Computers as Theatre

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incidents that cause actual pain or harm (such as erasing a file or destroying a document). In summary, surprises and reversals are tools for changing what people understand and expect, for stimulating interest and involvement, and for orchestrating the shape of the action.

In this chapter, we have attempted to define elements of form and structure that are characteristic of dramatic action and to relate them to human-computer activity. In the next chapter, we will consider how the dramatic theory presented in Chapters 2 and 3 can be employed to understand and orchestrate human action in representational worlds.

Chapter Four

Dramatic Techniques for Orchestrating Human Response

Form and Experience

The goal of the previous two chapters was to establish a groundwork in dramatic theory that involves principles of dramatic form and structure. This chapter will explore techniques for applying that theoretical knowledge to the task of designing interesting, engaging, and satisfying human-computer activities. The effectiveness of these techniques relies on the relationship between form and experience, in terms of both the ways in which form influences content and the direct impact of the formal and structural qualities of a work on human thought and emotion.

Drama Versus Narrative

One way to get at the special qualities of drama that are most relevant in the design of human-computer activity is to contrast it with a related form that has been more commonly employed by interface designers—namely, the art of narrative. Narrative has been employed as the structural backbone of such applications as adventure games and tutorial-style computer-assisted instruction. Its uses have also been investigated by workers in the area of information retrieval and presentation [see, for instance, Lehnert, 1977; Dyer, 1983; and Don, 1990].

Why have we chosen drama rather than narrative as a global model for human-computer activities? How are human-computer activities more like plays than stories? Can't we get the same kind of intellectual and emotional gratification from a good book as we do from a good play? To focus on the key differences, recall the basic Aristotelian definition of drama: the imitation of an action with a beginning, middle, and end, which is meant to be enacted in real time, as if the events were actually unfolding. Incidents are selected and arranged by the playwright in a way that is true to the causal relationships among them.

The key differences between drama and narrative can be summarized as follows:

- *Enactment*, meaning to act out rather than to read. Enacted representations involve direct sensing as well as cognition. To state it more simply, the stuff of narrative is *description*, while the stuff of drama is *action*.
- *Intensification*, meaning that incidents are selected, arranged, and represented, in general, so as to intensify emotion and condense time. Narrative forms generally employ the reverse process, *extensification*, where incidents may be reported from a number of perspectives and in ways that expand or explode time (for example, perceptions that take only an eye-blink in the "real time" of the characters in a novel by James Joyce or Virginia Woolf consume whole chapters with perceptual and cognitive detail). The common-sense observation is simply that time has a different scale when you are acting out than it does when you are reading. In Aristotelian terms, this is one of the *formal* differences between drama and narrative. (For a semioticist's view of the way in which drama accomplishes the condensation of action, see Hilton [1991], especially p. 4.)

- *Unity of action versus episodic structure:* Another basic difference between drama and narrative is in the structure of incidents. Dramas typically represent a strong central action with separate incidents that are causally linked to that action, something the neoclassicists called the *unity of action*. Narrative tends to be more episodic; that is, incidents are more likely to be quasi-independent and connected thematically rather than causally to the whole. Drama is typically more intense, tightly constructed, economical, and cathartic than narrative. And it is very important to remember that these things are part of the form itself; that is, *drama affords these qualities because of the kind of thing it is.*

The notion of enactment is intrinsic to human-computer activity because of its multisensory nature, as we discuss at length in this chapter and in Chapter 2. Another strong advantage of a dramatic model is illustrated by the simple observation that there are limits on the amount of time that a person can comfortably spend *actively* engaged in a representation. I know from many years of acting in and directing plays, and even from playing cowboys and Indians in my youth, that when you're *acting something out*, three or four hours is about the upper limit of your emotional energy. I know from the many hours that I spend humped up over a hot computer that the energy limit, at least for a person of my age range, is roughly the same.[1] Fundamentally, this is an issue of magnitude and closure. The criterion of magnitude (discussed near the end of Chapter 2) suggests that the limitation of *duration* of an action has aesthetic and cognitive aspects as well as physical ones.

[1] I feel obliged to include a remark by one of my anonymous reviewers: "Four hours max 'humped over a hot computer?' Wimp! In fact, I would argue that after four hours you may be just starting to get somewhere interesting . . ." My reply is, yes, I'm a wimp. Life is too short to beat the hell out of yourself doing something that should take a quarter of the time and be an order of magnitude more fun.

So, to return to the examples of a narrative approach to human-computer activity at the beginning of this section, we may observe that, in today's marketplace, narrative-style text adventure games have given way to graphical adventure games in which the action is represented in a multisensory, first-person way, with a stronger central action. The designers at Lucasfilm Games have been pioneers in this shift to a more dramatic approach. As Lucasfilm designer Ron Gilbert puts it:

> If I could have my way, I'd design games that were meant to be played in four to five hours. The games would be of the same scope that I currently design, I'd just remove the silly time-wasting puzzles and take the player for an intense ride. The experience they would leave with would be much more entertaining and a lot less frustrating. The games would still be challenging, but not at the expense of the player's patience [Gilbert, 1989].

Gilbert's philosophy has been evident in all of his recent game designs, and he and his colleagues at Lucasfilm should be credited with inventing an approach to adventure games that delivers all the punch of a good movie (see Color Plate I). Interestingly, although Lucasfilm's storytelling games do in fact take much less time to play than the average narrative-style adventure, people pay the same price for them—willingly trading off narrative duration and description for a shorter, more intense blast of dramatic excitement.

In the realm of computer-aided instruction, dramatic and simulation-based approaches have largely supplanted tutorials in many content domains.[2] Among the leaders in this trend has been Joyce Hakansson, who has designed and produced such learning products as *Ducks Ahoy!*, in which adventures with ducks in Venice help young students gain

[2]In 1981, I attended a meeting of the National Council of Teachers of Mathematics. In those days, teachers preferred computer programs that provided drill and practice, and they were extremely skeptical of "game-like" approaches. There were, however, several highly successful game-like activities that were being used in classrooms. A survey of teachers revealed that when a learning game was effective in the classroom, it was reclassified by teachers as a "simulation," thus circumventing the categorical problem with games.

dynamic planning skills, and *Seahorse Hide 'n' Seek*, through which children develop sensitivity to color, shape, and scale by helping a seahorse hide from its predators in an underwater landscape. The product has also been used as a beginning point for creative improvisations among its young users. Another pioneering group is The Learning Company, publisher of such products as *Rocky's Boots* and *Reader Rabbit*, in which basic concepts in science and language arts are learned through the manipulation of virtual objects in dramatic contexts.[3] In the realm of information retrieval and multimedia design, the Guides project described in Chapter 6 will be used as an example of an approach that involves both narrative and dramatic elements. Finally, the new computer-based medium known as virtual reality (also discussed in Chapter 6) employs a fundamentally dramatic approach to applications such as training simulation and scientific visualization.

Structure and Artistry

For the nonspecialist, the idea of a dramatic model may seem to have more to do with content—interesting situations and colorful characters, for instance—than with structure. As a structuralist critic, I have been assailed by both theatre and computer people for taking what they perceive as a rather bloodless approach. Structure is not always well understood, and even when it is, its uses are seen to be analytical rather than productive. When we see a good film or go to a good play, we are moved by things that seem to transcend structuralism—a beautiful image, dialogue and action that speak deeply and genuinely about life. There seems to be a contradiction here. If it's all so structured, how does it get to seem so lifelike? Surely there is more to it than structure, more to it than a computer could be programmed to create. People

[3]It is interesting to note that the designer of *Rocky's Boots*, a landmark simulation that helps kids learn about logic by constructing circuits and using them to create more elaborate systems, was also the creator of the first graphic adventure game, *Adventure*, implemented for the Atari VCS in 1979. Warren Robinett is now a leading programmer in the virtual-reality medium. All of his work illustrates a dramatic notion of enactment.

often criticize my approach by countering that a computer program can never be smart or sensitive enough to make a beautiful work of art.

These observations are, I think, absolutely true, and they point to the artistry that is essential in every beautiful made thing. Artistry transcends and saturates the process. We do not know what it is that gives a person the ability to conceive or create magnificence in art. We cannot hope to recreate such ability computationally, at least not with today's technology or any of its conceivable descendants. But our discussion of the structural aspects of a "beautiful" dramatic action is not intended to serve as a wholly sufficient explanation for its beauty. Human-computer activity, like other art forms, requires artistry that can be contributed only by human beings. But artistry is deployed within the constraints of the medium, the tools, and the formal and structural characteristics of the kind of thing that the artist is trying to create. Artistry and structure are interdependent; both must be present if beauty is to be the result. Perhaps more important in this stage of the evolution of computer-based media is the fact that artistic sensibility must drive the notion of *desired experience* from which the design of technological components must be derived.

