfied this requirement would have to include some sort of adaptive mechanism, an apparatus for accumulating and interpreting its experience. While few interactive works currently contain such mechanisms, many have exhibited a form of evolution, not through internal mechanisms but through the refinements and adjustments made by their creators—responses to observations made of interactions between the work and the audience. The inclusion of learning mechanisms in interactive works will no doubt become increasingly common.

Models of interaction

There are a number of distinct models that can be used to represent the interaction between an artwork and an interactor. I will examine four models that I find particularly useful. The artwork can be conceived of as a navigable structure or world, a creative medium in its own right, a transforming mirror, or an automaton. While each interactive work can be profitably examined in the light of several of these models, each model offers a unique perspective on the issues involved in interaction.

Navigable structures

The navigable structure can be thought of as an articulation of a space, either real, virtual, or conceptual. The artist structures this space with a sort of architecture and provides a method of navigation. Each position within the conceptual space provides a point of view, defined and limited by the surrounding architectural structure. Exploring this structure presents the spectator with a series of views of the space and its contents. The sequence in which the spectator experiences these vistas forms a unique reading of that space. In virtual reality systems, the architectural metaphor can be taken literally. In other works, the architecture is more like a conceptual paradigm, a method of organization of intellectual perspectives, opinions, or emotions.

The architecture can be regular and highly formalized. On the other hand, it can be highly idiosyncratic. The possible structures range from the latticework of a regular and highly interconnected network to the single serial path of a narrative. Navigable structures present the audience with a series of options and the consequences for each possible decision, but there are several distinct models defining how these paths diverge and recombine.

Some works utilize an open plan resembling a city map, a structure that tends to invite wandering. In Jeffrey Shaw's work *The Legible City*, this metaphor is presented literally. The spectator uses a stationary bicycle to navigate through the computer-generated, three-dimensionally rendered representation of a city projected on a large video screen. Instead of buildings, the streets are lined with letters of the alphabet, transforming the street facades into texts:

> Bicycling through this city of words is consequently a journey of reading. Choosing direction, choosing where to turn, is a choice of texts and their juxtaposition, and the identity of this city emerges in the conjunction of meanings these words generate as they emerge along the bicyclist's path.[11]

Hypermedia-based works use a treelike branching structure in which one moves from a fairly general starting point into greater and greater specificity, encouraging a more focused and structured exploration in which each choice carries with it a responsibility. In Paul Sermon's work *Think About the People Now*, the interactor makes a series of decisions that increasingly define their place in time and space, relative to a single event, that of a protester burning himself to death during the two minutes silence on Remembrance Day in Whitehall, London. Navigating through the structure, one may miss the event altogether, hear an ambulance go past, or overhear someone's horrified words. On the other hand, one's decisions may lead to the time and place of the protest and the choice to watch or look away. One may even find oneself in the role of the protester, covered in gasoline, faced with the decision of whether or not to light the match. Through a series of decisions, the interactor moves into a highly specific position for which he or she is, in a sense, accountable. Alternatively, the interactor can adopt different roles in what Sermon calls the "social construction,"[12] and can experience a variety of conflicting perspectives on the event, the metaexperience that the work as a whole represents.

Navigable structures have some of the characteristics of a maze or labyrinth, except that the interactive work does not usually have a goal or exit, a reward in the conventional sense. Discussing another of Jeffrey Shaw's works, *Point of View*, in which the structure of a labyrinth is intentionally invoked, Erik Colpaert comments that "The correct route is unimportant—It doesn't even exist."[13] The reward, if one insists on using such a term, is the unfolding experience of exploration and discovery, the collection of points of view resulting in a personal reading of the work.

The metaphor of the labyrinth has some disturbing implications. Is the interactive artist sending the audience, like rats, through a laboratory maze? Indeed, people sometimes feel irritation when faced with an interactive artwork, because they feel that their "behavior" is being judged. There is some justification for this feeling, as the interactor does reveal something in the process of

interacting. One solution to this problem is to make the method of interaction as familiar or banal as the action of pedaling the bicycle used in *The Legible City*. In addition, in Shaw's work, the letters that line the streets are permeable, so that one can bicycle right through them. The street layout exists as a suggestion that the spectator can choose to ignore, rather than an imposition.

In these examples, the artists are clearly addressing the issue of subjective interpretation. Indeed, to some degree, the subjectivity of interpretation is the topic of these works. The artists allow the interactor to establish a personal identity in the context of the work; this identity is a reflection of the decisions that the interactor makes on his or her path through the possibilities presented. It is possible, and generally intended, that the interactor try out other possible identities, to explore alternate readings of the same structure.

It is a mistake to conclude that by presenting a variety of perspectives, the artist is being objective and disinterested. Through selection of the specific points of views offered, how they are linked together, and the design of the method of navigation, the artist holds significant expressive power, which is enhanced by this apparent objectivity. This is analogous to the situation encountered in hypertext databases that presume to completely cross-reference the information that they contain. The system of cross-referencing used remains a powerful expression of the ideas of the creator, emphasizing certain kinds of relationships while effectively discouraging others. Creating such structures is similar to designing the infrastructure of a community or society; it charges the space politically. At the same time, such a structure is comforting, because in limiting the options available at any one time, it assists the interactor in deciding how to proceed. It gives one a coherent structure within which and against which one may establish an identity.

It is ironic that wide-open interaction within a system that does not impose significant constraints is usually unsatisfying to the interactor. It is difficult to sense interaction in situations in which one is simultaneously affecting all of the parameters. It has been my experience that the interactor's sense of personal impact on an interactive system grows, up to a point, as his or her freedom to affect the system is increasingly limited. The constraints provide a frame of reference, a context, within which interaction can be perceived.

While the constraining structure subtly expresses itself, the interactors' ability to navigate the system gives them a sense of free-

dom. This freedom exists only in relation to the established structure; it is a representation of freedom, a symbolic freedom. By relinquishing a relatively small amount of control, an interactive artist can give interactors the impression that they have much more freedom than they actually do. The clearest example of this can be found in disk-based video games where the system gives the user the impression that he or she is moving at great speed through, or just above, a certain terrain. The video disk is made up of short clips that link together in a branching and merging structure. In the most effective cases, the image presented on the screen is only the central section of a larger image. If the user tries to turn to the left while the system is in the middle of a linear segment, the section of the frame that the user sees is immediately shifted in that direction, giving an immediate sense of responsiveness, but the interactor is, in fact, still traveling along the same restricted path. The illusion that the user has the freedom to roam the entire terrain is maintained for a surprisingly long time, especially if the user is moving at a high "virtual" speed (i.e., without time to reflect on the degree to which his or her actions are being reflected). The navigable structure and its system of navigation together make up a guidance system through which the trajectory of the user through the work may be subtly controlled.

The static artwork can be looked at in two opposing ways. It can be seen as authoritarian in its refusal to reflect the presence and actions of the spectator, or it can be seen as giving the spectator complete freedom of reflection and interpretation by not intervening in this process. An interactive artwork can likewise be seen as loosening the authority of the traditional work, or as interfering in the interactor's subjective process of interpretation.

This irony gets increasingly pronounced as the technology of interaction becomes more and more sophisticated. In the introduction to his book, *Artificial Reality II*, Myron Krueger says, "Imagine that the computer could completely control your perception and monitor your response to that perception. Then it could make any possible experience available to you."[14] Florian Rötzer responds to this scenario by saying, "The freedom in virtual space is sacrificed in the final control over the environment, over every thought, when and if it becomes possible to successfully couple our neurons directly with the computer."[15] When a system monitors interactors to this extent, it has effectively taken control of the interactors' subjectivity, depriving them of their idiosyncratic identity and replacing it with a highly focused perspective that is

entirely mediated by the system. Subjectivity has been replaced by a representation of subjectivity. The fact that the system responds to the interactor does not guarantee in any way that the system is responsible to the user; the interactor can fairly easily be pushed beyond reflection to the edge of instinct, capable only of visceral response to the system's stimuli, mirroring the system rather than the reverse.

A variation of the navigable structure is found in the work of communications artists who design interactive communications systems and networks. Instead of creating subjective points of view and offering a method of navigation through or between them, communications artists create systems that interconnect individuals, that offer methods of communication. These artists are inventing alternate communities. An example is *Habitat*, an artificial on-line community developed for Lucasfilm by Randy Farmer and Chip Morningstar. Using simple Commodore 64 computers connected by phone lines, they have created a complex world in which thousands of participants adopt identities, participate in a simulated economy, and exercise democratic control over the course and structure of their community.

In France, a few years ago, I encountered an intriguing device called *Le Flashing*. It was a tiny radio transceiver in the shape of a wearable pin that had a light-emitting diode on the front. The device could be set to transmit and receive on a variety of wavelengths. The wearer selected personal wavelengths from a range representing a variety of sexual preferences. When two people with corresponding frequencies came within a few feet of each other, the diodes on each device would begin to flash. Whereas *Habitat* creates an environment distinctly separate from our conventional reality, *Le Flashing* creates alternative systems of communications that rest invisibly on top of existing social structures.