Human-computer activity is like drama in the sense that the primary designer (or playwright) is not the only human source of artistry in the completed whole. In the case of theatre, the director, actors, designers, and technicians who are involved in rendering a performance all make contributions that require artistry. In human-computer activity, there may be a legion of programmers who have designed and architected programs on which a given activity depends, graphic designers who created images and animation, wordsmiths who authored text (or text-generating algorithms), and so on. A fundamental but often overlooked source of human artistry is the people who actually engage in the designed activity; that is, the *human agents*. (The notion of human agency—the active collaboration of people with programs in the shaping of human-computer experiences—is the reason for my avoidance of the word "user" throughout this book.)

Constraints

Everyone who participates in an artistic endeavor, be they playwrights, actors, visual artists, or human agents, exercises creativity. One of the less known contributions of structure is its role in *constraining* the creative process. The relationship between creativity and constraints is mysterious and symbiotic.

Constraints—limitations on human behavior—may be expressed as anything from gentle suggestions to stringent rules, or they may be only subconsciously sensed as intrinsic aspects of the thing that a person is trying to do or be or create. All of us are always operating under some set of constraints: the physical requirements of survival (the need for air, food, and water); the limitations of language on verbal expression; the rules of social acceptability in public situations (e.g., wearing clothes). The ability to act without any such constraints is the stuff of fantasy—the dream of flight, for instance, or the pursuit of immortality. Yet even such fantasy powers can be lost by the failure to comply with other, albeit mythical, constraints (witness Prometheus). It is difficult to imagine life, even a fantasy life, in the absence of any constraints at all.

Why People Must Be Constrained

People engaged in human-computer activities are subject to some special kinds of constraints. Some constraints arise from the technical capabilities and limitations of the system itself: If the system has no speech processing capability, for instance, a person must employ the keyboard for verbal input and is constrained by its vicissitudes—the "QWERTY" layout, for example, and the presence or absence of function keys. Other constraints arise from the nature of the activity as it is comprehended by the system. Typically, what you can do in a given application environment such as a word processor, drawing program, or computer game is but a subset of all that you might be able to do with your computer.

The design of a human-computer activity should be informed by an analysis of constraints to determine how much people should be constrained and what kinds of constraints are most appropriate. That analysis begins with understanding the various reasons why constraints are necessary.

The hardware-related reasons for constraints are fairly straightforward. They will also change, depending upon the elaborateness, completeness, and cost of various implementations of the system. For example, pointing devices that can be used to enable gestural input currently have a limited range; hence people must be constrained to stand within a few feet of a receiver.[4] Physical acts like running or manipulating objects in a fantasy world require that conventions be devised through which the desire to perform such actions can be expressed. Such conventions, mandated by the technical limitations of systems, are a form of constraints.

Constraints are necessary to contain the action within the mimetic world—a software-related problem. For example, in an interactive fantasy version of a Sherlock Holmes mystery, it would be important to constrain people to the customs and technology of Arthur Conan Doyle's nineteenth-century London (for example, no ballistics tests could be used to prove that a bullet was fired by a certain gun). Any human-computer system, no matter how elaborate, cannot be expected to comprehend all possible worlds simultaneously. Preventing people from introducing new potential is essential in the creation and maintenance of dramatic probability.

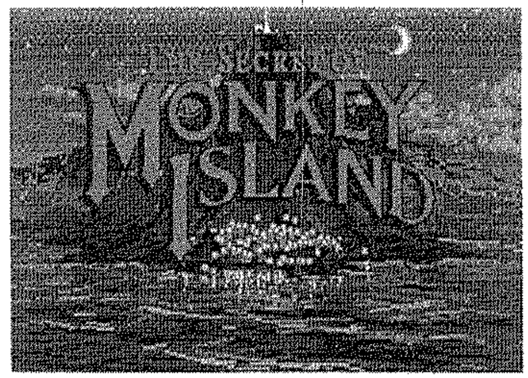
What is the relationship between the experience of creativity and the constraints under which we perform creative acts? In fantasies about human-computer systems, people like computer-game enthusiasts and science-fiction writers tend to imagine magical spaces where they can invent their own worlds and do whatever they wish—like gods [for example, see Vinge, 1981]. Even if such a system were technically feasible—which it is not, at the moment (the rhetoric of virtual

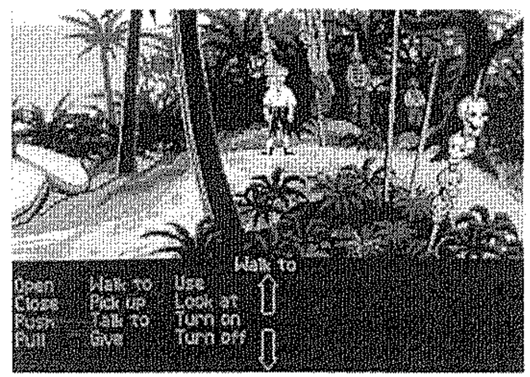
[4]Recently, I took part in a demonstration of a new CD-I player that employed an infrared remote controller. I pointed at the screen, pressed the button, and nothing happened. The demonstrator hastily explained that the pointing device was, of course, "talking to" the console that was placed a few feet to the left of the screen and not to the screen itself—a constraint that threatened to short-circuit my nervous system.

Color Plate I

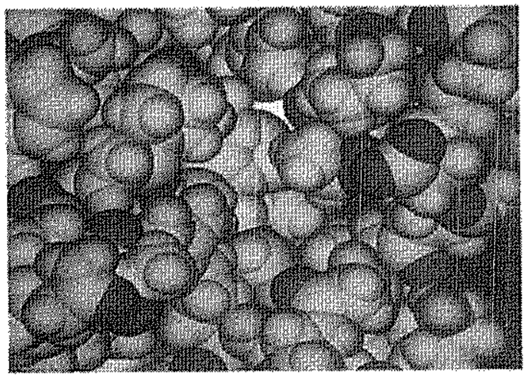
Ron Gilbert's *The Secret of Monkey Island*. The game takes players for an intense, first-person romp through a pirate's world.

Graphics by Steve Purcell, Mike Ebert, Mark Ferrari, and Martin Cameron.





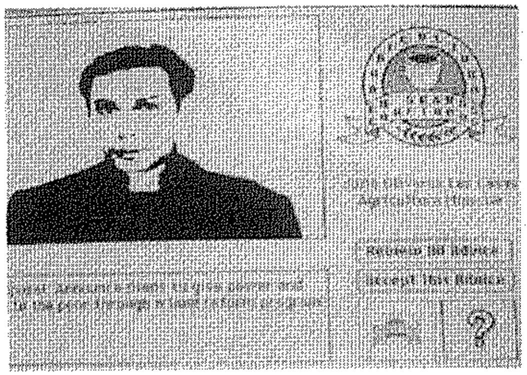
Color Plate II



Docking molecules at the University of North Carolina's Virtual Reality Laboratory. The multisensory representation allows a person to employ physical as well as intellectual skills in solving such problems.

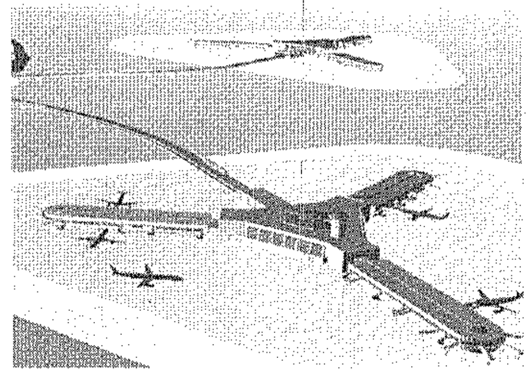
Courtesy of GRIP Project, Department of Computer Science, University of North Carolina at Chapel Hill. Supported by the National Institutes of Health, Division of Research Resources, under grant RR-02170.

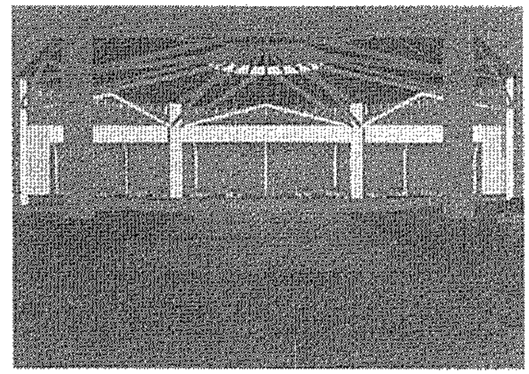
Color Plate IV



A character from *Hidden Agenda* by TRANSFiction Systems. Characters change their behaviors in response to the player's choices and actions as the leader of a Central American country.