In *Habitat*, no attempt is made to accurately represent the individuals participating. They are allowed to design identities for themselves. The carrier of communications between participants is therefore not transparent; this is part of the pleasure of participating. The transformations of the communicating medium are quite obvious, especially due to the low-resolution, cartoonlike representations of the participants. Where the transformations of the medium are not made visible, however, the possibility for powerful manipulation occurs. As we become less and less connected in local communities and increasingly involved in virtual commu-

nities, we stretch the intimacy of personal communications over longer and ever more complex pathways, making ourselves increasingly vulnerable. Communications systems are inherently vulnerable to surveillance. For example, a device like *Le Flashing*, in another set of hands, could be used to track down "sexual deviants."

Traditionally, so-called common carriers like the phone system have been restricted from introducing information into their own networks; they are allowed only to transmit information from source to destination. We trust that the telephone represents us accurately, transmitting our voice, and therefore, our intentions and meanings, without distortion. But the native intelligence of communications networks is rapidly increasing. Already our voices are echo-canceled, digitized, and multiplexed as they speed from phone to phone. Videophones and teleconferencing rely on significant amounts of data compression to achieve usable transmission speeds. Images are reconstituted at the receiving end with varying degrees of faithfulness to the original. It is a small step from this type of processing to interpretation. Already someone has decided what information is worth preserving in an image, and what is not. The neutrality of communications networks will become an increasingly significant, and at the same time slippery, issue.

The invention of media

It is often said that interactive artworks blur the line between the artist and the audience. The audience becomes creator in a medium invented by the artist. The artist enables the interactors to express themselves creatively.

Myron Krueger has developed a complex set of video-centered interactions that he calls *Videoplace*.[16] The *Videoplace* installation is made up of a video camera, a video projector, and a rack of specialized processors. The interactor's image, as seen by the camera, is interpreted as a silhouette. This silhouette is analyzed in various ways and a response is generated and updated thirty times a second. Writing of a subset of these interactions called *Individual Medley*, he has said:

> Each is a restricted aesthetic medium that can be composed through body movements. In fact, your body becomes a means of creating art. The goal of these

> interactions is to communicate the pleasure of aesthetic creation. Since these media are unfamiliar, dwelling as they do on dynamic images controlled by movements of the viewers' bodies, artists trained in traditional static media have no automatic advantage in creating pleasing results.[17]

There is no question that people are given a tangible and "empowering" experience of creativity from an interaction of this sort. This is precisely because the medium is "restricted." Presenting a limited range of possibilities reduces the likelihood that the interactor will run up against a creative block, and allows the medium to guide the inexperienced hand of the interactor, reducing the fear of incompetence. Such a creative experience is more powerful than traditional examples of "guiding" media, such as paint-by-numbers, because the interactor makes decisions throughout the creative process. The interactor is therefore, to some degree, genuinely reflected in the resulting creation.

In the hands of technologists, a medium evolves towards apparent transparency (i.e., the development of a complete range of pigments for oil paints, or the evolution from early low-resolution black-and-white television to natural color high-definition TV). The message (as per McLuhan) that such a medium conveys may be powerful, but it is generally unintentional. Of course, interactive artists intentionally express themselves through the opacities and idiosyncrasies of the media that they create. These media reflect, but also guide and transform, the gestures of the interactor.

The interactor becomes a creator. But, as the conceivers of the media, interactive artists reserve a privileged position for themselves. The product of the spectator's creative interaction is often "pleasing," but would rarely qualify as "serious" art. To quote Krueger: "It is the composition of the relationships between action and response that is important. The beauty of the visual and aural response is secondary."[18]

When the Apple Macintosh first came onto the market, the MacPaint program, which simulates, to a degree, the visual artist's basic tools, sent a shock wave through the creative community. For the first year, MacPaint-produced posters were everywhere, an apparent explosion of the freedom of, and possibility for, self-expression. But while the MacPaint medium reflected the user's expressive gestures, it also refracted them through its own idiosyn-

cratic prism. After a while, the posters began to blend together into an urban wallpaper of MacPaint textures and MacPaint patterns. The similarities overpowered the differences. Since then, graphics programs for computers have become much more transparent, but that initial creative fervor that MacPaint ignited has abated. The restrictions that made MacPaint easy to use were also the characteristics that ultimately limited its usefulness as a medium for personal expression. One can look at the distribution of a creative medium in the form of a software package as a subtle form of broadcasting.

Transforming mirrors

While all interactive works reflect interactors back to themselves, in many works the idea of the mirror is explicitly invoked. The clearest examples are interactive video installations in which the spectator's image or silhouette becomes an active force in a computer-generated context. Examples include aspects of Myron Krueger's *Videoplace* work, Ed Tannenbaum's *Recollections* and Very Vivid's *Mandala*. The spectator sees some representation of himself or herself on a video projection screen. This representation follows the movements of the interactor like a mirror image or shadow, transformed by the potentials with which the artist has endowed the space. These transformations are realized by software running on a computer. In such work, the content is contained in this difference between the gesture and its transformed or recontextualized reflection.

The myth of Echo and Narcissus, told by Ovid in the *Metamorphoses*, provides an interesting context in which to examine the question of reflections and distorted mirrorings. Echo was a nymph who used to tell stories to Juno in order to distract her while Jupiter consorted with the other nymphs. When Juno discovered Echo's deceptions, she punished Echo by removing her ability to source words. She retained only the ability to repeat back the last words said to her. And so, when she saw Narcissus in the forest and fell in love with him, she had only his words of rejection to transform into an expression of her love. The interactive artist transforms what is given into an expression of something other, making Echo a patron deity of interactive art.

Later, in the most familiar part of the story, Narcissus glimpses his image in a pool of water, and falls in love himself. He does not

initially realize that it is his own image, and falls into despair that the youth in the pool does not return his love.[19] Noting that the name "Narcissus" is derived from the Greek word *narcosis* (numbness), McLuhan writes

> This extension of himself by mirror numbed his perceptions until he became the servomechanism of his own extended or repeated image. The nymph Echo tried to win his love with fragments of his own speech, but in vain. He was numb. He had adapted to his extension of himself and had become a closed system.[20]

The myth presents two kinds of reflection: the perfect, mirrorlike, synchronous reflection of Narcissus in the pool and the delayed and distorted reflections of Echo's speech. In the "Sounds" chapter of *Walden*, Thoreau, describing the sound of distance church bells, writes:

> The echo is, to some extent, an original sound, and therein is the magic and charm of it. It is not merely a repetition of what was worth repeating in the bell, but partly the voice of the wood; the same trivial words and notes sung by a wood-nymph.[21]

While the unmediated feedback of exact mirroring produces the closed system of self-absorption (the reflection of the self is reabsorbed), transformed reflections are a dialogue between the self and the world beyond. The echo operates like a wayward loop of consciousness through which one's image of one's self and one's relationship to the world can be examined, questioned, and transformed.

In many of Krueger's *Videoplace* interactions the interactor's image is the device through which the "artificial reality" is explored. The transformations of this silhouette are the keys to the understanding of the world depicted on the video screen. The self-image is the known reference against which the phenomena of transformation are registered. In my own work, *Very Nervous System*, a computer looks out through a video-camera and gathers a sense of the physical gestures of the interactor. These impressions are immediately translated into sounds or music, reflecting and accompanying the gestures, thereby transforming the interactor's awareness of his or her body. In both cases, the character of the

experienced phenomenon is discovered as a change in a representation of the self.

The relationship between the interactor and the transformed reflection is stereoscopic. When we look into a three-dimensional space, each of our two eyes sees a slightly different image. What transforms the image that the right eye sees into the image that the left eye sees is a change in point of view. The tension that exists between these two points of view is resolved by the brain into the revelation of depth. An interactive artwork presents, in the form of the transformed reflection, an image of the self from another point of view that likewise produces a sort of stereoscopic tension.

Transformed mirroring is also found in *Tumbling Man* by Chico MacMurtrie and Rick W. Sayre. In this work, participants wear jumpsuits wired with sensors that detect the opening and closing of elbow and knee joints and the lowering of the chin. This information is used to control similar joints in a life-size pneumatic robot through a radio link. The robot mimics the general posture of participants, but the robot is carefully designed so that it doesn't follow the participant's gestures exactly. The robot's appendages are constructed of metal pipes containing free-rolling metal balls, and the joints are intentionally loose. This adds a rich complexity and indeterminacy to the movement of the robot, enabling it to rock, heave, and tumble with momenta derived from, but not copied from, the movements of participants. Generally, two participants work together, each with control over a changing fraction of the robot's joints, resulting in movements that are a partial and shifting reflection of both participants.[22] An additional level of interaction exists between the two participants as they work together to gain some mastery over the robot. The robot arouses strong empathy, on one hand as an eloquent reflection of the participants' struggles, and on the other as a subject of domination by the participants.

The question of domination raises an important issue. For many people, interaction has come to mean "control." People look to interactive technology for "empowerment," and such technologies can certainly give the interactor a strong sense of power. This is clearly the attraction of video games. In these games, the mirror transforms the interactor's gestures largely by amplification, but what is actually offered is the amplification of a gesture within a void, a domination of nothingness, the *illusion* of power. In particular, this is a fantasy of power bereft of responsibility. In the recent Gulf War, the video-game fantasy of power was reconnected to the

power of actual armaments. In the process, the sense of responsibility was lost; the personal accountability of the pilots was cleverly amputated, dissolved by the interface.