Color Plate III





Autodesk's three-dimensional CAD program. The system allows direct manipulation of scale and allows for better visualization through the ability to fluidly change visual and conceptual point of view.

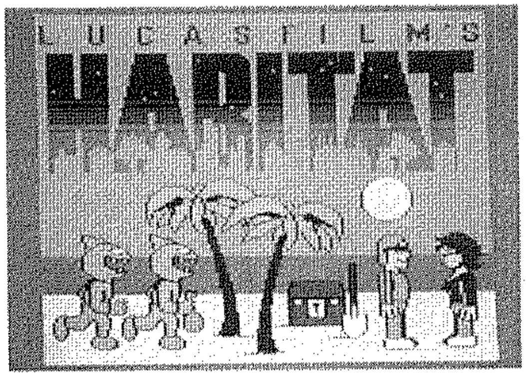
(a) The Orlando International AutoCAD computer-aided design (CAD) software from Autodesk. This shaded visualization shows the main elements of the project.

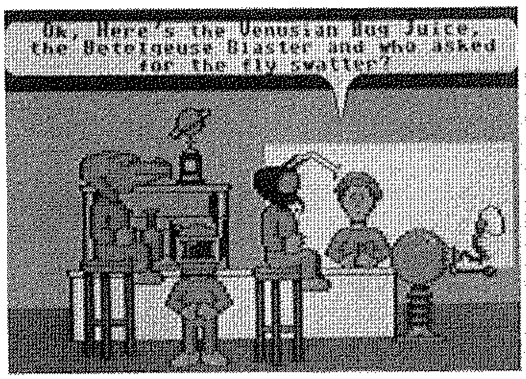
(b) This shaded rendering demonstrates the capability of AutoShade to enhance the model geometry created in AutoCAD. Shown are the skylight and supporting structure in the airside building's transfer section.

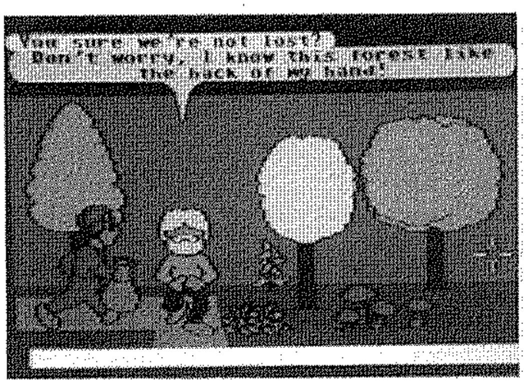
Used with permission.

Color Plate V

Screens from *Habitat*, a networked world developed by Lucasfilm Games in association with Quantum Computer Services, Inc.

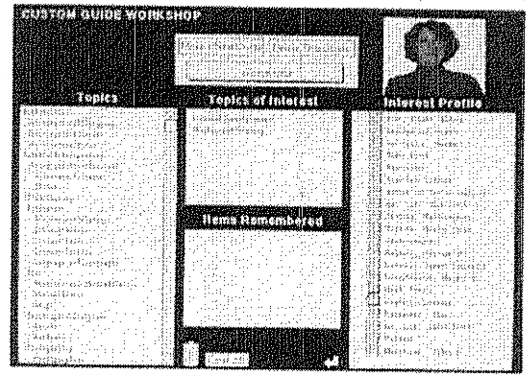






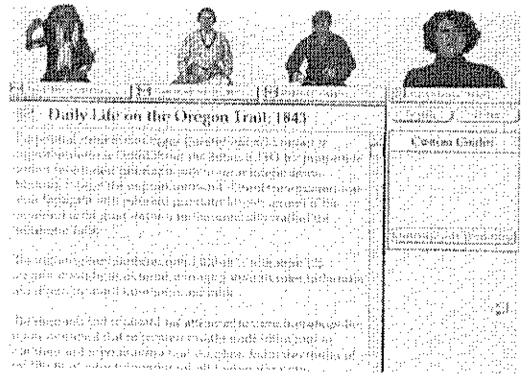
Color Plate VI

The custom guides workshop in Guides 3.0. The System Guide is available to coach people on the use of the workshop. The window at the right of the display gives a dynamic "preview" of the information items that a custom guide prefers based on the topics a person has told it to be interested in.



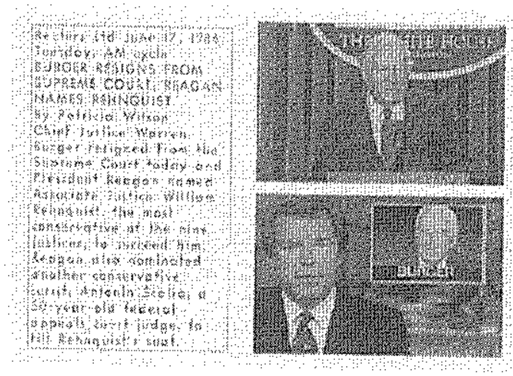
Color Plate VII

Lively agents help people find information in the Guides project.



Color Plate VIII

The NewSpeek display developed by Walter Bender.



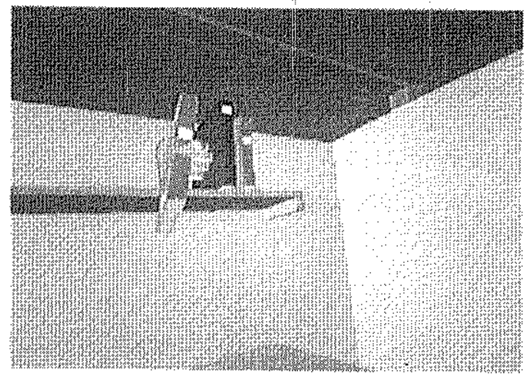
Color Plate IX

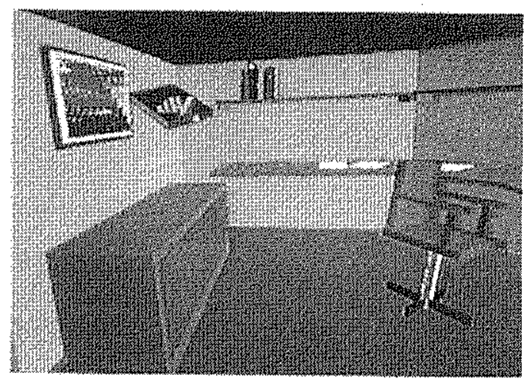
The "old" and "new" settler woman guide. The new version is shot against a neutral background, and the costume has been toned down to merely suggest the character's historical role.

Computers as Theatre

Color Plate X

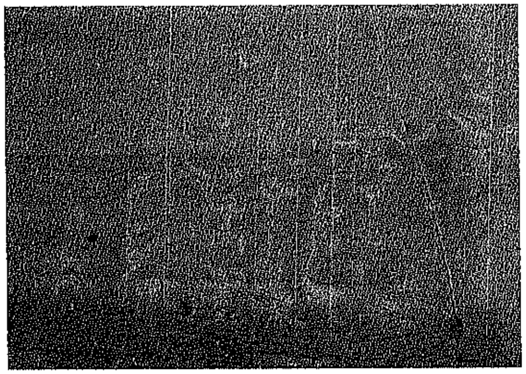
Scenes of a virtual reality office that users may "enter," created by the Cyberspace Research team at Autodesk, Inc. Interactivity in Cyberspace includes such actions as grasping, moving, releasing, throwing, etc.



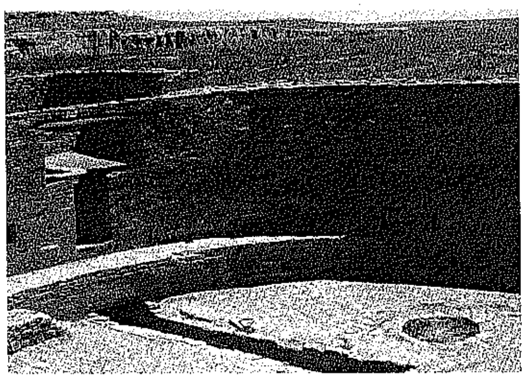


Color Plate XI

The Holodeck, today's cultural icon for the promise of dramatic human-computer activity. In this episode, two members of the Starship Enterprise crew relax with an interactive Sherlock Holmes mystery.



Color Plate XII
Anasazi petroglyphs.
Photograph by Kurt Hulteen.



Color Plate XIII
The great kiva at Chaco Canyon.
Photograph by Kurt Hulteen.

reality notwithstanding)—the experience of using it might be more like an existential nightmare than a dream of freedom.

The relationship between creativity and limitations has been examined in some depth by psychologist Rollo May. In *The Courage to Create*, May asserts the need for limitations in creative activities:

> Creativity arises out of the tension between spontaneity and limitations, the latter (like river banks) forcing the spontaneity into the various forms which are essential to the work of art. . . . The significance of limits in art is seen most clearly when we consider the question of form. Form provides the essential boundaries and structure for the creative act [May, 1975].

A system in which people are encouraged to do whatever they want will probably not produce pleasant experiences. When a person is asked to "be creative" with no direction or constraints whatever, the result is, according to May, often a sense of powerlessness or even complete paralysis of the imagination. Limitations—constraints that focus creative efforts—paradoxically increase our imaginative power by reducing the number of possibilities open to us. Limitations provide the security net that enables us to take imaginative leaps:

> Imagination is casting off mooring ropes, taking one's chances that there will be new mooring posts in the vastness ahead. . . . How far can we let our imagination loose? . . . Will we lose the boundaries that enable us to orient ourselves to what we call reality? This again is the problem of form, or stated differently, the awareness of limits [May, 1975].

The closed, knowable nature of a mimetic world provides a similar security net. People respect the limits of a mimetic world by refraining from introducing new potential into it (for instance, avoiding words or actions that the system is unlikely to "know" about). In exchange for this complicity, people experience increased potential for effective agency, in worlds in which the causal relations among events are not obscured by the randomness and noise characteristic of open systems (like "real life").

Characteristics of Good Constraints

May's analysis suggests that constraints—limitations on the scope and nature of invention—are essential to creativity. Certainly, some constraints on the choices and actions that may be expressed by people are technically essential to any human-computer activity. The question is how those constraints should be determined and expressed. The standard techniques for introducing constraints—instructions, error messages, or dialogue boxes, for instance—are almost always destructive of our *engagement* in the activity by forcing us to "pop out" of the mimetic context into a metacontext of interface operations.

Constraints can be either *explicit* or *implicit*. Explicit constraints, as in the case of menus or command languages, are undisguised and directly available. When we are in doubt about the "legality" of certain choices or actions, we should be able to find the rules and protocols of a system straightforwardly expressed, either in the manual, or in an on-line "help" facility. Implicit constraints, on the other hand, may be inferred from the behavior of the system. We can identify implicit constraints when a system fails to allow us to make certain kinds of choices. There is no way, for example, to negotiate with the enemy in most combat-based computer action games. In most word processors, there is no facility for "drawing" or "painting" images in a document, and the absence of drawing tools makes it less likely that we will think of doing so. Some constraints have both implicit and explicit qualities. In Microsoft Excel, for example, menu-based operations are not selectable and the document cannot be closed until the current item has been properly entered on the spreadsheet. If we attempt such an "illegal" maneuver, nothing happens at all. We may infer from this "nonbehavior" that we must do something else or do something differently.

Explicit constraints can be used without damage to engagement if they are presented before the action begins. A good example is the determination and expression of rules in child's play, which occurs before play actually begins and cre-

ates a contract binding the participants to behave within certain constraints. Once the action has started, however, explicit constraints often prove disruptive—an argument about the rules can ruin a perfectly good session of cowboys and Indians ("Wait a minute—who says Indians can only be killed with silver bullets?").[5] Implicit constraints are preferable during the course of the action, simply because the means for expressing them are usually less intrusive than those used for explicit constraints.

Constraints may also be characterized as *extrinsic* or *intrinsic* to the mimetic action. Extrinsic constraints have to do, not with the mimetic context, but with the context of the person as operator of the system. Avoiding the "reset" and "escape" keys during play of a game has nothing to do with the game world and everything to do with the behavior of the computer. Playing an improvised scene without the use of language has nothing to do with the dramatic action of the scene but is an extrinsic constraint designed to improve the actors' gestural acuity—a different context than the mimetic one. Extrinsic constraints have been used successfully in a variety of sports and other disciplines to distract the part of consciousness that can interfere with performance [see Gallwey, 1976]. The technique is generally inappropriate in human-computer activity, however, because it sets up a secondary context that demands part of a person's attention.

Extrinsic constraints can be made to appear intrinsic when they are expressed in terms of the mimetic context. If the "escape" key is defined as a self-destruct mechanism, for

[5] An interesting exception is the ongoing process of rule-making and enforcement that is sometimes an element in children's play—a sort of *metagame* that provides its own distinct pleasures. A similar metagame occurs in the theatre when stagehands and "real people" wander in and out of the action, as in some of the plays of Christopher Durang and Thornton Wilder, or in certain productions of Brecht. Seen in this way, the metagame is also mimetic, and the actors are merely performing the roles of "real people" as well as portraying other dramatic characters. Because it is mimetic, this is a "false" context shift, much like a play within a play, or a dream in which one has false awakenings. Such metagames or metaplays do not violate engagement, but enhance it through the same means as the mimetic "core" activity.

instance, the constraint against pressing it in the course of flying a mimetic spaceship is intrinsic to the action. We need not shift gears to consider the effect of the key upon the computer or the game program. Expressing constraints in this manner preserves the contextual aspect of engagement.

Another good example of well-contextualized extrinsic constraints is the "borders" option in Microsoft Word 4.0. Once we have reached the screen in which borders can be created, we see a graphical, direct-manipulation interface. We can move lines of various types around in a representation of a document until the desired border style has been achieved. Unfortunately, getting to this neat little border construction screen is problematic at best. We must select "paragraph" from the "format" menu and then click on a "borders" button on the paragraph screen, a logical hierarchy that is forced upon the activity. Directness is obliterated by the operational overhead created by this scheme. A second problem is that buttons defining border styles coexist with the direct-manipulation display on the borders screen and have doppelgänger functionality. Nested within the button problem is the additional difficulty that the top three buttons invoke actions, while the fourth is also used inconsistently to indicate a state or mode that we may have entered by combining other elements via direct manipulation. No wonder people have difficulty with it. (My husband, a senior engineer at Apple Computer, hasn't figured it out.)

The mimetic context itself can be teased apart, especially in task-oriented activities. Bødker [1989] uses the interface for creating footnotes in Microsoft Word as an example of how a task that is part of the general context of document creation is nevertheless extrinsic to the subcontext of writing the text. The WYSIWYG-style interface for authoring does not work for footnote creation; the flow of the authoring activity is disrupted by the dialogue box that requires the author to specify the form of a footnote before actually writing it. The point here is that an activity that may be part of the mimetic whole can be seen to inject extrinsic constraints if it is staged or represented poorly. Bødker's example can be seen as a failure in

the arrangement of incidents, with the by-product of disrupting engagement.

Constraints should be applied without shrinking our perceived range of freedom of action: Constraints should limit, not what we can do, but what we are likely to think of doing. Such *implicit* constraints, when successful, eliminate the need for explicit limitations on our behavior. Context is the most effective medium for establishing implicit constraints. The ability to recognize and comply with implicit, context-based constraints is a common human skill, exercised automatically in most situations and not requiring concentrated effort or explicit attention. It is the same skill that we use to determine what to say and how to act when we interact with a group of unfamiliar people—at a party, for instance. The limitations on behavior are not likely to be explicitly known or consciously mulled over; they arise naturally from our growing knowledge of the context. The situational aspects of the current context and the way in which they have evolved over the course of the action establish dramatic probability that influences our actions and expectations. In summary, then, constraints that are implicit and intrinsic to the mimetic context are least destructive of engagement and other qualities of experience, although explicit and extrinsic constraints can be successfully employed if they frame rather than intrude upon the action.

Establishing Constraints Through Character and Action

Since human-computer activities are dramatic in nature, it is reasonable to look for guidance in the development of constraints to other dramatic forms: theatrical performance and improvisation. In the theatre, the actor is constrained in the performance of a character primarily by the script, and secondarily by the director, the accoutrements of the theatre (including scenic elements, properties, and costumes), and the performances of fellow actors. The actor must work within exacting constraints, which dictate the character's every word, choice, and action. In spite of these narrow limits, the actor still has ample latitude for individual creativity. In the words of acting teacher Michael Chekhov:

> Every role offers an actor the opportunity to improvise, to collaborate and truly co-create with the author and director. This suggestion, of course, does not imply improvising new lines or substituting business for that outlined by the director. On the contrary. The given lines and the business are the firm bases upon which the actor must and can develop his improvisations. *How* he speaks the lines and *how* he fulfills the business are the open gates to a vast field of improvisation. The "hows" of his lines and business are the ways in which he can express himself freely [Chekhov, 1953].