Interaction is about encounter rather than control. The interactive artist must counter the video-game-induced expectations that the interactor often brings to interaction. Obliqueness and irony within the transformations and the coexistence of many different variables of control within the interactive media provide for a richer, though perhaps less ego-gratifying experience. However, there is a threshold of distortion and complexity beyond which an interactor loses sight of himself or herself in the mirror. The less distortion there is, the easier it is for the interactor to identify with the responses the interactive system is making. The interactive artist must strike a balance between the interactor's sense of control, which enforces identification, and the richness of the responsive system's behavior, which keep the system from becoming closed.

Because explicit interactivity is still a relatively new feature in artworks, the audience often approaches the works with skepticism. The audience requires proof that the work is interactive. This seems like a reasonable expectation. In navigable work, establishing the responsive character of the work is not difficult, but in works where the character of the interaction is more complex, providing proof is not always so easy. The proof that will most easily satisfy the audience is "predictability" (i.e., if one makes the same action twice, the work will respond identically each time). Unfortunately, this test only works for simple interactive devices with no memory and no ability to adapt. More complicated systems might perceive a repetition of an action as the establishment of a pattern, and respond to this new quality in the behavior of the participant with a new kind of response.

I noticed an interesting pattern emerging in the interactions between the audience and an early manifestation of *Very Nervous System*. This version would, in fact, respond identically to identical movements. People entered the installation and set about verifying the predictability of the system. They made a gesture, as a question to the space, and mentally noted the sound that that gesture had made. They repeated the gesture once or twice, again as a question, and got the same result. The third repetition seemed to satisfy the participants that the system was in fact interactive. The way they held their body and the look on their face changed. They made the

gesture again, this time as a command to the system, not a question. The physical dynamics of the command gesture was significantly different from the previous, more tentative questioning gestures, and the system responded with a different sound.

The complexity of this relationship is, in this case, not so much a function of the complexity of the system but of the complexity of the participants themselves. The system was not programmed to interpret motivation; it merely reflected what it saw. The critical point is that aspects of movement that might reflect motivation were not filtered out. By increasing the amount of filtering that is applied in the perceptual process that the interactive system employs, the designer increases the reliability of the resulting information and therefore the unambiguity of control, but at the same time the richness of that information is reduced.

Interactive technologies are hybrids of communications media and control media. We don't expect to control someone by talking to them on the telephone, except to the degree that a relationship of control has been elsewhere established. We do expect to be able to control the telephone itself, as well as our computers, our automobiles, and our smart bombs. But as our technologies evolve and become more complex, they begin to exhibit human behavior. For example, much current research in the field of human-computer interface is focused on the the creation of computer-simulated anthropomorphic "agents" to whom the user can pose questions and assign duties. Our interactions with such agents begin to take the form of communication, but the relationship is still intended to be one of control. This relationship of control is desirable to the degree that our technologies are extensions of ourselves. But these extensions are not just enlargements of the boundaries of our autonomous individualities; they are interfaces through which our contact with the outside world is mediated. The interface becomes a containing environment; if control over this environment is insisted upon, it becomes a system of insulation and isolation from both otherness and ambiguity.

"Virtual reality" presents an interesting context in which to examine this question. To the extent that virtual reality is intended as a technology for presentation or visualization, its conventional control interface of DataGlove and Polhemus trackers is quite adequate, and the lack of ambiguity appropriate. But the creators of these systems dream of creating comprehensive, shared "realities," in which case we must question the philosophy behind the

interface. In virtual reality systems, the participant acts on and moves through the environment with a few linear controllers. As the technology evolves, the visual renderings grow increasingly "real," but the relationship between the participant and the reality remains simplistic. Our interface with the real world and with other people is complex and highly nonlinear, and, from a "control" point of view, very ambiguous. Interface designs appropriate for the cockpit are not necessarily appropriate in our relationships with the world around us.

Many interactive artists create their own interfaces. Without the pressures and restrictions involved in getting a saleable and reliable product "to market," they are free to incorporate a richer complexity and ambiguity into these interfaces. Myron Krueger has been developing the interface technology for *Videoplace* for almost two decades. Unlike virtual reality control technologies, which are primarily "sensing" technologies, his interface is a "perceiving" technology. The Polhemus and the DataGlove involve the sensing of a small number of essentially unambiguous parameters. In *Videoplace* the many thousands of individual pieces of information making up a video camera's image are digested by various processors that attempt to make some kind of sense out of what the camera is seeing. Krueger has gone to great lengths to develop methods that derive relatively unambiguous information from the image, but perception is inherently prone to errors and ambiguity. It interprets what it senses, and therefore exhibits something very much like subjective judgment. Because such perceptual mechanisms are generally very complex, they often display unexpected behaviors as well as those intended by their creator. In *Artificial Reality II*, Krueger writes: "Indeed, one of the strong motivations guiding this work is the desire to compose works that surprise their creator."[23] This apparent contradiction between the desire for control and the desire for surprises is common among interactive artists. James Seawright, one of the earliest creators of interactive sculptures, explained, "My aim is not to 'program' them but to produce a kind of patterned personality. Just as a person you know very well can surprise you, so can these machines."[24]An engineer might suspect that this expressed taste for surprises is a cover for bad design. But an engineer's aims are different. Interactive artists balance control and surprise to suit their "interactive aesthetic."