The value of limitations in focusing creative activity is recognized in the theory and practice of theatrical improvisation. Constraints on the choices and actions of actors improvising characters are probably most explicit in the tradition of *commedia dell'arte*. Stock characters and fixed scenarios provide *formal* constraints on the action in that they affect the actor's choices through formal causality. Conventionalized costumes for each character, a standard collection of scenic elements and properties, and a repertoire of *lazzi* (standard bits of business) provide *material* constraints on the action. Likewise, people who are engaged in computer-based mimetic activities are subject to formal and material constraints.

Constraints expressed on the level of character may function as either material or formal constraints, depending upon how they affect the action. Traits and predispositions provide materials from which action is formulated. They also give form to thought, language, and enactment.

Specific objectives or motivations on the part of the human agent(s) constrain the action in both games and task-oriented applications. Highest-level objectives (or, in the lingo of method acting, "super-objectives") are usually known explicitly before the action begins. Computer games provide obvious examples. In *Star Raiders*, for instance, the objective of the human character is to destroy all the Zylons in several quadrants of the galaxy. In *Zork*, the objective is to gather all the treasures in the maze and return them to the trophy room. In

Parker Brothers' *The Empire Strikes Back*, the objective is to destroy as many of the Imperial Walkers as possible before they reach the power plant and blow up the planet. However, as science fiction author Harlan Ellison observed in an unpublished review of the game, it is not possible to meet that goal because the bad guys just keep getting better—an affliction shared by many video games. "The lesson," moans Ellison, "is the lesson of Sisyphus. You cannot win. You can only waste your life struggling and struggling, getting as good as you can be, with no hope of triumph." One might speculate that this incredibly frustrating feature of game design contributed to the decline of the video-game genre in 1983 and 1984.

In task-oriented applications, the choice of the application itself indicates an awareness of super-objectives: Word processors are used to create documents, drawing programs are used to create graphical compositions, etc. However, as applications become more integrated and flexible (or are replaced by "environments" as conceptual units in the human-computer universe), people's goals cannot be so readily inferred by simply noticing what applications they launch. Increasingly, systems will need to employ either explicit conversations with people to determine task objectives or implicit user-modeling techniques to infer objectives from behavior, as discussed below.

The way in which a computer-based system responds to a person can help to narrow down and flesh out the person's objectives, and it can also lead to fairly predictable kinds of action. People who play computer games find that their objectives are rapidly elaborated as the action progresses, through the workings of dramatic probability. As the Zylons close in on a friendly starbase in a game of *Star Raiders*, for instance, we discover that we must develop a strategy for preventing the starbase from being surrounded or captured in order to fulfill our super-objective; otherwise, the action will be prematurely terminated. Hence a whole series of fairly predictable, causally related choices on the part of the human character is stimulated by the single super-objective that has been expressed as a formal constraint at the beginning of the game.

When a person's super-objective is not clear-cut from the point of view of the computer (as in the case of integrated applications or environments), techniques could be devised for inferring it, without imposing explicit limitations. For instance, the system might notice what tools we select, how often, and in what combinations. This noticing behavior could enable the formulation of a hypothesis about our immediate objective, leading to the automatic tailoring of the environment and tools. As other tool sets are used, the system could formulate a more global hypothesis about the whole activity. If the activity is such that inferences of this type have a low probability of being accurate or a high probability of being annoying or confusing, explicit dialogue could be employed. Explicit dialogues with the "system" about our intentions (as in the Bødker example earlier in this chapter) can be tedious and disruptive. Conversely, casting the conversational partner as an agent *character* (as opposed to the amorphous "system") can provide contextual smoothing. For instance, in a research project at Apple Computer, Allen Cypher developed a program that can sense repetitive activity (Figure 4.1). When the program notices that a person is doing something over and over (such as adding numbers or animating an object frame-by-frame), an agent named "Eager" appears and offers up a plan for completing the activity. This highly animated dialogue, coupled with the program's power to clarify the person's objectives and help to achieve them, provides a very attractive means for introducing formal constraints [Cypher, 1990 and 1991].

In activities where we interact with more contentful worlds (such as simulation environments), a system might utilize templates to ascertain our objectives. A system could notice what we are doing, select a template that most nearly matches our apparent motivation, and adjust the system's contributions to the action accordingly. For instance, a person interacting with a simulation of a space station might be trying to redesign it or trying to learn how to operate its controls, or perhaps to experience the environment under various conditions. There is the beginning of a "plot" implicit in each of

these goals, and the system could assist in bringing that plot to life. The system's reasoning might go something like this: "If he is doing x, then he probably wants y. Therefore incidents a, b, and c are likely to cause him to make choices d, e, and f." A template would contain the candidate objective and a set of incidents that would be likely to elicit certain responses based on that objective. The system might then use the person's actual responses as a measure of the accuracy of its initial inference and switch templates if necessary. When it had established a person's objective with a high degree of confidence, the system might kick off a specific scenario by enacting a predesigned *inciting incident*. Furthermore, information about individual people could augment such templates, tailoring the action to such traits as a person's job and skills as well. Such templates would function as recipes for the formulation of action and could be used to both predict and constrain a person's behavior.

Material constraints may be provided implicitly through exposition presented during the action. People discover "physical" and behavioral aspects of a mimetic world, characters, and past events in this manner. To ensure that people become familiar with such elements early on, the designer of a simulation-based activity may wish to delay active human participation until the bulk of the exposition has been presented. The "attract mode" of many arcade games performs this expository function. The notion of "guided tours" employed by Apple Computer attempts to exhibit the properties and behaviors of key objects in narrated simulations, a kind of pre-activity exposition. In the Guides project at Apple, the represented character actions of slumping, doing other things, and falling asleep indicate through enactment a guide's reduced level of interest in the piece of information that is currently displayed. This expository behavior implies that the guide will have little to suggest in the way of related items.

The kinds of actions that a person can take in representational worlds are also constrained by the capabilities of the input and output devices used in the system. By constraining what—or whether—people may see, hear, and say, the system