This desire for surprise rises partly out of the nature of the medium. Computers are the greatest expression of man's desire to

control. They are a pure representation of authority. They are constructed of the utterly unambiguous "elementary particles" of presence and absence, on and off, one and zero. Computers are a metatechnology, almost infinitely flexible and bristling with potential. In the face of this medium of absolute determination, artists often feel a kind of loneliness or claustrophobia. Pushing the technology until it surprises is one way of escaping from the numbing effects of staring deeply into your own constructions.

Automata

Although he hopes that his works will surprise him, Myron Krueger feels that "nothing should happen in an interactive medium unless it is a response to some action by the participant"[25] since this would be confusing to the interactor. Other artists create artworks that are not intended to be an extension of the interactor; their creations are essentially self-motivated and autonomous. These automata survey and maneuver through their environment, of which the spectators are only one aspect.

The Holy Grail for these artists is the self-replicating, self-sustaining machine—artificial life. The immediate aims are less lofty. Norman White aims to endow his robots with what he has termed "artificial sanity," which he defines simply as the machine's ability to make sense of its environment.

Whereas most interactive works present acoustic, visual, or conceptual environments, these works present individual entities. As a result, their interactions with the public take on the nature of social behavior and relationships. Although these works use many of the approaches and technologies used by other kinds of interactive works, it is not the individual interactor who is reflected in these works so much as human behavior itself. In a sense, the responsive environment and the automaton complement each other, representing both sides of the relationship between man and the social and natural environment.

A particularly provocative example is White's *Helpless Robot*. This is an unusual robot because although capable of perceiving, it is incapable of moving.

> I see the work behaving as the classic "hustler." For instance, it might initially enlist human cooperation with a polite "Excuse me . . . have you got a moment?" or any

> one of such unimposing phrases. It might then ask to be rotated: "Could you please turn me just a bit to the right? . . . No! not that way . . . the other way!" In such a way, as it senses cooperation, it tends to become ever more demanding, becoming in the end, if its human collaborators let it, dictatorial.[26]

Another of White's robots, *Facing Out, Laying Low*, interacts with its audience and environment, but can become bored or overstimulated, in which cases it becomes deliberately antisocial and stops interacting.

This kind of behavior may seem counterproductive, and frustrating for the audience. But for White, the creation of these robots is a quest for self-understanding. He balances self-analysis with creation, attempting to produce autonomous creatures that mirror the kinds of behaviors that he sees in himself. These behaviors are not necessarily willfully programmed; they often emerge as the synergistic result of experiments with the interactions between simple algorithmic behaviors. Just as billions of simple water molecules work together to produce the complex behaviors of water (from snowflakes to fluid dynamics), combinations of simple programmed operations can produce complex characteristics, which are called emergent properties, or self-organizing phenomena.

These emergent properties, like the surprises that Krueger and Seawright seek, represent to interactive artists transcendence of the closed determinism implied by the technology and the artists' own limitations. While such unexpected characteristics delight artists, they represent the ultimate nightmare for most engineers. The complex systems within which we already live and operate are perfect breeding grounds for emergent behaviors, and this must be taken into account as we move into greater and greater integration and mediation.

Designing the future

Interactive artists are engaged in changing the relationship between artists and their media, and between artworks and their audience. These changes tend to increase the extent of the audience's role in the artwork, loosening the authority of the author or creator. Rather than creating finished works, the interactive artist creates relationships. The ability to represent relationships in a functional way

adds significantly to the expressive palette available to artists. The power of this expression is multiplied by the fact that the interactors themselves become referents of the work. The works are somewhat akin to portraits, reflecting back aspects of the interactors, transformed so as to express the artist's point.

Mirrors give us back an image with which to identify. We look at the marks we have made on our world to give us a sense of our significance. We distinguish ourselves from others by the uniqueness of our point of view. We compare ourselves to others like us in order to understand our similarities and differences. By providing us with mirrors, artificial media, points of view, and automata, interactive artworks offer us the tools for constructing identities—our sense of ourselves in relation to the artwork and, by implication, in relation to the world.

It is clear that these relationships, and the images of self that they reflect, are merely representations, simplified symbols that are used to refer to the more complex operations of what we call "real" life. Navigable structures are a way of *representing* subjectivity. Limited media are ways of *representing* creativity. Mirrors, and in a more abstract way automata, are ways of *representing* ourselves. All of these representations are also personal expressions of the artists who made them possible. The artist's act of expression is moved to a higher level of abstraction although the artwork's final manifestation retains a compelling apparent actuality. Rather than lessening the authority of the creator, these works represent a shift in the nature of that authority.

As interactive technologies become increasingly common in our everyday relationships, and as they approach transparency, these simplified representations replace the relationships to which they initially referred. This substitution turns the interesting ambiguities of control and subjectivity in interactive art into serious issues of control, manipulation, and deception.

The trouble begins as the user's awareness of the interface ends. A transparent interface is desirable from a functional point of view because it allows the user to work without considering the interface at all, but no interface can be truly transparent. When an interface is accepted as transparent, the user and his or her world are changed; the transforming characteristics of the interface, no longer contained by a visible apparatus, are incorporated into the user and the user's worldview. In mirroring works like *Videoplace*, we watch our silhouette encounter a world. We may be drawn at

times to identify strongly with this "shadow," but it remains clearly separate from us. In immersive environments, rather than observing, we inhabit this shadow, this limited representation. Currently, the technology is cumbersome, but as it evolves toward apparent transparency, the danger arises that we will become, literally, "a shadow of our former selves."

McLuhan often referred to technologies as "extensions of man." But in fully interactive technologies, the flow of information goes both ways; the apparatuses become more like permeable membranes. If there is a balance of flow back and forth across this membrane, then the interactive technology is an intermingling of self and environment. If there is an imbalance, then the technology extends either outwards from the organic boundary of the interactor or inwards into the interactor. If the flow across the interface is predominantly inward,then the technology has become a foreign agent, an infiltrating extension of the outside. If the input is dazzling enough, we are left in a daze, responding only on instinct: unconscious reflex rather than conscious reflection; we become extensions of the technology.

The infiltration can be very subtle. Television expands the reach of our vision, while at the same time filtering the content. We trade the subjectivity of our personal point of view for centrally collected and broadcasted images and information. Interactive media have the power to likewise expand the reach of our actions and decisions. We trade subjectivity for participation and the illusion of control; our control may appear absolute, but the domain of that control is externally defined. We are engaged, but exercise no power over the filtering language of interaction embedded in the interface. Rather than broadcasting content, interactive media have the power to broadcast modes of perception and action.

This broadcasting corresponds to a deeply felt need in our society; our technologies have caused an information explosion, and now we look for technological solutions to the problems that the explosion has produced. We no longer have the ability to take in and interpret the mass of information presented to us. Conscious reflection is painful if not impossible; we are desperate for filters. We welcome anything that will simplify our media-amplified reality. By filtering out apparent irrelevancies, giving us simplified representations of our relationships, interactive media make it easier for us to make decisions. These filters operate like a belief system. In fact, perception itself is a kind of *personal* belief

system, without which we would be unable to function. When we forfeit the right or power to decide for ourselves the nature of these systems of generalization, we commit ourselves to an "objectivized" point of view that is entirely in the control of others; we head back into the Middle Ages, when the Roman Catholic Church defined the world. The greater danger is that we may forfeit that control without realizing that anything has been lost. If we are given a sufficiently virtual *representation* of freedom and personal autonomy within a limiting structure, we lose awareness of the artifice; we are unaware that we have adopted a belief system and its attendant simplifications.

Surrendering our subjectivity for "objectivized" viewpoints, we are given, in return, a representation of responsibility, a virtual enfranchisement. Each participant in an interaction receives the *sensation* of responsibility; each has the *ability to respond*. The simplified relations of interactive media provide us with a space in which we can feel and accept responsibility. We cede some of the operations of our conscience to the interface in exchange for a measure of ethical tension that we feel we can endure.

At the other extreme, interactive technologies can also simplify the task of decision-making by bombarding the interactor with decisions at a rate that removes the possibility of thought. Video games provide a familiar example. Speed is intoxicating because it makes us, in some sense, unconscious, incapable of reflection; speed relieves us of the burden of responsibility, because there is no time to measure the consequences of an action. The skills required are programmed into our brains through repetition, so that our responses become instinctive, requiring no conscious thought. We return to the paradise before consciousness and moral dilemma.