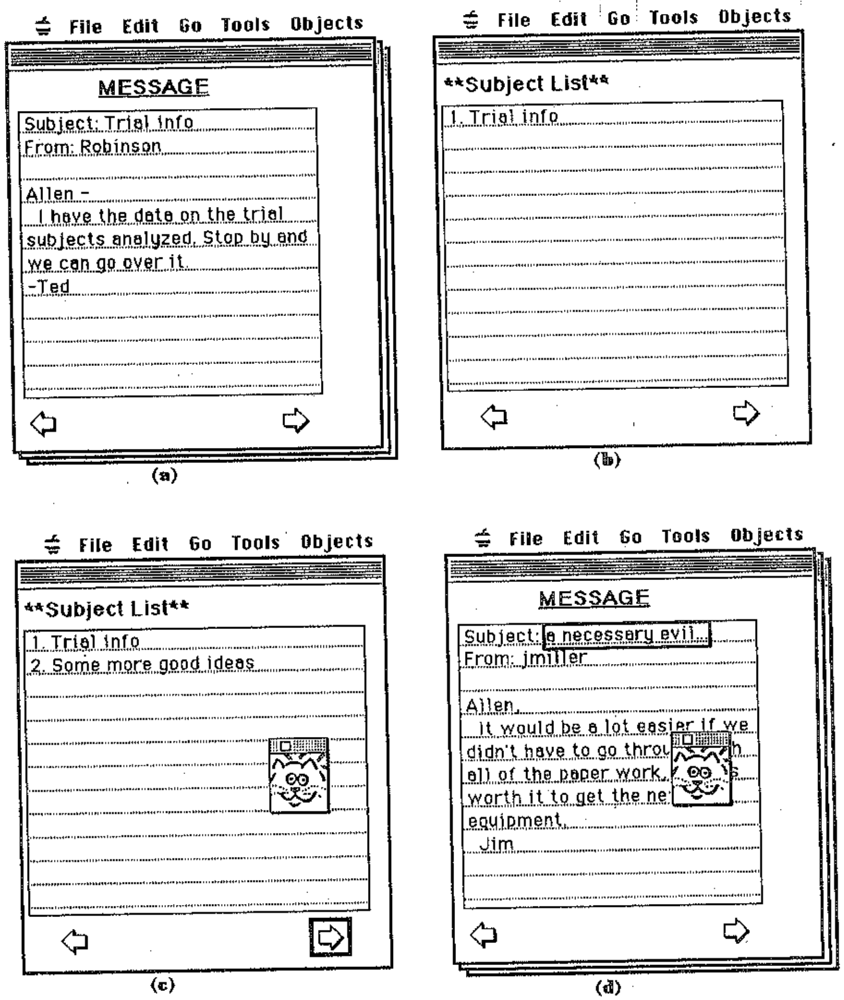
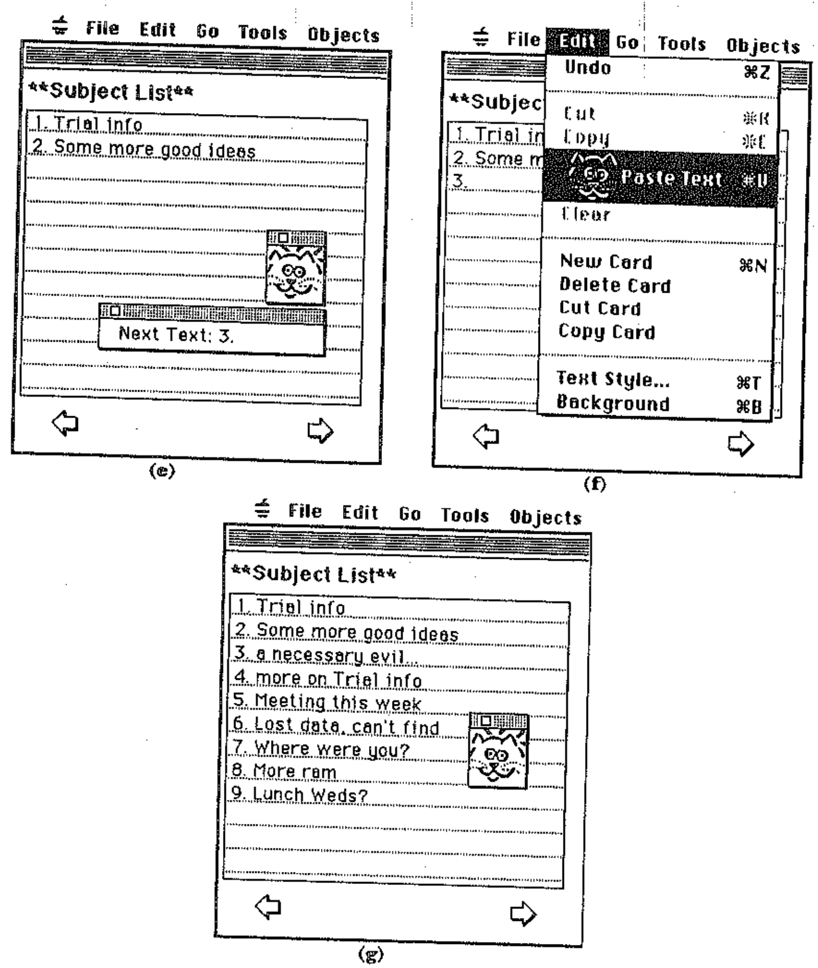


Figure 4.1 "Eager" is an agent-like entity that notices patterns of action and tries to create programs to continue those patterns. Here, the user has a stack of message cards (a) and she wants to make a list of the subjects of the messages. She copies the first subject and pastes it into a new "Subject List" card (b). Then she goes to the second message, copies its subject, and adds it to the list. At this point, the Eager icon pops up (c), since Eager has detected a pattern in the user's actions. Eager also highlights the right-arrow



button in green (c), since it anticipates that the user will click here next. Eager continues anticipating that the user will navigate to the third message, select (d) and copy its subject, go to the Subject List, click at the start of the third line (e), type "3" (f), and then paste in the subject (g). The user is now confident that Eager knows what to do, so she clicks on the Eager icon and it completes the task automatically (h).

may implicitly constrain their thoughts, choices, and actions. In systems that employ simple language parsers, for instance, words that are unknown to the system cannot effect any change in the world; choices and actions that are represented by unknown words cannot be performed.

It is difficult to avoid such a disruptive effect when people are allowed or encouraged to make choices that they cannot effectively express to the system. For instance, the text adventure games developed by Infocom are presented entirely in a verbal mode. People are encouraged to use natural language to express their choices, and so they expect words to work. They have no clue to tell them which words are unknown to the system *except the experience of failure*. On the other hand, given the text-based nature of the game and the equipment that it is usually run on, people are never encouraged to attempt to express themselves through gestures or physical actions. The absence of visual and kinesthetic modes in the system is accepted as a given, and the resulting constraints are unobtrusive. Such constraints are extrinsic to the action but may be utilized effectively if they are presented simply and explicitly, or if they are integrated into the mimetic context (for example, "this ship is not equipped for voice communication").

Generally, the more modes that are present in the interface (verbal, visual, auditory, etc.), the more complex the system must be in order to handle the reception and interpretation of a wide variety of inputs and to formulate and orchestrate its responses. Constraining people through limitations on input and output capabilities becomes less effective as the number of modes in the interface increases; separate sets of constraints for each mode serve to confuse and frustrate people. In a multimodal interface environment, intrinsic formal and material constraints are therefore preferable to those based on the technical characteristics of the interface.

Engagement: The First-Person Imperative

In the foregoing discussion, *engagement* was held up as a desirable—even essential—human response to computer-mediated activities. Engagement has cognitive components,

but it is primarily understood as an emotion. Why should we demand that all human-computer activities elicit this particular emotional response? What is its nature, and what is its value? What can designers do to guarantee that it occurs?

Engagement, as I use the concept in this book, is similar in many ways to the theatrical notion of the "willing suspension of disbelief," a concept introduced by the early nineteenth-century critic and poet Samuel Taylor Coleridge.[6] It is the state of mind that we must attain in order to enjoy a representation of an action. Coleridge believed that any idiot could see that a play on a stage was not real life. (Plato would have disagreed with him, as do those in whom fear is induced by any new representational medium, but that is another story.) Coleridge noticed that, in order to enjoy a play, we must temporarily suspend (or attenuate) our knowledge that it is "pretend." We do this "willingly" in order to experience other emotional responses as a result of viewing the action. When the heroine is threatened, we feel a kind of fear for and with her that is recognizable as fear but different from the fear we would feel if we were tied to the railroad tracks ourselves. *Pretending that the action is real* affords us the thrill of fear; *knowing that the action is pretend* saves us from the pain of fear. Furthermore, our fear is flavored by the delicious expectation that the young lady will be saved in a heroic manner—an emotional response that derives from knowledge about the *form* of melodrama.

The phenomenon that Coleridge described can be seen to occur almost identically in drama and computer games, where we feel for and with the characters (including *ourselves* as characters) in very similar ways. Yes, someone might cry, but manuscripts and spreadsheets aren't pretend! Here we must separate the activity from its artifacts. The *representation* of a manuscript or spreadsheet as we manipulate it on the screen is in fact pretend, as compared to physical artifacts like data files (in the computer's memory or on a storage medium) and hard copy. The artifacts are real (as are actors, lighting

[6] For an analysis and thorough bibliography of Coleridge's criticism, see Allen and Clark [1962], pp. 221–239.

instruments, and reels of motion-picture film), but the rules involved in working with the *representations* (plays or human-computer activities) must subsume the knowledge, at some level, that they are representations. Why? First, because the fact that they are representations is the key to understanding what we can do with them. Second, because their special status as representations affects our emotions about them, enabling experiences that are, in the main, much more pleasurable than those we feel in real life. The distinguishing characteristic of the emotions we feel in a representational context is that there is *no threat of pain or harm in the real world.*

The key to applying the notion of "willing suspension of disbelief" to representational activities that have real-world artifacts is to ensure that the likelihood of *unintentional* effects on those artifacts approaches zero. The other day I experienced a power failure while I was working on this manuscript. I had learned to save my work often, but losing just a few paragraphs evoked plenty of unpleasant real-world emotion. Quite simply, *my system should never have let that happen.* My first word processor, although it lacked nearly all of the features that I appreciate in the one I use today, had a fail-safe feature that took the opportunity to automatically save an active file whenever there was a pause in the input stream—on the average, about every seven seconds. For people who use systems without such a feature, a power outage can be a context shift of the worst possible kind. Such interruptions to the flow of representational activity must be avoided if the powers of representational media are to be preserved. Saving my work has receded from an obsession to a kind of tic, but it shouldn't be there nipping at my subconscious at all.