Technology mirrors our desires; interactive technologies, in particular, reflect our desire to feel engaged. We feel increasingly insignificant, and so we desire the affirmation of being reflected; we are tired of the increasing burden of consciousness, and so we are willing to exchange it for this sense of affirmation. In this trade, the interface becomes the organ of conscience, the mechanism of interpretation, the site of responsibility. The design of these technologies becomes the encoding of a kind of moral and political structure with its attendant implicit social contract.

Our involvement in the process of this reinvention of society is crucial. If a new sort of social contract is being drawn up, it is

important that the terms, conditions, and implications be thoroughly explored before we are committed by default through the momentum of technological development, which is also the momentum of our own frustrated desires. If we allow ourselves to lose consciousness of the influence of the interface, we lose our ability to question the terms of the contract; the contract will be effectively invisible. If we accept the transformed images reflected back through the mediating technologies as images of ourselves, we surrender the ability to control who we are.

Perhaps this transformation of society and humanity is inevitable. Perhaps the "individual" is becoming obsolete. It is already being proposed, by artists like Stelarc and roboticists like Hans Moravec, that the human body is obsolete. In virtual environments, the dematerialization of the body has, indeed, already begun. The idea of the individual changes when the body loses its role or meaning, because our bodies are the experiential apparatuses that define each of our subjective points of view.

The situation is full of contradictions; issues of subjectivity and control flip-flop. The technology that might allow a woman in virtual space to redefine her body, to escape the trap of her socialized identity, is the same technology that would allow that identity to be manipulated from the outside. The technology that provides alternative communications links and invents new kinds of community is the same technology that offers undreamt-of degrees of surveillance. The technology that can connect you to the world in unprecedented ways is the same technology that can isolate you in a fantasy of your own, or another's, construction.

What is clear is that there are many important issues to be explored. There is no question that there are exciting potentials for the use of interactive media, but the utopian rhetoric that, for example, has characterized discussions of virtual reality in the popular press must be countered with responsible examinations of the cultural and political implications of these technologies. Interactive artists, at a privileged position at the junction of culture and technology, have the potential to contribute significantly to this discourse. In the process they must carefully avoid becoming merely public relations devices for government and industry. The artists' role is to explore, but at the same time, question, challenge, and transform, the technologies that they utilize.

Notes

1. Itsuo Sakane, "Introduction to Interactive Art," in *Catalogue: Wonderland of Science-Art* (Kanagawa, Japan: Committee for Kanagawa International Art & Science Exhibition, 1989), 3.

2. Quoted by Octavio Paz, "The Castle of Purity," in *Marcel Duchamp* (New York: Viking Press, 1978), 85.

3. Laurence Sterne, *The Life and Opinions of Tristram Shandy* (Harmondsworth: Penguin Books, 1986), 450

4. Ibid., 452.

5. Octavio Paz, "The Castle," 80.

6. Ibid., 86.

7. Quoted by Cynthia Goodman, *Digital Visions* (New York: Harry N. Abrams, 1987), 134.

8. John Cage, "45' for a Speaker" (1954), in *Silence* (Middletown, Conn: Wesleyan University Press, 1973), 155.

9. Henry Cowell, "Current Chronicle," *Musical Quarterly*, January 1952.

10. No satisfactory term has yet been proposed to describe the person who engages in interaction with an artwork. Roy Ascott has suggested the term "user," but that carries implications that the artwork is at the service of that person, implying an imbalance in the relationship between person and artwork that is potentially misleading. "Interactor" is used here for the sake of simplicity.

11. Jeffrey Shaw, ed., *The Legible City* (Amsterdam: Colophon, 1990), G.

12. Paul Sermon, in *Der Prix Ars Electronica* (Linz: Veritas, 1991), 124.

13. Erik Colpaert, "Here, There and Everywhere," in Shaw, *The Legible City* (Amsterdam: Colophon, 1990), G.

14. Myron W. Krueger, *Artificial Reality II* (Reading, Mass: Addison-Wesley, 1991), xvi.

15. Florian Rötzer in "On Fascination, Reaction, Virtual Worlds and Others," included in this volume.

16. For a full description, see Krueger, *Artificial Reality II*.

17. Ibid., 48

18. Ibid., 86.

19. See Ovid, *Metamorphoses*, trans. Rolfe Humphries (Bloomington: Indiana University Press, 1983), 68–73.

20. Marshall McLuhan, *Understanding Media*, 51.

21. Henry David Thoreau, *Walden*.

22. After Chico MacMurtrie and Rick Sayre, in Sermon, *Der Prix Ars Electronica* (Linz: Veritas, 1991), 126–28.

23. Krueger, *Artificial Reality II*, 89.

24. Quoted by Cynthia Goodman, *Digital Visions*, 141.

25. Krueger, *Artificial Reality II*, 45.

26. Norman White, in *Der Prix Ars Electronica* (Linz: Veritas, 1990), 181.