Furthermore, engagement entails a kind of playfulness—the ability to fool around, to spin out "what if" scenarios. Such "playful" behavior is easy to see in the way that people use spreadsheets and word processors. In my house-buying example in the previous chapter, I played around with different scenarios for making trade-offs in my purchase decision. The key quality that a system must possess in order to

foster this kind of engagement is reversibility—that is, the ability to take something back. What if I failed to save a copy of my spreadsheet before I monkeyed around with a scenario that turned out to be disastrous? What if that scenario altered a significant amount of my data? The theory of hypertext suggests one solution, where various stages of a "document" (or, more correctly, an activity) can be saved and linked to the current version. This solution is unsatisfactory in that it is likely (at least in contemporary hypertext systems) to create a bewildering proliferation of documents. I don't really want to page back through versions of my work; I want to turn back the clock. The dimension of change is best represented through time, not fixed states. A simple chrono-scrollbar would suffice. Yes, the implementation is hard, but the hardest part is probably visualizing the appropriate representation in the first place.

I notice how word processing has changed my writing style. Now I am able to move chunks of text (roughly corresponding to ideas or elements in an argument) around within a document. I can more easily experiment with the visual components of the information I am creating by changing fonts and paragraph styles. But there is nothing sadder or more disruptive than seeing the message, "`Can't Undo.`" With a typewriter, I still had the hard copy and a handy bottle of correcting fluid. Here again, the notion of document creation as an activity unfolding through time is superior to a notion of independent operations on an artifact of which one must remember to take snapshots.

Engagement is what happens when we are able to give ourselves over to a representational action, comfortably and unambiguously. It involves a kind of complicity. We agree to think and feel in terms of both the content and conventions of a mimetic context. In return, we gain a plethora of new possibilities for action and a kind of emotional guarantee. One reason why people are amenable to constraints is the desire to gain these benefits.

Engagement is only possible when we can rely on the system to maintain the representational context. A person should never be forced to interact with the system *qua* system; indeed, any awareness of the system as a distinct, "real" entity would explode the mimetic illusion, just as a clear view of the stage manager calling cues would disrupt the "willing suspension of disbelief" for the audience of a traditional play. Engagement means that a person can experience a mimetic world directly, without mediation or distraction. Harking back to the slogan, "the representation is all there is," we can see that interface designers are often engaged in the wrong activity—that is, representing what the *computer* is doing. The proper object of an "interface" representation is what the *person* is doing with the computer—the action. Thinking about things this way automatically avoids the trapdoors into meta-level transactions with "the system."

Characteristics of First-Person Experience

Another way to describe a person's involvement in the representational context of human-computer activity is as a *first-person* experience [see Laurel, 1986b]. In grammar, the personness of pronouns reflects where one stands *in relation to* others and the world. Most movies and novels, for example, are third-person experiences; the viewer or reader is "outside" the action and would describe what goes on using third-person pronouns: "First he did this, then they did that." Most instructional documents are second-person affairs: "Insert Tab A into Slot B"; "Honor your father and your mother." Operating a computer program is all too often a second-person experience: A person makes imperative statements (or pleas) to the system, and the *system* takes action, completely usurping the role of agency.

Agency is a key component of first-person experience. Although we may describe experiences in which we are not an agent using first-person pronouns (I saw this, I smelled that), the ability to *do* something sooner or later emerges as a criterion. On the one hand, doing very simple things can be an expression of agency—looking around, for instance, or reaching out and touching something (such simple types of

agency are often responsible for the "breakthrough" experiences reported by many people who have used contemporary virtual-reality systems). On the other hand, doing something relatively complex in an indirect or mediated way may not have a first-person feel. In the early days of computing, programmers would submit a program and data on punched cards and come back to pick up the results a day or two later. Although they were telling the computer what to do quite exactly, during the hours of waiting for the computer to "crunch" those programmers were not experiencing a feeling of agency. Today, imploring a system to do something in a highly constrained, formal language can engender a similar feeling that somebody (or something) else is in control.

This is not to say that people cannot experience agency when there are computer-based agents in the representational environment. Agents that are well characterized and amenable to dialogue and collaboration can give a person the sense of being one of several agents in a complex action. An agent can be a mentor or a dictator, a liberator or a jailor. The difference is in the person's experience of *agency*—the power to take action—whether the context includes other agents or not.

First-person sensory qualities are as important as the sense of agency in creating satisfying human-computer experiences. Quite simply, the experience of first-person participation tends to be related to the number, variety, and integration of sensory modalities involved in the representation. The underlying principle here is *mimetic;* that is, a human-computer experience is more nearly "first-person" when the activity it represents unfolds in the appropriate sensory modalities. The intuitive correctness of this notion is witnessed by the direction of technical evolution in the areas of simulators and games—toward higher resolution graphics and faster animation, greater sound capabilities, motion platforms, and mimetic input devices like force-feedback controllers. In task-oriented applications, new technologies are allowing researchers to replace indirect or symbolic representations and manipulations with direct, concrete ones—for example, physically pointing or speaking as opposed to typing, spatial and graphical representation of data as opposed to textual representation, etc. (see Color Plates II and III). Likewise, the evolution of natural-language interfaces is beginning to replace the elaborate conventions of menu-based and command-based systems with systems that employ language in ways that are mimetic of real-world activities like conversation and question-and-answer dialogues [see, for instance, Schmandt, 1985].[7]

Sensory first-personness is not limited to the system's "output"; it must include the modalities that people can employ when they take action in mimetic worlds. Since it is all one representation, the desire for symmetry between "input" and "output" modalities is strong. Engagement is disrupted when my machine talks to me (especially if it asks me a question) and I can't *talk* back.[8] Furthermore, the real-world relationships among modalities affect our expectations in representational worlds that include them; for instance, greater force applied to the throwing of an object should make it appear to go farther, surfaces that look bumpy should feel bumpy, and balloons make noise when they pop.

When we sit back and contemplate the complexity involved in creating first-person experiences, we are tempted to see them as a luxury, not a necessity. But we mustn't fall prey to the notion that more is always better, or that our task is the seemingly impossible one of emulating the sensory and experiential bandwidth of the real world. Artistic selectivity is the countervailing force—capturing what is essential in the most effective and economic way. A good line-drawn animation can sometimes do a better job of capturing the move-

[7]This paragraph is adapted from "Interface as Mimesis" [Laurel, 1986b].

[8]The Guides project provides a counter-example. The several guides do in fact speak at various points in the program. The desire for I/O symmetry is mitigated by context: The guides are cast as storytellers, embodying a conventional relationship in which one person talks and others listen without interruption. Even so, the product would undoubtedly be improved by the addition of voice input. But if and when it is implemented, then the content and conversational style of that input will need to measure up to those of the computer-enacted agents—a tall order.

ments of a cat than a motion picture, and no photograph will ever capture the essence of light in quite the same way as the paintings of Monet. The point is that first-person sensory and cognitive elements are essential to human-computer activity. There is a huge difference between an elegant, selective multisensory representation and a representation that squashes sensory variety into a dense but monolithic glob of text.

Multisensory experience offers advantages that go beyond engagement, as media theorist Tom Bender describes:

> The kinds of information we receive from our surroundings are quite varied, and have different effects upon us. We obtain raw, direct information in the process of interacting with the situations we encounter. Rarely intensive, direct experience has the advantage of coming through the totality of our internal processes—conscious, unconscious, visceral and mental—and is most completely tested and evaluated by our nature. Processed, digested, abstracted second-hand knowledge is often more generalized and concentrated but usually affects us only intellectually—lacking the balance and completeness of experienced situations. . . . Information communicated as facts loses all its contexts and relationships, while information communicated as art or as experience maintains and nourishes its connections [Bender, 1973].

Bender's observations have been supported quite persuasively by the "multimedia revolution" in computer-based educational activities. Likewise, educational simulations (as opposed to tutorial or drill-and-practice forms) excel in that they present *experience* as opposed to *information*. Learning through direct experience has, in many contexts, been demonstrated to be more effective and enjoyable than learning through "information communicated as facts." Direct, multisensory representations have the capacity to engage people intellectually as well as emotionally, to enhance the contextual aspects of information, and to encourage integrated, holistic responses. This broad view of information subsumes artistic applications, as well as traditional knowledge representation. What Bender calls "direct experience," plus the experience of personal agency, are key elements of human-computer activity.

Empathy and Catharsis

In drama, we experience empathy with the characters; that is, we experience *vicariously* what the characters in the action seem to be feeling. Empathy is subject to the same emotional safety net as engagement—we experience the characters' emotions as if they were our own, but not quite; the elements of "real" fear and pain are absent. When we are agents in a mimetic action, our emotions about our *own* experiences partake of the same special grace. When I took my five-year-old daughter on the *Star Tours* ride at Disneyland (a wild ride combining flight simulator technology with *Star Wars* content), she turned to me in mid-shriek and shouted, "If this was *real*, I'd be *scared!*"

Even in task-oriented applications, there is more to the experience than getting something done in the real world, and this is the heart of the dramatic theory of human-computer interaction. Our focus is not primarily on how to accomplish real-world objectives but rather how to accomplish them in a way that is both pleasing and amenable to artistic formulation—that is, in a way in which the designer may shape our experience so that it is enjoyable, invigorating, and whole.

When we participate as agents, the shape of the whole action becomes available to us in new ways. We experience it not only as observers or critics but also as comakers and participants. Systems that incorporate this sensibility into their basic structure open up to us a whole new dimension of dramatic pleasure. This is the stuff of dream and desire, of life going *right*. It is the vision that fuels our love affairs with art, computers, and any other means that can enhance and transform our experience.

The experience of pleasure in a whole action is also influenced by how that action is defined or bounded. In the domain of document creation, for instance, my pleasure and satisfaction has been enormously increased by developments in word processing and printing technology that allow me to engage in more of the *whole* action, from inception to final result. In the days of typewriters, one created documents that would be completely transformed in appearance (one hoped)

through the process of publication. Through the addition of document design to the application of word processing, and with the assistance of a laser printer, I can now influence the final appearance of a publication through my own (design and formatting) actions, and I can bask in the sense that the thing is really *done* by seeing it in something that closely approximates its published form. We will develop this example further in Chapter 6.

The most complex and rewarding result of dramatic action is *catharsis*, defined by Aristotle as the pleasurable release of emotion. That's not to say that all emotions aroused by a play are necessarily pleasant ones. Pity, fear, and terror are mainstays of noncomic forms. It is not the emotion itself, but its release that is deemed "pleasurable." Furthermore, emotions aroused by a play differ in context and expectation from those experienced in real life. When we are viewing a play or film or even riding a roller coaster, we expect emotions to be aroused and to have the opportunity to release them. Aristotle's point is that emotional arousal and release is intrinsically pleasurable in the special context of representations; indeed, that is one of their primary values to us.

In Chapter 1 we discussed a Brechtian view of catharsis that suggests that emotional closure necessarily takes place beyond the temporal "ending" of a play. Brecht's hypothesis was based on a view that requires the integration of the experience of a play into our ongoing life. Brecht's ideas have been interpreted primarily in a political and social light. Julian Hilton offers a more semiotically inclined view of the same phenomenon:

> The totality of the performed event functions as a means of reflective support to the audience, which by no means stops when the performance itself stops. Indeed, in the case of fundamental mythologic structures, such as the Pygmalion/Galathea mythology to which I referred above, their power derives doubly from their synecdochic property of representing in parable form a common human truth and from their persistence in real time operations of the imagination—that is, the imagination uses such myths in a way similar to programming macros or subroutines. The attraction of reflective support is

> that it accepts and draws interest from the potential for contradictory resolution of any problem and turns the contract of error from a negative one (a loss of truth or of totality in content) into the leading edge of investigation [Hilton, 1991].

Catharsis depends upon the way that probability and causality have been orchestrated in the construction of the whole; it also depends upon our uninterrupted experience of engagement with the representation. More than that, it is the pleasure that results from the completion of a form. The final form of a thing may be suspected from the beginning or unforeseen until the very end; it may undergo many or few transformations. It may be happy or sad, because the "success" of the outcome in terms of the representational content is not nearly so potent as the feeling of completion that is implicit in the final apprehension of the shape of a whole of which one has been a co-creator. The theory of catharsis dictates that no matter how monumental or trivial, concrete or abstract, the representation affords the occasion for the complete expression of those emotions that have been aroused in the course of the action. In plain terms, it means that we must design clear and graceful ways for things to end.

Of all forms of human-computer activity, computer games are both the worst and best at providing catharsis. They are the best when a player or a computer-based opponent wins, and they are the worst when no one wins, but the action is truncated because it could not continue.[9] In task-oriented environments, the trick is to define the "whole" activity as something that can provide satisfaction and closure when it is achieved. This depends in part on being able to determine what a person is trying to do and striving to enable them to do *all* of it. In simulation-based activities, the need for catharsis strongly implies that what goes on be structured as a whole action with a dramatic "shape." If I am flying a simulated jet fighter, then either I will land successfully or be blown out of the sky, hopefully after some action of a duration that is sufficient to provide pleasure has had a chance to unfold. Flight simulators shouldn't stop in the middle, even if the training goal is simply to help a pilot learn to accomplish some midflight task. Catharsis can be accomplished, as we have seen, through a proper understanding of the nature of the whole action and the deployment of dramatic probability. If the end of an activity is the result of a causally related and well-crafted series of events, then the experience of catharsis is the natural result of the moment at which probability becomes necessity.

[9]Here again, it seems that the designers at Lucasfilm are in the forefront. Ron Gilbert counsels game designers to avoid situations in which a player must "die in order to learn what not to do next time." [Gilbert, 1989] In a presentation at SIGGRAPH '90, LucasArts Entertainment's research director Doug Crockford showed a re-edited version of *Star Wars* in which Luke Skywalker was killed in his first battle with Darth Vader. The story was over in less than three minutes.

This chapter has analyzed various ways in which dramatic ideas and techniques can be employed to influence the way human-computer activities *feel* to people who take part in them. Hopefully, it has illustrated some of the benefits of a dramatic approach in terms of engagement and emotion. The chapter has emphasized the need to delineate and represent human-computer activities as organic wholes with dramatic structural characteristics. It has also suggested means whereby people experience agency and involvement naturally and effortlessly. The next chapter explores structural techniques more deeply, returning to Aristotle's six elements, and suggesting principles and rules of thumb for designing each of them in the computer domain.

> that it accepts and draws interest from the potential for contradictory resolution of any problem and turns the contract of error from a negative one (a loss of truth or of totality in content) into the leading edge of investigation [Hilton, 1991].

Catharsis depends upon the way that probability and causality have been orchestrated in the construction of the whole; it also depends upon our uninterrupted experience of engagement with the representation. More than that, it is the pleasure that results from the completion of a form. The final form of a thing may be suspected from the beginning or unforeseen until the very end; it may undergo many or few transformations. It may be happy or sad, because the "success" of the outcome in terms of the representational content is not nearly so potent as the feeling of completion that is implicit in the final apprehension of the shape of a whole of which one has been a co-creator. The theory of catharsis dictates that no matter how monumental or trivial, concrete or abstract, the representation affords the occasion for the complete expression of those emotions that have been aroused in the course of the action. In plain terms, it means that we must design clear and graceful ways for things to end.

Of all forms of human-computer activity, computer games are both the worst and best at providing catharsis. They are the best when a player or a computer-based opponent wins, and they are the worst when no one wins, but the action is truncated because it could not continue.[9] In task-oriented environments, the trick is to define the "whole" activity as something that can provide satisfaction and closure when it is achieved. This depends in part on being able to determine what a person is trying to do and striving to enable them to do *all* of it. In simulation-based activities, the need for catharsis strongly implies that what goes on be structured as a whole action with a dramatic "shape." If I am flying a simulated jet fighter, then either I will land successfully or be blown out of the sky, hopefully after some action of a duration that is sufficient to provide pleasure has had a chance to unfold. Flight simulators shouldn't stop in the middle, even if the training goal is simply to help a pilot learn to accomplish some midflight task. Catharsis can be accomplished, as we have seen, through a proper understanding of the nature of the whole action and the deployment of dramatic probability. If the end of an activity is the result of a causally related and well-crafted series of events, then the experience of catharsis is the natural result of the moment at which probability becomes necessity.

[9]Here again, it seems that the designers at Lucasfilm are in the forefront. Ron Gilbert counsels game designers to avoid situations in which a player must "die in order to learn what not to do next time." [Gilbert, 1989] In a presentation at SIGGRAPH '90, LucasArts Entertainment's research director Doug Crockford showed a re-edited version of *Star Wars* in which Luke Skywalker was killed in his first battle with Darth Vader. The story was over in less than three minutes.

This chapter has analyzed various ways in which dramatic ideas and techniques can be employed to influence the way human-computer activities *feel* to people who take part in them. Hopefully, it has illustrated some of the benefits of a dramatic approach in terms of engagement and emotion. The chapter has emphasized the need to delineate and represent human-computer activities as organic wholes with dramatic structural characteristics. It has also suggested means whereby people experience agency and involvement naturally and effortlessly. The next chapter explores structural techniques more deeply, returning to Aristotle's six elements, and suggesting principles and rules of thumb for designing each of them in the computer domain.